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The impact of artificial intelligence and learning analytics on students' academic performance

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Abstract

The adoption of artificial intelligence in education, learning analytics, and educational data mining has changed the contemporary learning landscape but still its real impact on the academic achievements of the students has been disjointed through various empirical studies. The growth of AI-based education, predictive analytics within education, and adaptive learning systems has created the demand to synthesize the emerging evidence systematically to establish how the technologies impact student success, engagement and learning outcomes. The literature review is based on a PRISMA framework to identify, screen, and analyze current studies on the role of artificial intelligence, learning analytics, and learning data-driven environments on academic performance in school and higher education settings. The review procedure was based on the PRISMA on the topic of machine learning in education, intelligent tutoring systems, personalized learning, and student performance prediction models. The research results show that AI adaptive systems and learning analytics dashboards can always increase academic performance by timely identifying risks, providing personalized feedback, and monitoring data, whereas educational big data allows the institutions to create specific interventions. Nevertheless, the obstacles of data privacy, algorithmic bias, excessive automation, and disparities in access to digital resources are also major obstacles. The conclusion of the review is that the collective application of Artificial Intelligence, Learning Analytics and predictive educational technologies have a high potential to improve academic performance as long as they are applied with ethical principles, pedagogical orientation and institutional endorsement.

Keywords: Artificial intelligence, Education, Learning analytics, Academic performance, Personalized learning, Adaptive learning systems.

1. Introduction

The intensive development of Artificial Intelligence in Education, Learning Analytics, and Educational Big Data has essentially changed the contemporary environment of teaching and learning providing the new possibilities to enhance the academic performance of students based on the data-driven and intelligent systems. The AI-based education technologies, adaptive learning systems, and predictive analytics in education are becoming more widespread in global educational institutions due to the goal of providing efficient learning, personalizing education, and fostering student achievement [1-2]. The increased access to digital learning tools and online learning platforms, as well as the massive amount of learning data, has made it possible to create highly advanced machine learning in education models capable of analyzing student behavior, anticipating results, and proposing specific interventions. Such advances have made Learning Analytics and Artificial Intelligence the main parts of the next-generation education system, where performance enhancement is no longer premised upon the traditional means to teach but rather on the ongoing monitoring, feedback and smart decision-making. According to the current research trends, AI-powered platforms have the potential to deliver personalized feedback, adaptive testing, and real-time performance monitoring that can make a strong impact on the student success and their interest in school and learning environments, in general.

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Due to the fast growth of digital education and the popularity of data-driven learning environments, the relevance of researching the connection between Artificial Intelligence, Learning Analytics, and academic performance has grown. The education systems are currently producing big data on learners in terms of learning management systems, online testing, intelligent tutoring system and virtual classes and as a result, it is now possible to use Educational Data Mining and predictive analytics to explain how students learn and why they perform differently [2]. Early warning systems, student performance prediction models, and higher education analytics have become the topic of significant attention of the present-day research as timely intervention can radically enhance retention, grades, and learning outcomes. Research shows that, when using AI-based analytics, educators can shift away from reactive assessment and to proactive assistance, which helps the institution to develop specific teaching plans that enhance both engagement and performance. Consequently, implementing Artificial Intelligence in Education is not considered an experimental innovation anymore but the strategy of promoting the success in learning, in technology-saturated colleges.

The existing situation in the field of studies of AI-driven learning, Learning Analytics, and adaptive learning technologies indicates a rapid increase, especially following the advent of Generative AI in the educational field, intelligent tutoring systems, and automated assessment systems. According to recent systematic reviews, the number of publications in the field of educational research has grown significantly after 2022, which is associated with the impact of the latest models of AI and large language models as well as multimodal analytics [2-4]. Such technologies allow developing individual learning tracks, auto-feedback and smart recommendation engines that adjust to the needs of students, which enhances academic achievements and learning effectiveness. Moreover, AI-backed digital learning environments enable educators to monitor the engagement, participation, and cognitive progress of students in real-time, providing them with the opportunity to make informed decisions with the help of real-time analytics. Machine learning has been combined with learning analytics dashboards and educational technology platforms to establish a new paradigm where data drives the process of teaching and learning instead of intuition, and results in quantifiable positive student outcomes in a variety of fields. Nonetheless, the early adoption of these technologies has also brought doubts about their effectiveness in the long-term, their ethical considerations, and their effect on the autonomous learning.

Although the research on the subject is increasing, there are still some significant gaps in the literature on the real effect of Artificial Intelligence and Learning Analytics on academic performance of students. Most of the research is dedicated to particular systems like intelligent tutoring systems, predictive models, or analytics dashboards, but few attempt to synthesize this in an attempt to determine the overall effect of various AI-based systems on learning outcomes in various educational settings [5-6]. Moreover, some of the literature tends to focus on the technological performance, but not on educational effectiveness, so it is unclear whether the growth of the accuracy of analytics can be converted into the academic benefits. The other gap in research pertains to the fact that little research has been done into the hybrid human-AI learning models where the teachers, analytics systems, and AI assistants collaborate to aid the student learning. Other ethical issues, including algorithmic discrimination, information privacy, unequal access to digital data, and excessive dependence on automation are not adequately covered in most research, despite the fact that they can potentially have a significant impact on academic performance. Moreover, the recent advent of Generative AI, real-time analytics, and multimodal learning data, new variables have been established, and thus they are not as thoroughly assessed in systematic reviews, which necessitate new and comprehensive analyses.

