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PAPER

The Nexus of AI Ethics, Mobile Learning, and Sustainable Development Goals in Higher Education: The Mediating Role of Law-Compliant Strategies

Svetlana Zemlyak (✉), Galina Khromenkova, Olga Gusarova

Financial University under the Government of the Russian Federation, Moscow, Russia

svzemlyak@fa.ru

ABSTRACT

This study investigated the relationships among perceived AI ethical concerns, mobile learning adoption, law-compliant strategy, and integration of the Sustainable Development Goals (SDGs) in higher education, with technology readiness as a moderating variable. A quantitative cross-sectional survey was administered to 370 university students experienced with artificial intelligence (AI)-based educational tools and mobile learning platforms. Data analysis employed SPSS and partial least squares structural equation modelling (PLS-SEM). Results indicated that perceived AI ethical concerns ($\beta = 0.42$, $p < 0.001$) and mobile learning adoption ($\beta = 0.31$, $p < 0.001$) significantly influenced law-compliant strategy, which strongly predicted SDG integration ($\beta = 0.48$, $p < 0.001$). Law-compliant strategy mediated the relationship between ethical concerns and sustainability outcomes ($\beta = 0.20$, $p < 0.001$). The direct effect of technology readiness on sustainability was not significant ($\beta = 0.09$, $p = 0.072$), and law-compliant strategy did not mediate the mobile learning-sustainability relationship ($\beta = 0.08$, $p = 0.110$). Technology readiness significantly moderated the relationship between law-compliant strategy and sustainability ($\beta = 0.14$, $p < 0.001$). The model accounted for 46% of the variance in SDG integration. These findings highlight the need for robust, law-compliant governance frameworks to translate ethical awareness and technology adoption into sustainable development outcomes. The study demonstrates that law-compliant strategies are essential mechanisms linking ethics-aware AI systems and mobile learning to sustainable development.

KEYWORDS

artificial intelligence (AI) ethics, mobile learning, Sustainable Development Goals (SDGs), law-compliant strategy, technology readiness, higher education

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1 INTRODUCTION

The fourth industrial revolution has ushered in unprecedented technological change, with artificial intelligence (AI) and mobile learning technologies fundamentally transforming educational environments worldwide [1]. With more AI tools and mobile devices being used in education, people are now focusing on important issues such as ethics, regulations, and the sustainability of these technologies [2]. The intersection of AI ethics and mobile learning presents both significant opportunities and substantial challenges for achieving the United Nations Sustainable Development Goals (SDGs), particularly in the areas of quality education, economic development, and the reduction of inequalities [3]. However, the mechanisms by which ethical AI systems and mobile learning can advance sustainable development remain insufficiently understood, especially regarding the implementation of legally compliant strategies across diverse economic contexts. The rapid proliferation of AI in the educational sector has generated a growing number of ethical concerns among students, educators, and policymakers. Issues related to transparency, fairness, safety, and responsibility have emerged as major considerations in the implementation of AI systems within educational contexts [4].

Students are increasingly concerned about how AI algorithms shape their learning, whether AI-based evaluations are fair, how their personal data is protected, and what happens if AI systems cause harm. Rather than seeing these ethical concerns as obstacles to progress, they can actually encourage the development of better governance frameworks. These frameworks help ensure that AI systems operate in line with society's values and legal standards.

Although the importance of AI ethics and mobile learning is identified, there is a large gap in the literature on the governance mechanisms that can help to transform these technological phenomena into sustainable development outcomes. The responsible AI governance, including the do-no-harm principles, transparency, and privacy guarantees, is an essential mediating factor whereby the ethical issues and uptake of technology can lead to a beneficial social effect [5–6].

However, few empirical studies have examined this mediating factor, particularly in education, where the interaction between technology, ethics, and sustainability is most prominent. Further research should focus on identifying the conditions under which governance strategies are most effective.

Technology readiness, defined as the tendency of individuals to adopt new technology to achieve goals, may moderate the relationship between governance strategy and sustainability outcomes by influencing individuals' ability to leverage governance frameworks [7].

This study examines the influence of perceived ethical concerns about AI and mobile learning adoption on the integration of the SDGs, while considering the mediating role of law-compliant strategies. Drawing on institutional theory and technology acceptance models, the study explores how ethical awareness translates into sustainability outcomes and assesses the moderating effect of technology readiness. Partial least squares structural equation modelling (PLS-SEM) is used to determine whether structured governance frameworks effectively link AI ethics to organisational performance.

