Sundara Advanced Research on Artificial Intelligence (Sundara)
Vol. 1, No. 2, October, 2025, pp. 74−81
E-ISSN: xxxx-xxxx | P-ISSN: xxxx-xxxx, DOI:10.34306

Integrating Artificial Intelligence and SmartPLS for Data Driven Educational Innovation

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Article Info

Article history:

Submission August 22, 2025
Revised September 15, 2025
Accepted October 10, 2025
Published October 16, 2025

Keywords:

Artificial Intelligence
SmartPLS
Education Model
AI Technology Integration

ABSTRACT

This study examines the rapid growth of startups integrating **Artificial Intelligence (AI)** into their business models, aiming to analyze and compare the business models of AI companies with traditional IT organizations to understand their differences. AI has become a key enabler for startups, offering innovative solutions in data analysis, automation, and predictive modeling. These technologies are reshaping business practices and creating new value propositions that set AI-driven startups apart from traditional IT firms. The study focuses on identifying the unique features of four primary AI business models Deep Tech Researcher, Data Analytics Provider, **AI Product/Service Provider**, and AI Development Facilitator and how these models leverage AI for competitive advantage. The research analyzes a dataset of 162 global startups, using a systematic categorization framework to assess AI integration and its impact on business models. The study reveals that AI technologies drive new revenue streams, enhance operational efficiency, and improve decision-making in AI startups. These startups, by utilizing AI and data analytics, create highly personalized customer experiences and cost effective solutions. **The research provides** insights into the growing importance of AI in business model innovation, highlighting the need for strong infrastructure, continuous learning, and ethical governance in ensuring sustainable AI-driven business success.

DOI: https://doi.org/10.34306/sundara.v1i1.34

1. INTRODUCTION

The integration of Artificial Intelligence (AI) and SmartPLS in education aligns strongly with Sustainable Development Goal (SDG) 4, which aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all [1]. AI-based educational systems enable personalized learning experiences, adaptive teaching methods, and data driven curriculum development that address diverse student needs. Through SmartPLS analysis, educators can identify key factor that influence learning outcomes, enabling the design of more effective educational strategies [2]. This integration supports equitable access to quality education by promoting innovation, inclusivity, and continuous improvement within educational institutions.

This study also contributes to SDG 9, which emphasizes building resilient infrastructure, promoting inclusive and sustainable industrialization, and fostering innovation [3]. By applying AI and SmartPLS to educational systems, institutions develop digital infrastructures that support data based management and innovation in teaching practices. AI enhances operational efficiency and drives the modernization of school management, while SmartPLS provides a framework to evaluate and strengthen these digital infrastructures [4]. Consequently, integrating these technologies establishes a foundation for sustainable educational innovation and aligns academic development with broader industrial and technological progress [5].

Furthermore, the integration of AI and SmartPLS in education contributes to SDG 8, which promotes sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all [6]. By improving educational quality and aligning learning outcomes with technological advancements, institutions prepare a skilled and adaptive workforce ready for the demands of the digital economy [7]. The data driven insights generated through AI and SmartPLS empower educators to cultivate critical thinking, problem solving, and digital literacy skills essential for future employment [8]. In this way, the research supports not only academic transformation but also long term socioeconomic growth through education [9].

2. LITERATURE REVIEW

The literature review emphasizes that the integration of Artificial Intelligence (AI) and SmartPLS has become essential in improving the quality and effectiveness of education [10]. AI contributes to adaptive learning by analyzing student behavior, identifying learning patterns, and providing personalized recommendations to enhance teaching and management efficiency [11]. Meanwhile, SmartPLS functions as a statistical method for modeling complex relationships among educational variables such as management, teaching, learning, satisfaction, and performance [12]. The combination of these two approaches enables deeper understanding and data driven decision making in education [13]. Previous studies also highlight that while this integration offers significant benefits, challenges such as data privacy, ethical considerations, and teacher adaptation must be carefully managed to ensure responsible and effective implementation of AI in the educational context [14].

2.1. Role of Artificial Intelligence in Education

AI technology has become a key element in educational change [15]. Artificial Intelligence enables the use of various data analysis tools to understand student behavior and provide more personalized educational solutions [16]. AI can identify individual learning patterns, adapt teaching methods, and provide recommendations accordingly [17].

