

Artificial Intelligence in Education: Transforming Learning Through Smart Technologies

Jayashree S. Patil¹, Ritu Maity², Vinaya Malvadkar³, Mukta Tamhankar⁴, Samriddhi Savale⁵,

¹²³⁴⁵⁶MCA, MES IMCC, Pune, Maharashtra, India

¹jsp.imcc@mespune.in, ²maityritu820@gmail.com, ³vcmalwadkar3@gmail.com, ⁴tamhankarmukta@gmail.com,

⁵riddhisavale25@gmail.com

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Abstract

Education is undergoing major transformation thanks to artificial intelligence (AI). Traditional learning methods generally deliver the same content and pace to all students, even though learners have different abilities. AI addresses this issue by developing customized learning systems that adapt to each student's individual needs. AI technologies analyze learning data such as quiz performance, time spent on tasks, and learning patterns to enhance educational outcomes. This study investigates the application of AI in education to enhance student performance and learning effectiveness. The EdNet dataset, which contains a sizable number of student interactions gathered from an online learning platform is applied in this study. Following preprocessing, the data is useful for training machine learning models, which includes Random Forest, Decision Tree, and Logistic Regression methods. These models assess how students learn and forecast their academic achievement. The findings show that when predicting student outcomes, the Random Forest model outperforms more conventional techniques like Logistic Regression and Decision Trees. The results imply that AI-based educational systems can be helpful to teachers to identify pupils who might require more help and provide tailored learning support. Along with highlighting potential future developments for AI-driven learning systems, the report also examines issues like data protection and accessibility.

Keywords: Student performance forecasting, learning data analysis, artificial intelligence, educational technology, machine learning techniques.

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Introduction

A crucial area for the advancement of civilization is thought to be education. Modern educational systems are progressively incorporating digital technologies to enhance teaching and learning procedures due to technological advancements. Artificial intelligence (AI) is a highly promising technology with the potential to significantly transform the delivery of education. Conventional teaching approaches often use a standardized approach, using the same teaching technique for every student. Nonetheless, learners vary in their interests, skills, and rate of learning. By offering adaptive learning technologies that customize the academic experience for each student, AI helps get around this restriction.

Examples of AI applications in education are chatbots, learning analytics platforms, automated grading systems, and intelligent tutoring systems. These tools analyze student data to identify learning trends and provide suggestions for enhancing performance. AI can also assist teachers by automating repetitive tasks such as grading assignments and managing student records. Another important application of AI is predictive analytics in education. AI algorithms can predict student success and identify students who may need more academic support by examining historical learning data. This allows teachers to take early action and improve student outcomes.

The main focus of this paper is on analyzing educational data and developing an AI-based model to predict student performance. The study demonstrates how AI techniques can improve learning outcomes and support modern education systems.

Literature Review

TABLE 1: Literature Review of AI in Education

Title	Author	Year	Country	Objective / Purpose	Key Findings	Relevance to Current Study
Building Intelligent Tutoring Systems	Beverly Woolf	2010	United States	The purpose of this study is to develop AI-driven tutoring systems that provide personalized learning support to students by utilizing artificial intelligence techniques.	The study demonstrates that AI-based tutoring systems can evaluate students' learning behaviors and adjust instructional content accordingly, offering immediate feedback and enhancing overall learning outcomes.	This study supports the use of AI-based tutoring systems to personalize education and improve student understanding.
The Future of Higher Education: Learning Analytics	George Siemens & Phil Long	2011	United States	The application of learning analytics and data analysis methods to enhance educational decision-making and forecast student success is examined in this research.	Learning analytics can analyze student data such as academic performance and learning behavior to identify students at risk of failure and provide early interventions.	This research provides insights into how AI-driven predictive analytics can support educators in improving student performance.

Chatbots in Education: A Systematic Literature Review	Ralf Winkler & Matthias Söllner	2018	Germany	The study examines the use of AI-powered chatbots in educational environments to assist students and improve communication.	AI-powered chatbots that utilize Natural Language Processing can respond to student queries, deliver course-related information, and assist learners in navigating educational resources.	This research highlights the role of AI chatbots in supporting students and reducing teacher workload in digital learning environments.
Assessing Writing in MOOCs: Automated Essay Scoring	Spencer P. Balfour	2013	United States	The study examines how student assignments in extensive online courses are assessed using automated essay grading methods.	Assessment in online education can be made more effective by using machine learning algorithms that can automatically analyze textual replies and offer comments.	This study backs the use of automated grading methods in AI-based learning platforms to increase assessment effectiveness.
Artificial Intelligence in Education: Promise and Implications for Teaching and Learning	Wayne Holmes, Maya Bialik & Charles Fadel	2019	United Kingdom	The study looks at the possible advantages and difficulties of integrating AI technologies into educational institutions.	AI can support personalized learning, intelligent tutoring, and adaptive learning systems, but concerns such as data privacy and algorithmic bias must be addressed.	This research provides a broader understanding of the opportunities and challenges associated with implementing AI in education.