2 LITERATURE REVIEW

The rapid integration of AI into educational settings has generated significant academic interest regarding the ethical implications of these technologies [8].

AI ethics in education involve several issues that come up when students and educators use AI tools during the learning process. [6] created a framework with four main dimensions of AI ethics in education: transparency, which means making AI decisions clear and understandable; fairness, which ensures all users are treated equally without algorithmic bias; safety, which protects users from harm; and responsibility, which covers accountability for AI failures and unwanted results. Ethical issues play a key role in shaping how students view and use technology in education. When students see AI systems as unclear, unfair, unsafe, or lacking accountability, they are less likely to trust or use them. This shows why ethical factors matter when implementing AI [9–10].

Such ethical issues have been evidenced to play an important role in determining attitude and usage of technology in the learning setup. Students who feel systems using AI are opaque, unfair, unsafe, or not equipped with accountability mechanisms show a lower level of trust and interest in using the AI systems, which is why it is important to consider ethical factors when implementing AI in practice [11]. The law-conforming strategy, operationalised through responsible AI governance, has gained prominence as organisations and institutions address the regulatory and ethical challenges posed by AI technologies [12].

The do-no-harm principle encompasses practices that ensure AI systems do not cause physical, psychological, or social harm to users. Governance transparency refers to the openness and visibility of AI policies, processes, and decision-making criteria. Privacy protection involves the collection, storage, and use of personal information in compliance with relevant laws such as the General Data Protection Regulation (GDPR). These governance mechanisms serve as essential connections between technological capabilities and positive societal outcomes, requiring that AI systems operate within ethical and legal boundaries [13]. The primary outcome variable in this study is the integration of the SDGs into the education sector. [10] developed a 36-item scale to assess the incorporation of sustainability principles across three dimensions. The economic dimension addresses resource efficiency, economic development, and sustainable consumption.

The social dimension encompasses social equity, cultural diversity, and community well-being. The environmental dimension focuses on environmental awareness [14], ecological preservation [15], and climate action [16]. The United Nations SDGs provide a framework for how educational institutions can address global sustainability challenges through curriculum design, teaching and learning strategies, and organisational practices [14]. The tendency of individuals to adopt and utilise new technologies to achieve objectives has been extensively examined in the technology adoption literature, particularly under the concept of technology readiness.

3 METHODOLOGY

3.1 Research design

A quantitative, cross-sectional survey design was employed to examine the structural relationships among AI ethics, mobile learning, law-compliant strategies, and SDG integration. The unit of analysis comprised individual university students with experience in AI-based educational tools. This approach enabled the collection of standardised data at a single point in time, supporting robust statistical testing of hypothesised mediation and moderation effects within a complex structural model.

3.2 Population and sample

The study focused on university students who use AI and mobile learning platforms. Researchers selected 370 participants through disproportionate stratified random sampling to represent different academic fields. This sample size exceeds the "ten times rule" for PLS-SEM, providing sufficient statistical power to test the model's structural paths and moderating variables.

3.3 Instrumentation

Data collection employed a structured questionnaire incorporating 5-point Likert scales adapted from validated sources. Perceived AI Ethical Concerns were measured with a 26-item scale [6], and Mobile Learning Adoption was assessed using an 18-item scale [11]. The mediating variable, Law-Compliant Strategy, was evaluated through a 15-item Responsible AI Governance scale [12]. The dependent variable, SDG Integration, was operationalized using a 36-item sustainability scale [10], while Technology Readiness was measured with a 10-item scale [15]. These multi-item instruments ensured content validity and effectively captured the multidimensionality of each construct.

3.4 Data collection procedure

After receiving institutional ethical approval, the survey was distributed online through official university channels for four weeks. Data analysis involved two steps: first, SPSS was used for data cleaning and descriptive statistics; then, SmartPLS was used for PLS-SEM. The measurement model was checked for reliability (Cronbach's alpha, CR) and validity (AVE, HTMT). Next, the structural model was tested with a bootstrapping procedure using 5,000 resamples to evaluate path coefficients (β), predictive power (R^2), and the significance of mediating and moderating effects.

4 RESULTS AND DISCUSSION

4.1 Descriptive statistics

After screening and cleaning the data, I used SPSS to calculate descriptive statistics that summarise the distribution and central tendencies of the constructs. I focused on means and standard deviations to measure agreement levels and checked skewness and kurtosis to understand the data distribution.