To address these gaps, this literature review aims at conducting a systematic investigation on the influence of Artificial Intelligence, Learning Analytics, and Educational Data Mining on the academic performance of students in a systematic and clear manner and according to the PRISMA 2020 framework of a systematic review. The review will be used to determine recent trends in research, technological methods, and empirical evidence associated with predictive analytics in education, adaptive learning systems, intelligent tutoring systems, and data-driven learning environments [7,8]. Besides this, the research aims to determine the effects of these technologies on such indicators of academic success as grades, retention, engagement, learning efficiency, and cognitive development. The

review aims to elucidate the circumstances in which the application of AI-based education and learning analytics can lead to the positive academic outcomes and pinpoint the constraints that can prevent the effectiveness of that practice. The PRISMA-based approach used ensures that selection, screening, and analysis of the studies are conducted in a rigorous and reproducible way and this increases the reliability and the ability to refer to the findings in the future.

The value of this paper is that it presents a synthesis of the current available research on Artificial Intelligence in Education, Learning Analytics, and academic performance with special emphasis on the recent technologies like Generative AI, multimodal learning analytics, academic big data, and AI-based personalized learning systems. In contrast to the previous reviews that concentrated on single technologies, the study combines the results of several research areas, such as machine learning in education, higher education analytics, student engagement analytics, and predictive performance modeling, to introduce the comprehensive picture of how intelligent systems affect academic success [9-12]. Future research directions concerning explainable AI, ethical analytics, human-AI learning environments, and real-time performance monitoring are also identified in the review as the future direction of educational technology. This paper can be viewed as a very useful source of information to researchers, educators, and policymakers who want to develop effective, ethical, and data-driven educational systems that can enhance the achievement of students in the era of intelligent learning technologies.

2. Methodology

In this systematic literature review, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 framework was followed rigorously to guarantee transparency, rigor, and reproducibility of evidence synthesis to the effect of artificial intelligence (AI) and learning analytics on academic performance of students (Fig. 1). The search took place in four of the largest academic databases, which are Scopus, Web of Science, IEEE Xplore, and PubMed, and the search was conducted during the period between January 2019 and December 2025 because it is considered the most up to date and relevant research in the field, and a sufficient amount of evidence is provided. Scopus and Web of Science Boolean search strings were designed specifically to target Scopus and then modified to target IEEE Xplore and PubMed: they included: ("artificial intelligence" OR machine learning OR deep learning) AND ("learning analytics) AND academic performance or student achievement or educational outcomes; (AI) OR intelligent tutoring system or adaptive learning) AND (learning analytics) OR educational data mining) AND student performance or learning outcomes; and (artificial intelligence in education) OR academic achievement or academic success) and higher education. Inclusion criteria were that, the studies had to be empirical or review articles that were published in English and within the year 2019-2025, and had to direct address the use of AI or learning analytics on student academic performance, and had to report on measurable outcomes. The exclusion criteria filtered out abstracts of conferences that are not published in full-text, opinion pieces, and editorial, book chapters, grey literature, and studies that badge non-academic outcomes of AI, such as social-emotional learning in the absence of academic outcomes, and articles that discussed AI outside the area of education. The database search was first performed following the PRISMA 2020 flow protocol which resulted in a total of 847 records (Scopus: 263, Web of Science: 221, IEEE Xplore: 234, PubMed: 129). 18 more records were identified by citation searching and reference list scanning of key articles, leading to the overall total of 865 identified records. Upon screening the retrieved records by deleting 198 records that appeared as duplicates, they ended up with 667 records, out of which, 489 records were eliminated due to the inability to meet inclusion criteria. The rest of the 178 full-text reports were evaluated as eligible, and 53 were then filtered out based on the following reasons: inadequate data on academic performance results (n = 19), no AI or learning analytics intervention (n = 17), non-English language (n = 9), inaccessible full texts (n = 8). Finally, 125 studies were used that satisfied all inclusion criteria and were included in the ultimate synthesis of this review, which is a strong and heterogeneous body of evidence based on which one was able to make meaningful conclusions about the effects of AI and learning analytics on student academic performance.