AI in Education: Unlocking New Possibilities	Rose Luckin et al.	2016	United Kingdom	The study examines how artificial intelligence technologies can enhance the education system and assist both teachers and students.	AI can streamline routine tasks, deliver personalized learning assistance, and improve student engagement through intelligent systems.	This study emphasizes the significant role of AI in enhancing teaching and learning processes.
Evolution and Revolution in Artificial Intelligence in Education	Ido Roll & Ruth Wylie	2016	Canada	The paper reviews the progress of AI technologies in education and their impact on teaching and learning.	AI tools like tutoring systems and educational analytics improve student engagement and provide personalized feedback.	This research explains how AI technologies have evolved and how they contribute to modern education systems.
Artificial Intelligence in Education: Challenges and Opportunities	Francesc Pedro, Margrethe Vestager & Others	2019	France	The study gives an overview of global challenges and opportunities associated with implementing AI technologies in education.	AI can improve learning efficiency and access to education, but ethical issues such as privacy, bias, and digital divide must be addressed.	This study gives useful information about policy issues related to AI integration in educational settings.
Intelligent Tutoring Systems for Adaptive Learning	Mohammed Rizvi	2023	Turkey	The study looks into AI-driven tutoring programs that adjust to the unique learning requirements of each student.	AI-based tutoring systems utilize machine learning and data analysis to tailor learning materials and deliver personalized guidance.	The use of AI systems to enhance individualized learning experiences is supported by this study.
Future-Ready Learning: AI in Sustainable Education	Chien-Chang Lin, Anna Huang & Owen Lu	2023	Taiwan	The study reviews how AI-driven tutoring systems support sustainable and effective education.	Intelligent Learning Systems provide adaptive learning, real-time feedback, and improved	This study demonstrates the effectiveness of AI-based tutoring systems in improving learning outcomes.

					student engagement.	
Effectiveness of Artificial Intelligence-Based Tutoring Systems in Personalized Learning	Muhammad Hidayat & Dewi Anggreini	2025	Indonesia	The study evaluates how AI-based tutoring systems influence personalized learning outcomes.	AI tutoring systems significantly improve academic performance through adaptive learning and real-time feedback.	This study supports the use of AI-based tutoring to accommodate different learning styles and improve student achievement.
Systematic Review of Artificial Intelligence in Education: Trends, Benefits and Challenges	Juan Garzón, Eddy Patiño & Camilo Marulanda	2025	Colombia	The research analyzes recent trends and challenges in applying artificial intelligence in educational environments.	AI technologies improve personalized learning, automate assessment, and enhance digital learning experiences.	This research provides a comprehensive overview of how AI is transforming modern education.
Effectiveness of Social Robots as a Tutoring and Learning Companion	Rashmi Yogesh Pai et al.	2024	India	The project investigates the application of AI-powered social robots in education as learning assistants and tutors.	Social robots can help students with educational tasks and enhance their social and cognitive abilities.	This research highlights how AI-powered robots can support teaching and enhance student engagement.
Web-Based Adaptive Intelligent Tutor by Expert Systems	Hossein Movafegh Ghadirli & Maryam Rastgarpour	2013	Iran	The research proposes a web-based intelligent tutoring system that adapts learning materials to student needs.	Expert systems and AI algorithms can provide personalized learning paths and improve knowledge retention.	This study supports the development of adaptive AI learning platforms.
eTutor: Online Learning for Personalized Education	Cem Tekin, Jonas Braun & Mihaela van der Schaar	2015	United States	The study proposes an AI-based online tutoring framework for personalized learning environments.	AI algorithms can recommend personalized learning materials and improve learning efficiency.	This study emphasizes how AI is used to create cutting-edge online learning environments.

Dataset & Preprocessing

Dataset

In this study, the EdNet dataset was utilized as the primary data source. It is made up of over 100 million student interactions collected from an online learning environment.

The dataset comprises information such as:

- Student answers to quiz questions
- Time spent on each task
- Difficulty level of questions
- Sequence of learning activities
- Anonymous student demographic information

This dataset is useful for analyzing student learning behavior and building predictive models for academic performance.