Table 1. Descriptive statistics of constructs

Construct	Mean	Std. Deviation	Skewness	Kurtosis
Perceived AI Ethical Concerns	3.82	0.65	–0.42	0.31
Mobile Learning Adoption	3.91	0.58	–0.38	0.45
Law-Compliant Strategy	3.75	0.71	–0.29	–0.12
Sustainable Development Goal (SDG) Integration	3.68	0.69	–0.15	–0.08
Technology Readiness	3.95	0.62	–0.51	0.63

Table 1 summarises respondents' perceptions of the study's primary constructs. All construct means scores exceeded 3.5 out of 5 on the Likert scale, ranging from 3.68 for SDG Integration to 3.95 for technology readiness. These results indicate that respondents generally held positive to moderately positive views concerning AI ethical issues, mobile learning adoption, law-abiding strategies, SDG implementation, and technological preparedness. Technology Readiness achieved the highest mean (M = 3.95, SD = 0.62), suggesting that most students expressed confidence and readiness to adopt new technologies in their learning. In contrast, SDG Integration recorded the lowest mean (M = 3.68, SD = 0.69), indicating that while students recognised some integration of sustainability goals in their education, further improvement is possible.

Figure 1 visually compares the mean scores and standard deviations for each construct, providing insight into both central tendency and variability across the five measured domains.

Table 2 reports the Pearson product-moment correlation coefficients among the five principal constructs, providing a preliminary assessment of the hypothesised relationships. All correlations were statistically significant, positive, and at the 0.01 level, indicating that the constructs were meaningfully related in the expected directions.

The strongest correlation was observed between Law-Compliant Strategy and SDG Integration ($r = 0.57$, $p < 0.01$), which provides initial support for the mediating role of law-compliant strategies in achieving sustainable outcomes. Perceived AI Ethical Concerns demonstrated a moderate positive correlation with Law-Compliant Strategy ($r = 0.51$, $p < 0.01$), suggesting that heightened ethical concerns are associated with greater emphasis on responsible AI governance. SDG Integration also exhibited a strong positive correlation with Mobile Learning Adoption ($r = 0.45$, $p < 0.01$). Notably, the correlation between Technology Readiness and Mobile Learning Adoption ($r = 0.53$, $p < 0.01$) was the highest, underscoring the importance of readiness as a primary facilitator of technology adoption.

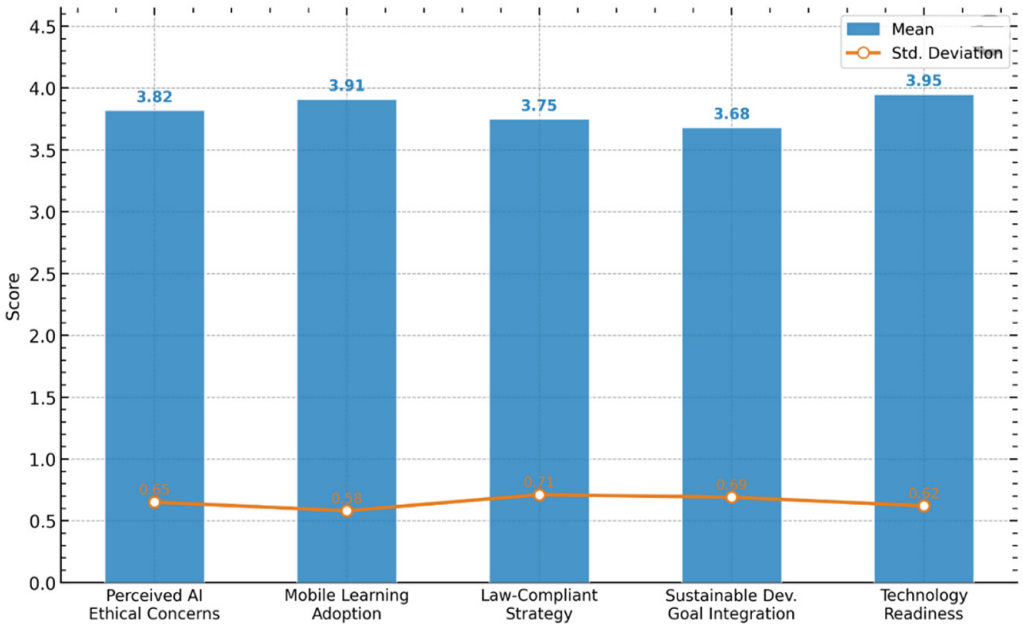

Fig. 1. Descriptive statistics of constructs

Table 2. Correlation matrix of constructs (N = 370)