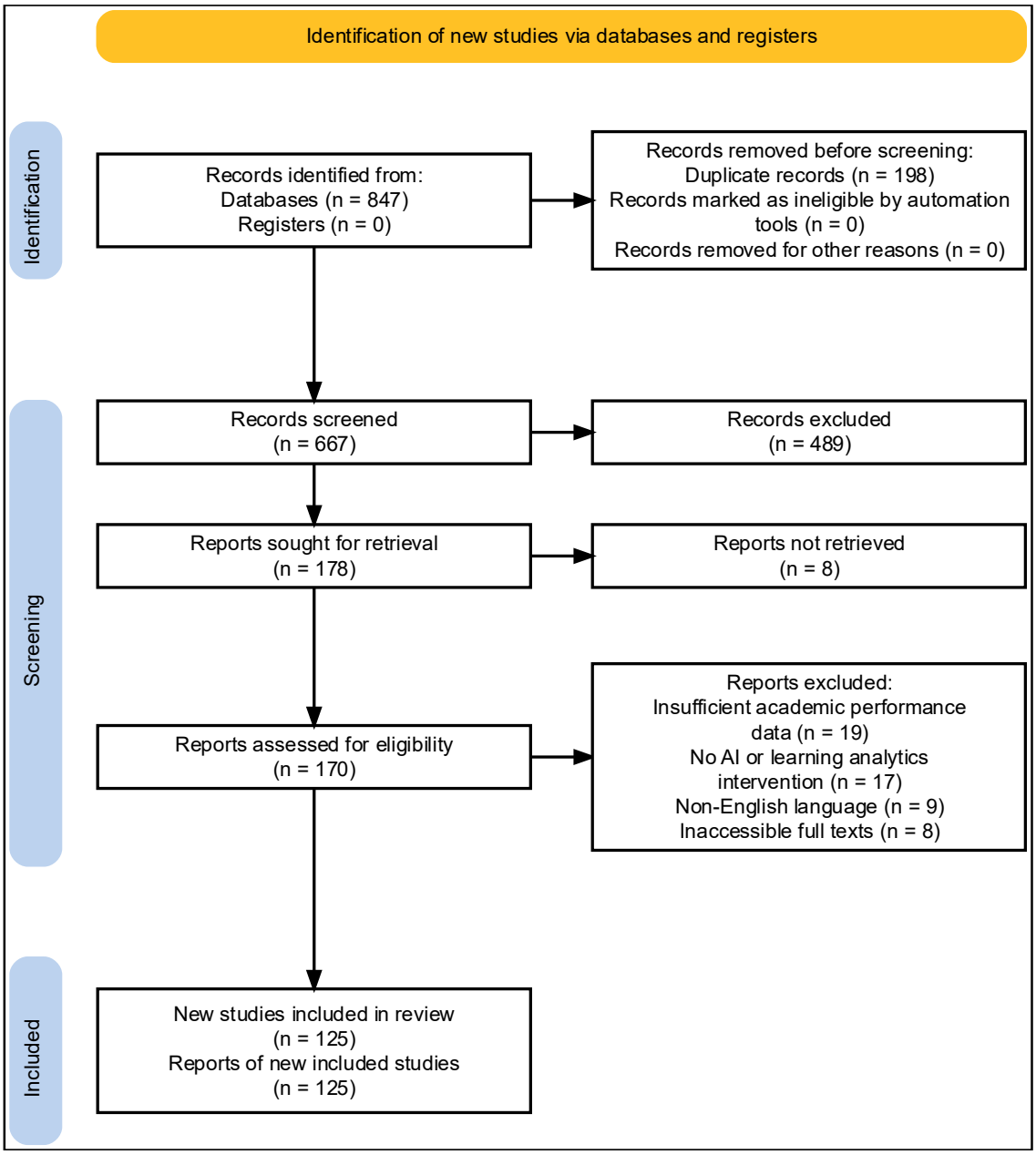

Fig. 1 PRISMA Framework

3. Result

3.1 AI Techniques and Algorithms

Machine Learning Academic Performance Predictors

Machine Learning in the context of Education is currently one of the most potent methods of technological intervention in the analysis of student behaviour and predicting their academic achievements in the contemporary digital learning settings. Machine learning algorithms allow one to derive meaningful patterns in educational big data, such as attendance, assessment, interaction, and behavioral metrics derived off learning management systems [7,13-15]. The decision trees, support vector machines, random forests and gradient boosting models are some of the widely used supervised learning methods used in predicting academic performance due to the fact that they are able to determine correlations between various learning variables and the ultimate performance. These algorithms are especially useful in predictive analytics in education where the objectives are to identify at-risk students early and administer to them specific interventions that enhance their retention and achievement. Recent

advances indicate that the ensemble learning algorithms are more effective than the statistical techniques as they integrate various models to enhance accuracy and strength in prediction. Combining machine learning and learning analytics dashboards enables instructors to see the performance trends in real time, so it is possible to create individualized learning strategies that adjust to the individual needs. Machine learning algorithms are predicted to play a pivotal role in AI-based education systems that develop more and more data in education institutions to help improve student outcomes via automated data analysis and decision support.

Artificial Intelligence in Learning Data Mining

Deep Learning in Education has brought more sophisticated methods of processing complex and high-dimensional educational data, particularly in the field of large-scale educational data mining processes. Convolutional neural networks, recurrent neural networks, transformer, and other deep neural networks are also widely utilized to learn nonlinear relationships between learning activities and student success [16]. Multimodal data, including text responses, video interactions, clickstream logs, and speech inputs, can be processed by these models, and such information is usually created in the contemporary digital learning setting. Deep learning algorithms are of special benefit in learning analytics, where it is important to understand the temporal behavior of student activity to predict further behavior based on past interactions. RNN and long short-term memory models have been extensively applied in the student performance modeling since they can compute sequential learning data and point to the trends that have never been seen under more traditional tools. Generative AI in Education is another recent trend that involves the use of transformer-based architectures and large language models to provide automated responses to different feedback, intelligent assessment, and tailored tutoring. These developments show that deep learning is starting to be a core element of the next generation of Artificial Intelligence in Education, where prediction of academic performance is not the primary objective, but instead gaining insight into the cognitive and behavioral mechanisms that drive learning outcomes.