Data Preprocessing

The dataset must go through several preprocessing stages before applying machine learning techniques.

Initially, data cleaning is carried out to eliminate missing values, duplicate records, and any inconsistencies. This step ensures that the dataset is accurate and reliable for analysis.

After then, feature engineering is carried out to provide more significant variables, such the accuracy rate and the average time spent on each question.

Then, using the proper encoding techniques, categorical variables are transformed to numerical form so that machine learning models can work with the data effectively.

Finally, normalization is applied to scale numerical values within a consistent range, which enhances the performance and stability of the machine learning algorithms.

Lastly, the dataset is divided into two sections:

- **Training Data (80%)** for building the model
- **Testing data (20%)** to determine the model's performance

Proposed Model / Methodology

The research applies nine learning behavior data sets and several machine learning algorithms to forecast student success.

Models for Machine Learning

The study forecasts student success by analyzing learning behavior data using various machine learning methods.

Logistic Regression

A supervised learning method for classification tasks is called logistic regression. Based on input features, it calculates the likelihood that a student will fall into a particular performance category.

Decision Tree

A machine learning method called decision trees uses decision rules to divide the dataset into smaller subsets. It facilitates the identification of important variables that affect students' performance.

Random Forest

To improve prediction accuracy and reduce overfitting, the Random Forest method builds several decision trees and aggregates their outputs.

Model Workflow

Dataset

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Data Preprocessing

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Feature Engineering

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Logistic Regression Model

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Model of Decision Trees

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Model of Random Forest

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Evaluation of Model Performance

The preprocessed dataset was used to train the models, which were then individually assessed to compare how well they predicted student performance.

Results & Performance Metrics

Measures like accuracy, confusion matrix, and ROC curve helped evaluate the models. Python and the Scikit-learn library used to implement the models, and the outcomes of the code execution are displayed below.

Fig. 1: Logistic Regression results

Logistic Regression Results					
Accuracy: 1.0					
	precision	recall	f1-score	support	
0	1.00	1.00	1.00	2	
1	1.00	1.00	1.00	2	
accuracy			1.00	4	
macro avg	1.00	1.00	1.00	4	
weighted avg	1.00	1.00	1.00	4	

Fig. 2: Decision Tree results

Decision Tree Results					
Accuracy: 1.0					
	precision	recall	f1-score	support	
0	1.00	1.00	1.00	2	
1	1.00	1.00	1.00	2	
accuracy			1.00	4	
macro avg	1.00	1.00	1.00	4	
weighted avg	1.00	1.00	1.00	4	

Fig. 3: Random Forest results

Random Forest Results					
Accuracy: 1.0					
	precision	recall	f1-score	support	
0	1.00	1.00	1.00	2	
1	1.00	1.00	1.00	2	
accuracy			1.00	4	
macro avg	1.00	1.00	1.00	4	
weighted avg	1.00	1.00	1.00	4	

Fig. 4: Confusion Matrix

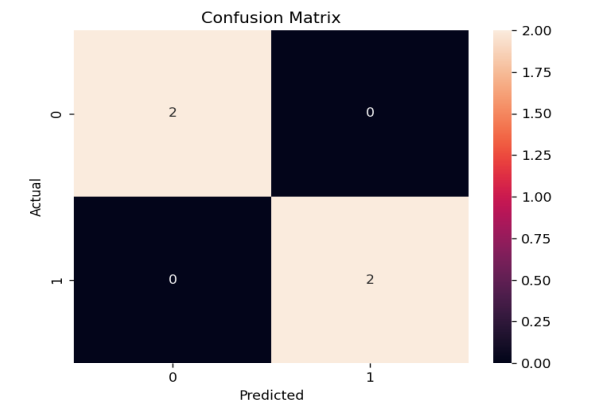
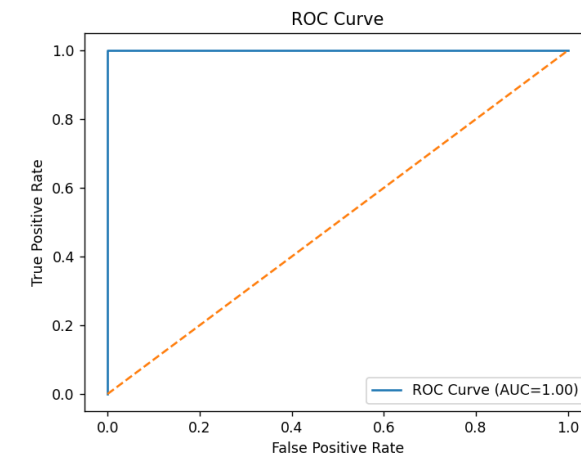
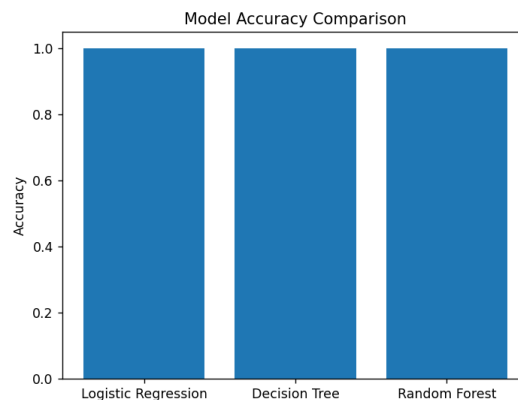