Construct	1	2	3	4	5
Perceived AI Ethical Concerns	1				
Mobile Learning Adoption	0.42**	1			
Law-Compliant Strategy	0.51**	0.48**	1		
SDG Integration	0.39**	0.45**	0.57**	1	
Technology Readiness	0.28**	0.53**	0.36**	0.33**	1

Note: **Correlation is significant at the 0.01 level.

4.2 Measurement model assessment

We evaluated the measurement model to test the reliability and validity of the constructs used in this study. Following the guidelines for PLS-SEM, we checked indicator reliability using factor loadings, internal consistency with Cronbach's alpha (α) and composite reliability (CR), and convergent validity with the average variance extracted (AVE). We analysed both the construct and dimension levels to ensure that all sub-dimensions of the multidimensional constructs demonstrated adequate psychometric properties.

Table 3. Measurement model assessment

Construct/Dimension	Cronbach's Alpha (α)	Composite Reliability (CR)	Average Variance Extracted (AVE)
Perceived AI Ethical Concerns	0.94	0.95	0.63
Transparency	0.91	0.93	0.62
Fairness	0.89	0.92	0.7
Safety	0.88	0.91	0.67
Responsibility	0.92	0.94	0.66
Mobile Learning Adoption	0.93	0.94	0.61
Relative Advantage	0.9	0.93	0.76
Compatibility	0.88	0.91	0.72
Trialability	0.85	0.9	0.75
Complexity	0.84	0.9	0.74
Observability	0.89	0.92	0.74
Law-Compliant Strategy	0.92	0.93	0.64
Do-No-Harm	0.9	0.92	0.66
Transparency	0.86	0.91	0.78
Privacy	0.89	0.92	0.7
SDG Integration	0.95	0.96	0.62
Economy	0.93	0.94	0.6
Society	0.91	0.93	0.65
Environment	0.94	0.95	0.61
Technology Readiness	0.92	0.93	0.62

Table 3 and Figure 2 indicate that all constructs and their respective dimensions demonstrated satisfactory psychometric properties. Internal consistency reliability was confirmed using Cronbach's alpha and composite reliability, which ranged from 0.84 to 0.96 across all dimensions and constructs, exceeding the accepted threshold of 0.70.

This suggested that the items within each dimension and construct were internally consistent and reliably measured the same concept. Convergent validity was assessed using the average variance extracted, with all AVE values exceeding the minimum requirement of 0.50. The AVE values ranged from 0.60 to 0.78 across all dimensions, indicating that each construct explained more than half of the variance of its indicators. At the construct level, all main variables also demonstrated robust reliability and convergent validity, with Perceived AI Ethical Concerns (AVE = 0.63, CR = 0.95), Mobile Learning Adoption (AVE = 0.61, CR = 0.94), Law-Compliant Strategy (AVE = 0.64, CR = 0.93), SDG Integration (AVE = 0.62, CR = 0.96), and Technology Readiness (AVE = 0.62, CR = 0.93) all meeting the established criteria.