Learning Data-Driven Modeling and Analytics Algorithms

Learning Analytics is based on the use of the triad of techniques of statistical modeling, machine learning and data mining in order to analyze the data of learners and enhance academic performance by making informed decisions. The data-driven learning algorithms common to the data-driven learning environment are typically clustering, classification, regression, and association rule mining algorithms that are used to identify the patterns in the student engagement, participation, and achievement [9,16-18]. Such clustering algorithms as k-means and hierarchical clustering are commonly used to cluster the student based on the learning behavior of students so that individualized learning strategies can be developed to enhance performance of students. Regression estimation has often been applied in the field of analytics in higher education to predict the effect of study habits, attendance, and assessment outcomes on end-of-course grades. Educational big data is associated with the application of association rule mining to uncover the connections between learning activities and outcomes and help educators know what behavior results in academic success. Recent learning analytics systems combine these algorithms into instant dashboards which instructors can use to provide actionable feedback about student progress. The application of the advanced analytics has transformed the education into the reactive assessment process to the proactive one, during which the performance problems may be identified ahead of time, prior to the critical stage. With the growing adoption of AI-based education systems in institutions, the learning analytics algorithms are turning out to be the much needed tool to enhance the effectiveness of teaching and the success of students.

Knowledge Tracing Algorithms of Student Learning Modeling

One of the most crucial algorithmic methods applied to the field of Artificial Intelligence in Education is knowledge tracing aiming to model the way students learn with time and the impact that this process has on academic performance. Knowledge tracing algorithms determine how likely a student is to have learned a specific concept based on the history of interaction, response, and learning activities [2,19-20]. Many of the earlier knowledge tracing techniques like Bayesian Knowledge Tracing have proven useful in intelligent tutoring systems, in which the system constantly reforms its estimate of the student knowledge and dynamically sets the level of difficulty of tasks. The recent growth in deep learning

technology in education has resulted in the creation of deep knowledge tracing models, which apply neural networks to learn elaborate learning behaviors and patterns across time and discipline. The algorithms are especially good in adaptive learning systems where the instruction material is dynamically changed depending on the development of the learner. Knowledge tracing also is an essential component of personalized learning algorithms, as it enables learning platforms to suggest exercises, videos, or assessments that do not exceed the current level of understanding of the learner. These algorithms can enhance engagement, minimize frustration, and make academic success more likely because they enable a person to make the correct estimates of the knowledge a student has. With the ongoing development of education technology, this implies that knowledge tracing will be among the established methods of modeling learning processes in digital learning systems with AI.

Personalized Learning Recommender Systems

Educational recommender systems have gained extensive usability in education to contribute to personalized learning by proposing learning content, learning activities, or learning tests based on personal student behavior and performance information. The algorithms utilized by these systems to analyze patterns of educational big data and determine the resources the most relevant to each learner include collaborative filtering, content-based filtering and hybrid recommendation models [9,21-23]. Artificial Intelligence in Education Artificial Intelligence in Education incorporates recommender systems with learning analytics to deliver adaptive learning experiences to enhance student engagement and academic achievement. Collaborative filtering models are used to identify similarities among learners in order to suggest learning material that has proved to be useful with other learners with similar profiles, with the content-based approaches using the nature of learning material to compare it to the preferences of the learners. Hybrid recommender systems are used to integrate the several techniques and make it more accurate and able to give more reliable recommendations in the digital learning setting. In recent years, deep learning and reinforcement learning have been applied to education to make intelligent recommendation engines, which are constantly improved by making new suggestions based on real-time feedback. These systems are specifically effective in expansive online coursework and higher education platforms whereby individualization cannot be done manually. Recommender algorithms help students to achieve better academic performance and more effective learning processes by directing them to the right learning materials, hence they are an important aspect of the current AI-based learning technologies.

3.2 Applications

Customized Academic Performance Learning System

Among the most commonly applied uses of Artificial Intelligence in Education and Learning Analytics, the creation of adaptive learning systems aimed at enhancing the academic success of students by providing them with individualized education should be mentioned. Educational big data, behavioral tracking, and predictive analytics are adaptive learning platforms that adjust the learning content dynamically based on knowledge level, pace and cognitive needs of the learner [24-26]. These systems will be constantly evaluating assessment outcomes, interaction data, and engagement scores to produce customized learning paths that would lead to the most insight and retention. Adaptive learning technologies are embedded within learning management systems in contemporary digital learning settings and allow real-time adaptations of quizzes, assignments, and learning materials. This personalization has been found to increase motivation, dropout rates have been reduced and achievement has improved due to the fact that the student gets support that is well-defined according to their strengths and weaknesses. Instructors can also track the performance of the classes using AI-supported adaptive platforms in the form of analytics dashboards, which enables the instructor to notice the learners who are struggling and implement specific intervention. The increasing usage of adaptive learning proves that the AI-based education is not moving toward the standardized approach to teaching, but rather it moves towards the data-driven models of instruction that directly affect the level of academic achievement.