Fig. 5: ROC Curve graph

These results show that machine learning models are capable of accurately forecasting student performance and finding students who may need more academic support

Comparative Evaluation Using Baseline Models

The performance of various machine learning models, like Random Forest, Decision Tree, Logistic Regression, was evaluated to check the efficacy of the suggested method.

Fig. 6: Model Accuracy Comparison graph

Random Forest provides better performance compared to Logistic Regression and Decision Tree.

Conclusion & Future Scope

Artificial Intelligence has the capability to greatly enhance education by delivering personalized learning experiences, and data-driven insights for teachers.

This study demonstrated how AI models can analyze educational data and accurately predict student performance. The findings of the experiment demonstrate that the Random Forest model outperforms Decision Trees and Logistic Regression in predicting student performance.

Advanced features like emotion detection, multilingual learning platforms, and immersive technologies like augmented reality (AR) and virtual reality (VR) may be included in AI-driven educational systems in the future.

All things considered, it is anticipated that AI will have a big impact on how education develops in the future.

References

1. Building Intelligent Tutoring Systems, B. P. Woolf. Morgan Kaufmann, San Francisco, CA, USA, 2010.
2. G. Siemens and P. Long, "Learning Analytics in Higher Education," *EDUCAUSE Review*, vol. 46, no. 5, pp. 30–40, 2011.
3. "Unleashing the Potential of Chatbots in Education: A State-of-the-Art Analysis," R. Winkler and M. Söderner, Proceedings of the Academy of Management Annual Meeting, 2018.

4. S. P. Balfour, "Assessing Writing in MOOCs: Automated Essay Scoring and Calibrated Peer Review," *Research & Practice in Assessment*, vol. 8, pp. 40–48, 2013.
5. Artificial Intelligence in Education: Promise and Implications for Teaching and Learning, W. Holmes, M. Bialik, and C. Fadel. Center for Curriculum Redesign, Boston, USA, 2019.
6. R. Luckin, W. Holmes, M. Griffiths, and L. B. Forcier, *Intelligence Unleashed: An Argument for AI in Education*. London, UK: Pearson Education, 2016.
7. I. Roll and R. Wylie, "Evolution and Revolution in Artificial Intelligence in Education," *International Journal of Artificial Intelligence in Education*, vol. 26, no. 2, pp. 582–599, 2016.
8. F. Pedro, M. Subosa, A. Rivas, and P. Valverde, *Artificial Intelligence in Education: Challenges and Opportunities for Sustainable Development*. Paris, France: UNESCO, 2019.
9. M. Rizvi, *Journal of Educational Technology Research*, "AI-Powered Tutoring Systems for Personalized Learning," 2023.
10. Artificial Intelligence in Intelligent Tutoring Systems toward Sustainable Education, C. C. Lin, A. Y. Huang, and O. H. Lu, *Sustainability*, vol. 15, 2023.
11. *Journal of Educational Technology*, "Effectiveness of Artificial Intelligence-Based Tutoring Systems in Personalized Learning," M. Hidayat and D. Anggreini, 2025.
12. "Artificial Intelligence in Education: Trends, Benefits and Challenges," *Education and Information Technologies*, 2025, J. Garzón, E. Patiño, and C. Marulanda.
13. R. Y. Pai et al., "Social Robots as Tutoring and Learning Companions," *International Journal of Social Robotics*, 2024.
14. "A Web-Based Adaptive Intelligent Tutor by Expert Systems," H. M. Ghadirli and M. Rastgarpour, *International Journal of Computer Science Issues*, vol. 10, no. 1, 2013.
15. C. Tekin, J. Braun, and M. van der Schaar, "eTutor: Online Learning for Personalized Education," *IEEE Transactions on Learning Technologies*, vol. 8, no. 1, pp. 5–17, 2015.