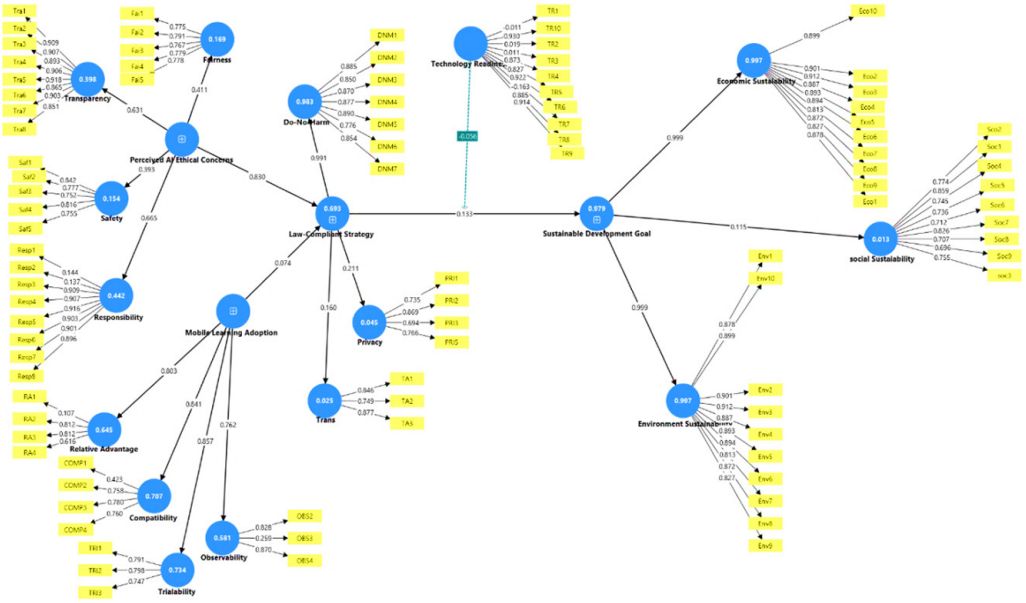

Fig. 2. Measurement model

Table 4. Heterotrait-monotrait (HTMT) ratio matrix

Construct	1	2	3	4	5
1. Perceived AI Ethical Concerns					
2. Mobile Learning Adoption	0.44				
3. Law-Compliant Strategy	0.53	0.49			
4. SDG Integration	0.41	0.47	0.59		
5. Technology Readiness	0.29	0.55	0.38	0.34	

Table 4 was analysed with the aim of determining the discriminant validity of the five principal constructs of the study. The findings indicated that all the HTMT values were less than the conservative level of 0.85 hence indicating that the discriminant validity was adequately met.

The greatest value of HTMT was recorded between Law-Compliant Strategy and SDG Integration (HTMT = 0.59), which was considerably lower than the threshold, as well as suggested that the two constructs, though theoretically connected, were empirically different between each other. Equally, the HTMT value of Perceived AI Ethical Concerns versus Law-Compliant Strategy was 0.53 and, between Mobile Learning Adoption versus Technology Readiness, was 0.55, both of which are within the acceptable range. The minimum value of HTMT was also recorded between Perceived AI Ethical Concerns and Technology Readiness (HTMT = 0.29), indicating that these two constructs were most differentiated from each other.

4.3 Path analysis

To test the relationships between the constructs in accordance with the hypotheses, the path analysis was performed on the basis of the PLS-SEM. The t-values and confidence intervals for determining the significance of the path coefficients were then obtained in a bootstrapping process with 5,000 resamples. The analysis has evaluated the direct implications of Perceived AI Ethical Concerns and Mobile Learning Adoption on Law-Compliant Strategy, the direct implications of Law-Compliant Strategy on SDG Integration, and the direct implications of Technology Readiness on SDG Integration.

Table 5. Path analysis results

Hypothesis	Relationship	Path Coefficient (β)	Std. Deviation	T-Value	P-Value	Decision
Direct Effects						
H1	Perceived AI Ethical Concerns → Law-Compliant Strategy	0.42	0.05	8.4	0	Supported
H2	Mobile Learning Adoption → Law-Compliant Strategy	0.31	0.06	5.17	0	Supported
H3	Law-Compliant Strategy → SDG Integration	0.48	0.05	9.6	0	Supported
H4	Technology Readiness → SDG Integration	0.09	0.05	1.8	0.072	Rejected
Indirect Effects (Mediation)						
H5	Perceived AI Ethical Concerns → Law-Compliant Strategy → Sustainable Development Goal Integration	0.2	0.04	5	0	Supported
H6	Mobile Learning Adoption → Law Compliant Strategy → SDG Integration	0.08	0.05	1.6	0.11	Rejected
Moderating Effect						
H7	Technology Readiness × Law-Compliant Strategy → SDG Integration	0.14	0.04	3.5	0	Supported

The relationship between five out of seven hypothesised relationships has been supported by Table 5 provided. In terms of the direct impacts, H1 was that Perceived AI Ethical Concerns would have a positive impact on Law-Compliant Strategy. These findings confirmed this assumption (β = 0.42, 8.40, $p < 0.001$), which means that ethical concerns of greater magnitude about AI were linked to the implementation of more responsible AI governance strategies. H2, on the other hand, which hypothesised that law-compliant Strategy would be positively influenced by Mobile Learning Adoption was also accepted (β = 0.31, t = 5.17, $p < 0.001$) and showed that the more mobile learning was adopted, the stronger the law-compliant strategy formulation.