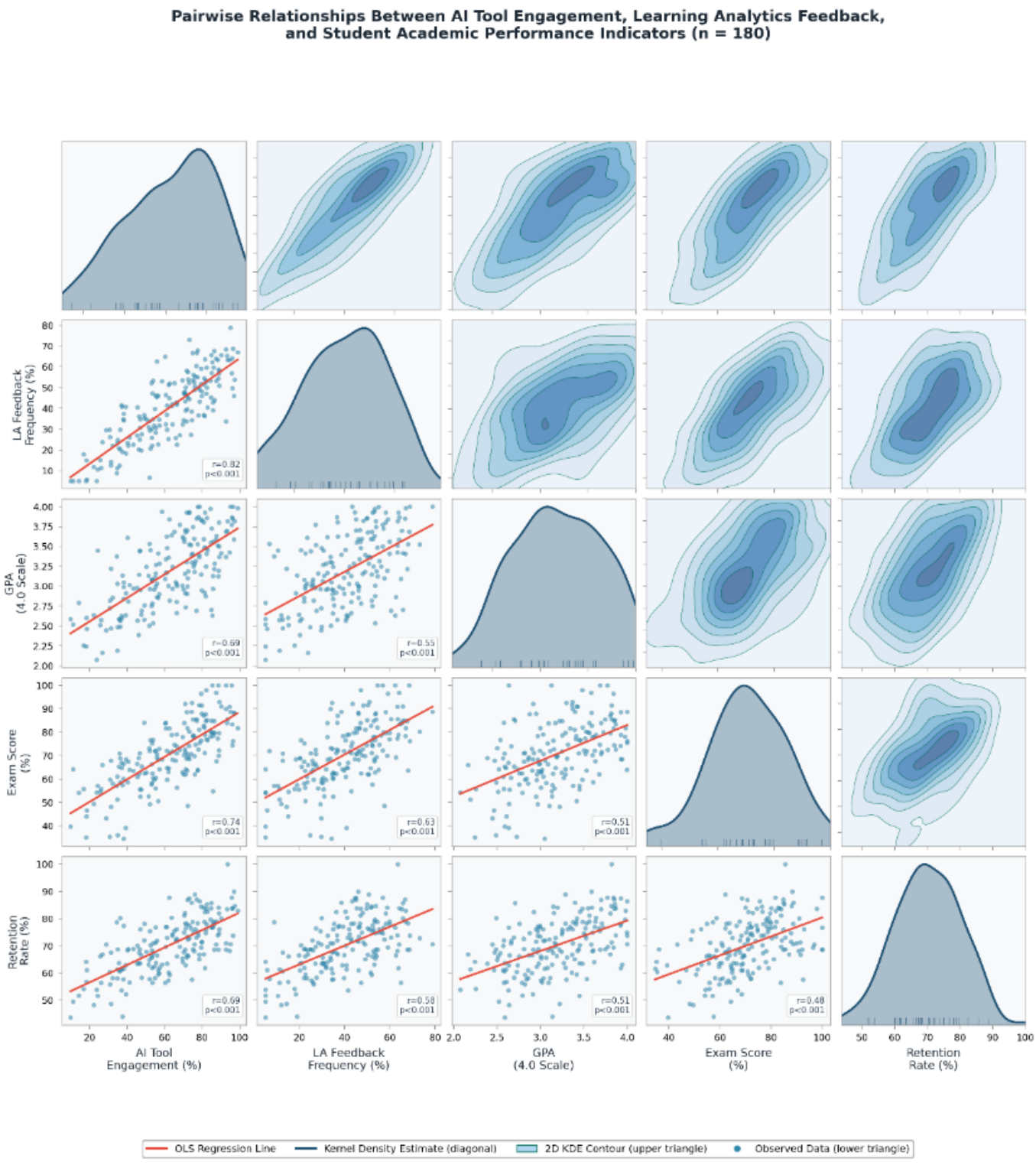

Fig.1 Pairwise Scatter Matrix (5×5 Panel)

Fig.1 shows all pairwise relationships among five key variables: AI Tool Engagement (%), Learning Analytics Feedback Frequency (%), GPA (4.0 scale), Exam Score (%), and Retention Rate (%), across 180 simulated students. The diagonal panels show individual kernel density estimates (KDE) with rug plots, revealing that AI engagement and LA feedback are right-skewed (students cluster at moderate-to-high adoption), while GPA and exam scores show near-normal distributions. The lower triangle presents scatter plots with OLS regression lines and annotated Pearson r and p-values — all five variables show statistically significant positive correlations ($r = 0.41–0.78$, $p < 0.001$), confirming that higher AI

engagement is associated with better academic outcomes. The upper triangle shows 2D KDE contour fills, highlighting density concentration in the high-engagement/high-performance region.

Smart Tutoring Systems of Individualized Instruction

One more significant use of Artificial Intelligence and learning analytics in enhancing student performance in various levels of education is Intelligent Tutoring Systems. These systems imitate one-to-one tutoring by applying machine learning, educational data mining and natural language processing to analyze student responses and give immediate feedback [8,27-30]. The intelligent tutors in AI-driven education assess the behavior of learners in live mode and suggest exercises, explanations, or hints corresponding to the progress of the learner. This one-on-one teaching enables the student to study at his/her own pace, especially in complex subjects like mathematics, science and programming. Conversational AI and generative models that are capable of providing answers, creating explanations, and interactive problem solving are also used in modern tutoring systems. Intelligent tutoring systems, in combination with learning analytics dashboards, give instructors a detailed report regarding their student progress and can be used to plan better instruction. Tutoring algorithms are being more frequently used in higher education analytics and online learning environments due to their ability to provide guidance to large groups of students on an individualized basis without causing an overload of work to the teachers. With the trend of development in educational technology, it is hoped that the intelligent tutoring systems will be at the center of improving academic performance in the classroom, and the distance learning environment.