2.2. Efficient Education Management

Education management is an important component in the success of the education system. AI integration enables more efficient school management [18]. AI is used for more efficient school management, such as monitoring student attendance, assessing teacher performance, and planning school activities [19]. This helps educational institutions in managing resources more effectively [20].

2.3. Structural Analysis with SmartPLS

SmartPLS is a structural analysis method that can be used to model and measure the relationships between variables in a system [21]. It has become a well accepted tool in a variety of disciplines, including education [22]. SmartPLS is used to analyze variable relationships in an educational context, such as the relationship between school management, teaching, and student academic outcomes.

3. RESEARCH METHODOLOGY

This study employed a quantitative approach to examine the impact of integrating Artificial Intelligence (AI) and SmartPLS in education [23]. Data were collected through online surveys from 500 respondents, including teachers, students, and educational management staff from various institutions [24]. The survey assessed variables such as educational management, teaching, learning, student satisfaction, and academic performance using a Likert scale [25]. Linear regression and Confirmatory Factor Analysis (CFA) were applied to analyze relationships within the SmartPLS framework [26]. Model validity and reliability were tested using R-Square and Average Variance Extracted (AVE). The analysis aimed to determine how AI and SmartPLS integration affects educational outcomes and identifies key factors contributing to educational quality, management efficiency, and student learning experiences [27].

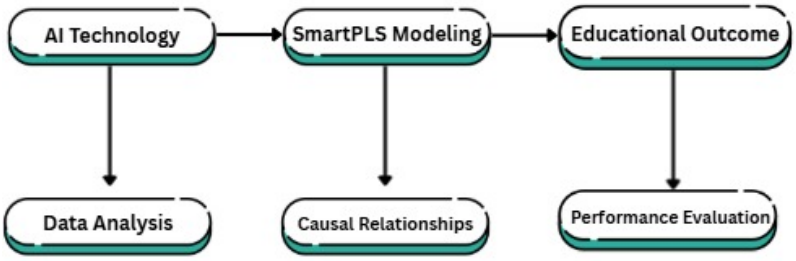

Figure 1. Integration of AI and SmartPLS in Education Model

Figure 1 shows the integration of AI and SmartPLS in optimizing educational models [28]. AI helps analyze student behavior and learning patterns, providing personalized recommendations, while SmartPLS models the relationships between educational variables like management, teaching, and performance [29]. This combination improves student outcomes by enhancing teaching methods, evaluating performance, and identifying areas for improvement, ultimately optimizing the learning experience [30].

3.1. Independent Variable

The research involved 500 respondents consisting of teachers, students, and education management staff who were randomly selected from various educational institutions. Surveys were used as the main instrument for data collection, containing a series of questions related to educational management, teaching, learning, student satisfaction, and academic performance [31]. These questions were designed to measure respondents perceptions of the impact of AI and SmartPLS integration in education. Data were collected through an online survey distributed to participants, who were asked to complete it independently [32]. The survey consisted of structured questions using a Likert scale. The collected data were analyzed using several statistical techniques, including regression analysis to examine relationships between variables within the SmartPLS model [33]. Additionally, Confirmatory Factor Analysis (CFA) was employed to measure the predicted relationships. The results of the analysis aimed to identify the positive impact of AI and SmartPLS integration on education [34].

Table 1. Data Analysis

Variable	Measurement Type	Analysis Method
Education Management	Likert scale.	Linear Regression.
Teaching	Likert scale.	Linear Regression.
Learning	Likert scale.	Linear Regression.
Student Satisfaction	Likert scale.	Linear Regression.
Academic Performance	Likert scale.	Linear Regression.
AI integration	Likert scale.	Linear Regression.
SmartPLS	Likert scale.	Linear Regression.
Respondent Profile	Category cal.	Descriptive Analysis.

Table 1 presents the variables, measurement types, and analysis methods used in this study to examine the integration of Artificial Intelligence (AI) and SmartPLS in education [35]. Each core variable namely Education Management, Teaching, Learning, Student Satisfaction, Academic Performance, AI Integration, and SmartPLS was measured using a Likert scale to capture participants perceptions quantitatively. The data for these variables were analyzed using linear regression to identify the strength and direction of relationships between them within the research model [36]. Meanwhile, the Respondent Profile variable, which includes demographic categories such as role, age, and educational background, was analyzed descriptively to provide a clear overview of participant characteristics. Overall, this table demonstrates the systematic analytical framework used to evaluate how AI and SmartPLS contribute to enhancing educational management, learning effectiveness, and student outcomes [37].