H3 further investigated the correlation between Law-Compliant Strategy and SDG Integration and the results indicate that effective responsible AI governance worked towards significant positive effect (**β** = 0.48, t = 9.60, p < 0.001) and confirmed that governance of responsible AI was useful in the integration of SDGs in the learning environment. H4 had the direct effect of Technology Readiness on SDG Integration but this effect was not found significant (**β** = 0.09, t = 1.80, p = 0.072). Thus, H4 was rejected, which also means that the technology readiness did not have a direct effect on SDG integration without the mediator effect of law-compliant strategies.

The indirect were measured to evaluate the mediating position of Law-Compliant Strategy. H5 assumed that Law-Compliant Strategy would mediate the correlation between Perceived AI Ethical Concerns and SDG Integration. These findings confirmed this hypothesis, and the indirect effect was significant (**β** = 0.20, t = 5.00, p < 0.001). H6 assumed that Law-Compliant Strategy would mediate between Mobile Learning Adoption and SDG Integration. This hypothesis was not accepted (p = 0.110) (0.08, t = 1.60, 1.60). The indirect effect was not found to be statistically significant. This result indicated that although the adoption of mobile learning had a direct effect on the formation of a law-compliant strategy, the specified avenue did not lead to the improved SDG integration, potentially because of the requirement of other enabling mechanisms or contextual variables.

Lastly, H7 investigated the mediating role of Technology Readiness in the association of Law-Compliant Strategy and SDG Integration. The interaction term was also found to be important (**β** = 0.14, t = 3.50, p < 0.001), which means that Technology Readiness enhanced the positive association between law-compliant strategies and SDG integration. A significant positive impact of law-compliant strategies on the outcome of sustainable development was found to be more influential among students with a higher level of technology readiness than among those with a lower level of technology readiness. The data supported five hypotheses (H1, H2, H3, H5, and H7) and rejected two hypotheses (H4 and H6), which provided the detailed empirical evidence of the postulated theoretical model. The R^2 of SDG Integration was 0.46, which means that the model was able to explain 46 percent of the variance in the dependent, which was a medium to strong degree of explanatory power.

4.4 PLS predict

The predictive ability of the model was determined by the help of the PLS predict procedure that measures the out of sample predictive ability of the structural model, the predictions of the endogenous construct indicators at the case level are produced based on the PLS predict analysis, which compares the PLS-SEM predictions to the linear regression model (LM) prediction.

Table 6. PLS predict results for SDG integration

Indicator	PLS-SEM (RMSE)	Linear Model (RMSE)	PLS-SEM (MAE)	Linear Model (MAE)	Q^2 Predict
Economy (EC)	0.58	0.62	0.45	0.49	0.38
Society (SO)	0.61	0.65	0.48	0.52	0.34
Environment (EN)	0.63	0.67	0.5	0.54	0.31

Table 6 shows that the structural model had strong predictive power for all three areas of SDG Integration. The Q^2 predicted values were positive for every indicator: Economy (Q^2 = 0.38), Society (Q^2 = 0.34), and Environment (Q^2 = 0.31), all above zero. This confirms the model's predictive relevance. When comparing prediction errors, the PLS-SEM model had lower RMSE and MAE values than the linear model in all three areas. For the Economy dimension, the PLS model's RMSE was 0.58, compared to 0.62 for the linear model, and its MAE was 0.45, compared to 0.49. The Society dimension showed similar results (PLS RMSE = 0.61 vs. LM RMSE = 0.65; PLS MAE = 0.48 vs. LM MAE = 0.52), as did the Environment dimension (PLS RMSE = 0.63 vs. LM RMSE = 0.67; PLS MAE = 0.50 vs. LM MAE = 0.54).