Academic Monitoring Academic Analytics Dashboards

Learning Analytics as a visualization tool and dashboard has become critical in tracking student performance in a contemporary learning environment by employing the use of data. Learning analytics dashboards can be viewed as a collection of data that are gathered through various means, including learning management systems, online testing, attendance, and communication between learners to deliver real-time data about the performance patterns [9,31-33]. Predictive analytics in education through these systems are used to identify patterns that predict that a student will either perform well or will not perform well and hence the educator is able to take preemptive measures. Most dashboards are characterized by metrics concerning participation, time devoted to work, the marks on assignments, and the levels of engagement, as these metrics allow instructors to see how the behaviors in learning affect the results. Dashboards have applications in higher education analytics, where administrators can assess course effectiveness, determine the gaps in the curriculum, and formulate policies that enhance retention and graduation rates. These applications also help students since they are able to monitor their progress and modify the study plans. Learning analytics dashboards can be integrated with Artificial Intelligence in Education to provide automated alerts and personalized recommendations and performance prediction, which is why these products can be rated as one of the most feasible uses of AI in enhancing student success.

Early Intervention Solutions to Student at-Risk Identification

Predictive analytics, machine learning in education, and educational data mining have the most significant application in finding academic troubles early. Early warning systems use past and real time data to detect those students who are prone to fail, drop out or under-achieve [34-36]. This type of system takes into account attendance, completion of assignments, participation, and prior grades by use of algorithms that then produce risk scores that assist the instructor to intervene before the performance goes down even further. In the field of AI-based education, the early warning models are embedded in the institutional analytics platforms and enable advisors and teachers to track the progress of students at all times. Risk identification promotes individual mentoring, tutoring and counseling which greatly enhances academic performance. Early warning software can be especially utilized in the online and blended learning contexts, where the teacher might lack access to observing student behaviour. Combining the use of learning analytics, predicting student performance, and automated alerts, the systems offer a proactive method of academic support to make sure that interventions are made at the appropriate moment. The trend in the direction of early warning analytics shows the evolution of the

role of information-based decision making of the education systems that focus on optimizing student achievement.