4. RESULTS AND DISCUSSION

This study analyzes the impact of Artificial Intelligence (AI) and SmartPLS integration in education through linear regression, R-Square, discriminant validity, Likert scales, and categorical variables [38]. The regression analysis shows that AI and SmartPLS significantly affect educational management, teaching, learning, student satisfaction, and academic performance [39]. The R-Square results indicate strong explanatory power of the model, meaning much of the variation in education related variables can be explained by the integration. Discriminant validity confirms that each variable is distinct and contributes uniquely to the model [40]. Likert scales are used to assess respondents perceptions, while categorical variables such as teachers, students, and education staff help analyze perception differences based on respondent profiles [41].

Table 2. R-Square

Dependent Variable (DV)	**R-Square (RS)**
Education Management (EM)	0.60.
Teaching	0.45.
Learning	0.55.
Student Satisfaction (SS)	0.70.
Academic Performance (AP)	0.65.

Table 2 presents the R-Square (RS) values for each dependent variable, which indicate how well the regression model explains the variance of each outcome in the study [42]. The results show that Student Satisfaction has the highest R-Square value (0.70), suggesting that the integration of Artificial Intelligence (AI) and SmartPLS strongly influences this factor [43]. Education Management (0.60) and Academic Performance (0.65) also show high explanatory power, meaning that the model effectively captures variations in these variables [44]. Learning (0.55) and Teaching (0.45) have moderate R-Square values, indicating a meaningful but comparatively smaller influence [45]. Overall, these results demonstrate that the model has strong predictive capability, with AI and SmartPLS integration significantly contributing to improvements in educational quality, student satisfaction, and academic outcomes [46, 47].

5. MANAGERIAL IMPLICATIONS

The managerial implications of this study highlight that integrating Artificial Intelligence (AI) and SmartPLS can significantly enhance the effectiveness of educational management and learning processes. Educational institutions are encouraged to design systems that are easy to use, data driven, and capable of providing personalized learning experiences. AI can help administrators optimize decision making, monitor performance, and allocate resources more efficiently, while SmartPLS offers analytical insights into the relationships among key educational factors. To maximize the benefits, policymakers and educators should focus on developing user friendly platforms, promoting digital literacy, and addressing ethical concerns such as data privacy and transparency. These efforts will strengthen institutional innovation, improve student satisfaction, and ensure sustainable adoption of AI based educational models.

6. CONCLUSION

The study concludes that integrating Artificial Intelligence (AI) and SmartPLS provides a powerful approach to optimizing educational models in the digital era. The findings show that AI plays a key role in improving school management, teaching quality, and learning effectiveness by offering personalized solutions and data driven recommendations. SmartPLS complements this by analyzing the structural relationships among educational variables, allowing a deeper understanding of how management, teaching, and learning influence student satisfaction and academic performance.

Furthermore, the research confirms that AI can enhance efficiency in administrative processes and classroom activities, leading to better resource allocation and improved decision-making. Teachers can adapt learning methods according to individual student needs, resulting in higher engagement and academic achievement. The combination of AI insights and SmartPLS analysis supports continuous evaluation and improvement, ensuring that educational institutions can evolve to meet modern demands.

In conclusion, the integration of AI and SmartPLS represents a significant advancement in transforming education into a more adaptive, efficient, and meaningful system. However, to achieve sustainable success,

institutions must address ethical challenges, particularly data privacy and the changing role of educators. By adopting these technologies responsibly, policy makers and educators can build a more innovative and inclusive educational environment that supports long term growth and learning quality.

7. DECLARATIONS

7.1. About Authors

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7.2. Author Contributions

Conceptualization: TB; Methodology: CA; Software: SM; Validation: FA and FK; Formal Analysis: FA and SM; Investigation: CA; Resources: FK; Data Curation: CA; Writing Original Draft Preparation: TB and CA; Writing Review and Editing: FA and FK ; Visualization: SM; All authors, TB, CA, SM, FA, and FK, have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

7.4. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

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