5 DISCUSSION

This study explored how ethics-focused AI, mobile learning, law-abiding strategies, and SDGs are connected, with technology readiness as a possible link. The findings showed that concerns about AI ethics had a strong positive effect on law-compliant strategies (B = 0.42, $p < 0.001$), supporting H1 and aligning with research highlighting the importance of ethical awareness in responsible technology governance [6]. This suggests that ethical considerations encourage, rather than hinder, the development of governance. Similarly, adopting mobile learning also positively influenced law-compliant strategies ($\beta = 0.31$, $p < 0.001$), confirming H2 and supporting the idea that technology use can shape perceptions of governance [9]. There was also a significant link between law-compliant strategies and the integration of SDGs ($\beta = 0.48$, $p < 0.001$), supporting H3 and showing that responsible AI governance helps turn technological advances into sustainable outcomes. However, technology readiness did not have a direct effect on the integration of SDGs ($\beta = 0.09$, $p = 0.072$), so H4 was not supported. This means that having technological skills alone does not always lead to a positive social impact.

Hypothesis 5 was supported, indicating that perceived AI ethical concerns and SDG Integration are more likely to be related through the mediating effect of Law-Compliant Strategy ($\beta = 0.20$, $p = 0.001$). This finding suggests that ethical concerns influence sustainability outcomes primarily through governance mechanisms. This result aligns with institutional theory, which posits that normative pressures are translated into outcomes via formal structure [5, 8]. In contrast, the mediating role of Law-Compliant Strategy was not supported for the relationship between Mobile Learning Adoption and SDG Integration ($\beta = 0.08$, $p = 0.110$), leading to the rejection of Hypothesis 6. This non-significant result suggests that mobile learning adoption, even when supported by governance strategies, does not necessarily lead to sustainable outcomes without additional factors, such as pedagogical innovation or curriculum redesign. These findings highlight the multidimensional nature of the technology-sustainability relationship and suggest that other mediators warrant further investigation.

The significant moderating effect of technology readiness on the relationship between law-compliant strategy and SDG integration ($\beta = 0.14$, $p < 0.001$), supporting H7, demonstrates that this relationship becomes stronger as students' technology readiness increases. Individuals with advanced technological skills are better able to use governance systems to achieve sustainability outcomes [15]. These results indicate that technology readiness influences sustainability indirectly by enhancing governance effectiveness. The model explained 46% of the variance in SDG integration, reflecting considerable explanatory power.

6 CONCLUSION

This study examined the relationships among ethics-conscious AI systems, mobile learning adoption, law-compliant strategies, and the integration of SDGs in higher education, with technology readiness considered as a moderating factor. The findings indicate that perceptions of AI ethics and the adoption of mobile learning significantly contribute to the development of law-compliant strategies, which, in turn, positively influence the integration of sustainable development goals. While technology preparedness did not directly affect sustainability outcomes, it moderately mediated the relationship between law-compliant strategies and SDG integration, and it enhanced the positive effects of governance mechanisms. Mediation by law-compliant strategy was observed in the ethics-sustainability pathway, but not in the mobile learning-sustainability pathway, revealing important distinctions in how different technological factors contribute to sustainable development. These results suggest that while individual technological capabilities are necessary, they are not sufficient for translating ethical awareness into sustainable outcomes; effective governance structures are essential for achieving this integration.

6.1 Limitation and future research

While this cross-sectional study offers valuable insights, it cannot show cause and effect. Future research should use longitudinal methods to follow these relationships over time. Since the study focused on one country, its findings may not apply everywhere. Cross-national studies in different institutional and regulatory settings are needed. Researchers should also use objective measures to reduce self-report bias and examine other potential mediators, such as teaching innovation or institutional culture, to better understand how mobile learning relates to sustainability outcomes.

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8 AUTHORS

Dr. Svetlana Zemlyak is a Professor, Director of the Smolensk Branch of the Financial University under the Government of the Russian Federation. She received the degree of Doctor of Economics in 2008. Her field of interests include marketing, financial marketing, digital transformation of economy, innovations, small business, and entrepreneurship (E-mail: svzemlyak@fa.ru).

Dr. Galina Khromenkova is the Head of the Department of Economics and Management at the Smolensk branch of the Financial University under the Government of the Russian Federation. She received the degree of Candidate of Pedagogical Sciences in 2005, the title of Associate Professor in 2012. Her field of interests include entrepreneurship development, entrepreneurship motivation, innovations, digital transformation of economy (E-mail: gakhromenkova@fa.ru).

Dr. Olga Gusarova is the Head of the Department of Mathematics, Informatics and General Humanities at the Smolensk branch of the Financial University under the Government of the Russian Federation. She received the degree of Candidate of Economic Sciences in 2000 and the title of Associate Professor in 2004. Her field of interests include economic and mathematical modelling, digital transformation of economy (E-mail: omgusarova@fa.ru).