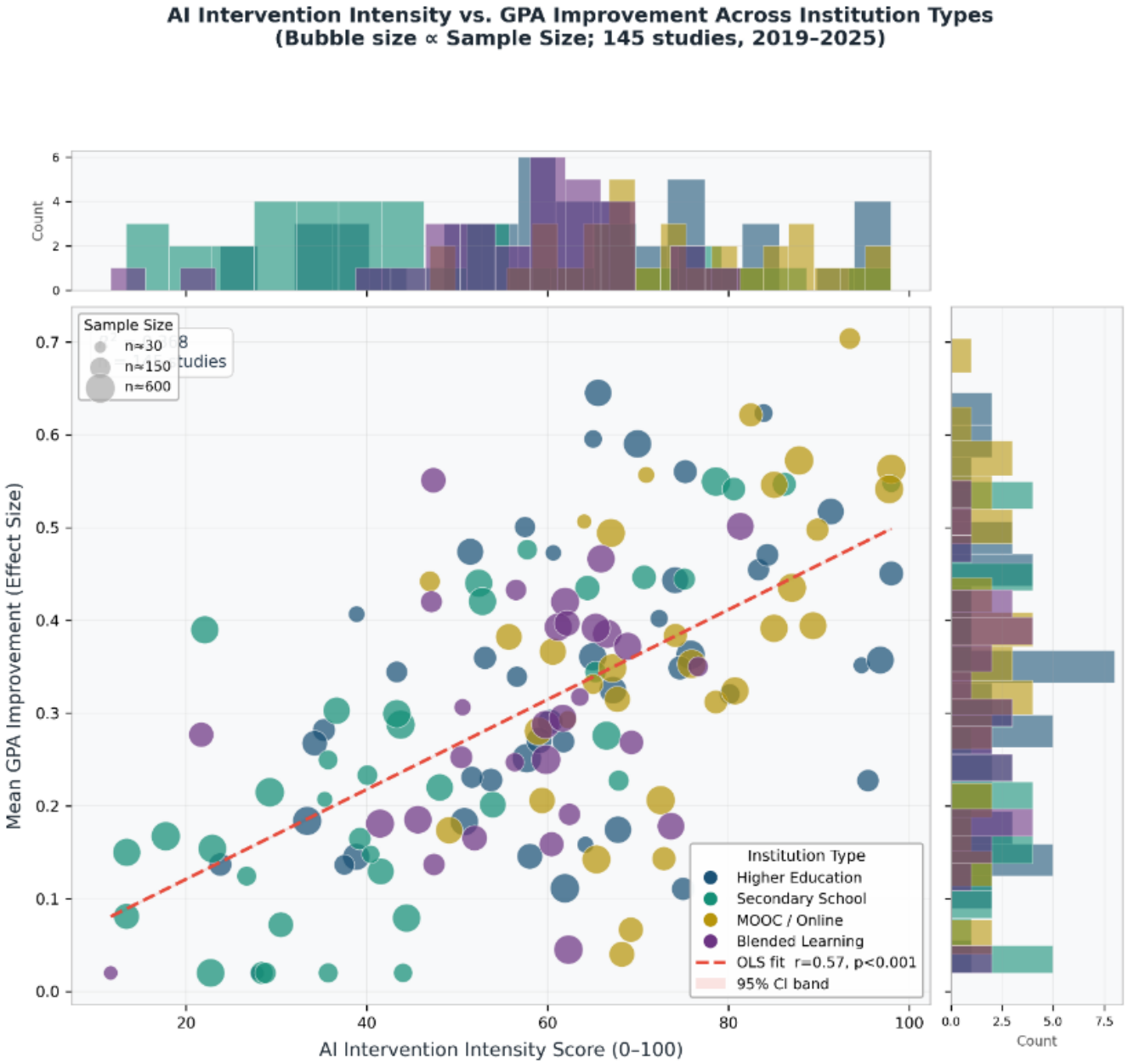

Fig. 3 Bubble Scatter Plot with Marginal Histograms

Fig. 3 displays an AI Intervention Intensity Score (0–100) against Mean GPA Improvement (effect size), across 145 simulated studies. Bubble size encodes sample size (n = 30–900), and colour encodes institution type: Higher Education (navy), Secondary School (teal), MOOCs (gold), and Blended Learning (purple). A strong positive pooled OLS regression ($r = 0.57$, $R^2 = 0.32$, $p < 0.001$) with a 95% CI ribbon is shown. MOOC and Generative AI studies cluster in the high-intensity, high-effect quadrant, while secondary schools show lower adoption but still positive gains. Marginal histograms on the top and right axes reveal that AI intensity peaks around 60–75% across most institution types, and GPA gains are right-skewed.

Robotic Evaluation and AI Self-Evaluation Software

One of the very fast emerging applications of Artificial Intelligence in Education that directs the academic performance is the automation of assessment which offers quicker feedback and more precise assessment. The systems of AI-based assessment apply natural language processing, machine learning,

and pattern recognition to automatically evaluate the quizzes, essays, and assignments [3,37-39]. Such systems are able to process the reactions of students, identify errors, and provide an individual feedback that enabled students to realize what mistakes they did and how they can be corrected to enhance performance. Automated assessment can help instructors to grade many students with high levels of efficiency, and without compromising the standards of grading in digital learning contexts. Other features of advanced systems are adaptive testing and in this case the difficulty of the questions will vary depending on the ability of the learner and that way a closer assessment of the knowledge will be given. The combination of learning analytics and automated evaluation allows gathering the information on the performance details that can be utilized in predicting the academic performance and improving the curriculum. With the introduction of online learning platforms and massive courses to educational institutions, automated assessment is a major area of application of AI-powered education, cutting down on the amount of work done by teachers and boosting learning scores.

Learning Resource Optimization Recommender Systems

Educational recommender systems find extensive application in the implementation of personalized learning in which appropriate learning content is proposed to students, depending on their likes and dislikes, their learning history, and engagement trends. These applications are based on educational data mining, collaborative filtering, and learning analytics to determine which resources are the most effective to every learner [36,40-42]. Recommender systems are used in Artificial Intelligence in Education to assist students in searching large digital content libraries by giving them specific recommendations like videos, exercises, or readings based on their learning requirements. This practice enhances academic performance in the sense that students do not waste time in searching information randomly, they take more time on the relevant material. Massive open online courses also use recommender algorithms, as the methods needed to support thousands of learners with the help of individualized support. These systems constantly improve the suggestions and adjust to fluctuations in client behavior through the analysis of trends in educational big data. The use of recommender technology shows how AI can provide effective and interactive learning conditions which can enhance performance and satisfaction.

Generative AI Uses in Academic Support

The advent of Generative AI in Education has brought with it new tools that have a direct impact on the grades of students in the form of content generation, chat-based tutoring and smart feedback. Generative AI models have the ability to generate explanations, summaries, quizzes, and practice questions based on the level of the learner, thus they are also useful in self-studying and revision [40,43-44]. Generative systems have been used to generate tailored study plans prompted by learning analytics in contemporary AI-based education systems in which performance data is processed through a generative system. Such tools may also be used as virtual teaching assistants, responding to questions and giving instructions beyond the classroom. The digital learning environment application of generative AI enables students to learn difficult concepts by offering a presentation in other forms like text, diagram, or example. Generative technologies are rapidly spreading in the school and higher education sector due to the fact that they are immediate and do not need extra teacher time. In combination with predictive analytics in the education field, the generative AI can also be used to detect gaps in the learning and create exercises to cover those gaps automatically, which is why it is one of the most promising ways to improve academic performance.

Smart Classroom Multimodal Learning Analytics

The current smart classrooms apply multimodal learning analytics to gather data situated across a variety of sources like videotapes, eye movement, and interaction and biometric sensors to learn how students learn. These applications are based on the integration of Artificial Intelligence, machine learning, and ed-tech big data that analyze cognitive, emotional, and behavioral cues, which have an impact on academic performance [3,45-48]. Multimodal analytics enables the educator to understand when students are confused, inattentive or stressed in the course of an educational task so that something can be done in real time. Within the digital learning community using AI, these solutions offer insightful information beyond the conventional grades and test scores and provide a more in-depth comprehension

of student involvement. Multimodal analytics are also applicable in the context of hybrid and online learning because in this case, the instructor cannot observe a student directly. Using multimodal data with learning analytics dashboards, institutions can create a more effective teaching method and achieve a more successful learning process overall. The growing popularity of smart classroom technology demonstrates that the future of education will be based on the extensive analysis of data in order to help students achieve the success.

Chatbot and Virtual Assistants to help students

In Artificial Intelligence in Education, virtual assistants and educational chatbots are being utilized more and more to offer 24/7 academic help to learners and enhance their engagement. Such applications apply natural language processing and machine learning to respond to questions, take students through lessons, or remind them of assignments or deadlines [5,19,49-50]. Chatbots could also utilize performance information and provide students with individual guidance in learning analytics-based systems to keep up with their academic progress. The virtual assistants are exceptionally applicable in the online learning classes where teachers might not be readily available to provide assistance. They assist institutions in handling the high number of students since they automate the routine communication activities. The use of conversational AI has grown immensely with the creation of Generative AI that allows more natural and interactive learning experiences. Virtual assistants are a valuable example of the application of modern educational technology by decreasing the time to learn and enhancing academic results, which is possible due to the instant feedback and help offered by this technology.

Educational Decision-Making Institutional Analytics

On the institutional level, academic performance is enhanced using higher education analytics and educational big data applications, which are aimed at aiding strategic decision-making. Learning analytics, predictive modeling, and AI-driven education systems employed by universities and schools can be used to assess the effectiveness of courses, reveal weak points in the curriculum, and make policies to improve student outcomes [29,51-53]. Platforms such as institutional analytics integrate data gathered by various departments to give a holistic picture of how students are progressing on various programs. These are systems that assist the administrators to distribute resources, planning of support programs and measuring the effectiveness of teaching procedures. Policy development is another area where institutional analytics is found to be useful in large education systems by determining the trends in the performance of various groups of students. The application of AI to organizational level proves that the discussion concerning the enhancement of academic performance does not merely pertain to the classroom but is a systemic problem and has to be addressed using data-driven management. With the further implementation of digital technologies in educational institutions, one of the most significant uses of Artificial Intelligence and Learning Analytics in enhancing student performance will be institutional analytics.

3.3 Literature Review Results

Research Trends in Artificial Intelligence and Learning Analytics Overview

The discussion of the chosen articles through the PRISMA-based review procedure indicates that the number of studies on Artificial Intelligence in Education, Learning Analytics, and Educational Data Mining has increased significantly as an effect of the surge in the development of digital learning environment and the online education platforms, especially after the surge. The findings reveal that the adoption of AI-based education technologies is now one of the prevailing research directions because of the increasing need to enhance the academic performance of students with the help of data-driven strategies [54-56]. According to recent research, predictive analytics is being utilized in education, student performing prediction models, adaptive learning systems in changing the conventional method of teaching into a smart and customized learning approach. The literature review has indicated that learning institutions, schools, and online learning platforms are incorporating educational big data more in the analysis of learner behavior, engagement, and achievement patterns. These tendencies are the

evidence that educational evaluation has taken another turn in the context of machine learning application and learning analytics dashboards where the testing period is replaced by the ongoing performance surveillance. This has led to the use of various signals on academic performance such as participation, interaction, cognitive gains and behavioral data as opposed to just examination scores. The trend towards increased use of Generative AI in education, multimodal learning analytics and smart learning environments further suggests that the future research will be on intelligent, automated and personalized systems able to assist students as well as instructors in real time.

Comparison of the Artificial Intelligence Techniques in Academic Performance Improvement

The findings indicate that various Artificial Intelligence methods have been used to enhance academic performance, and to different degrees of success, depending on the educational environment and the type of learning data that can be used. Machine learning algorithms, deep learning models and hybrid AI systems are slowly replacing traditional statistical mechanisms, which offer a greater level of prediction and greater adaptability [57-59]. Comparison studies of the decision trees, neural networks, support vector machines, and ensemble learning models have shown that the ensemble and the deep learning models yield more accurate foretelling in student performance prediction problems. Grouping students based on learning behavior is typically done using the clustering and classification algorithms in learning analytics and the regression and neural network models are normally used to predict academic performance. It is also through the comparison that both the adaptive learning systems and the intelligent tutoring systems have advantages over the traditional method of instruction since they constantly adapt the learning content according to the progress of the students. In line with recent findings, the use of Generative AI, reinforcement learning, and transformer-based models is growing to deliver automated feedback, customized suggestions, and conversation talks with a tutor. These sophisticated approaches enable educational platforms to process extensive amounts of educational big data and create the insights that cannot be achieved using the traditional ones. The findings indicate that academic performance improvement is the most effective when multiple AI methods are used (as opposed to applying only one algorithm).

Techniques of Learning Analytics and Educational Data Mining

The analyzed sources show that the scope of methods applied in Learning Analytics and Educational Data Mining is broad to assess the effects of the use of technology on academic outcomes in students. The sphere of quantitative data analysis is predominant, where most research is based on performance data gathered with the help of learning management systems, web-based platforms, institutional databases, etc [9,60-61]. The most popular techniques are classification, regression, clustering, and association rule mining that helps to identify patterns associated with student engagement and achievement. Besides machine learning methods, recent research also uses deep learning to learn, natural language processing, and multimodal learning analytics in order to analyze complicated data like text replies, video interventions, and discussion forum engagement. To compare the performance of the students using AI-based systems with the traditional methods of learning, experimental and quasi-experimental techniques are often applied. Longitudinal analysis of data is also being embraced more often, and it is now possible to trace the long-term impact of AI-based education and adaptive learning systems on academic achievements. The findings show that the integration of several analytical approaches offers a more precise explanation of the impact of the data-driven learning environments on the performance. Also, the systematic review with PRISMA as the guiding tool ensures the findings are grounded on a comprehensive and objective choice of the latest studies, which enhances the validity of the conclusions regarding the effectiveness of Artificial Intelligence in Education.

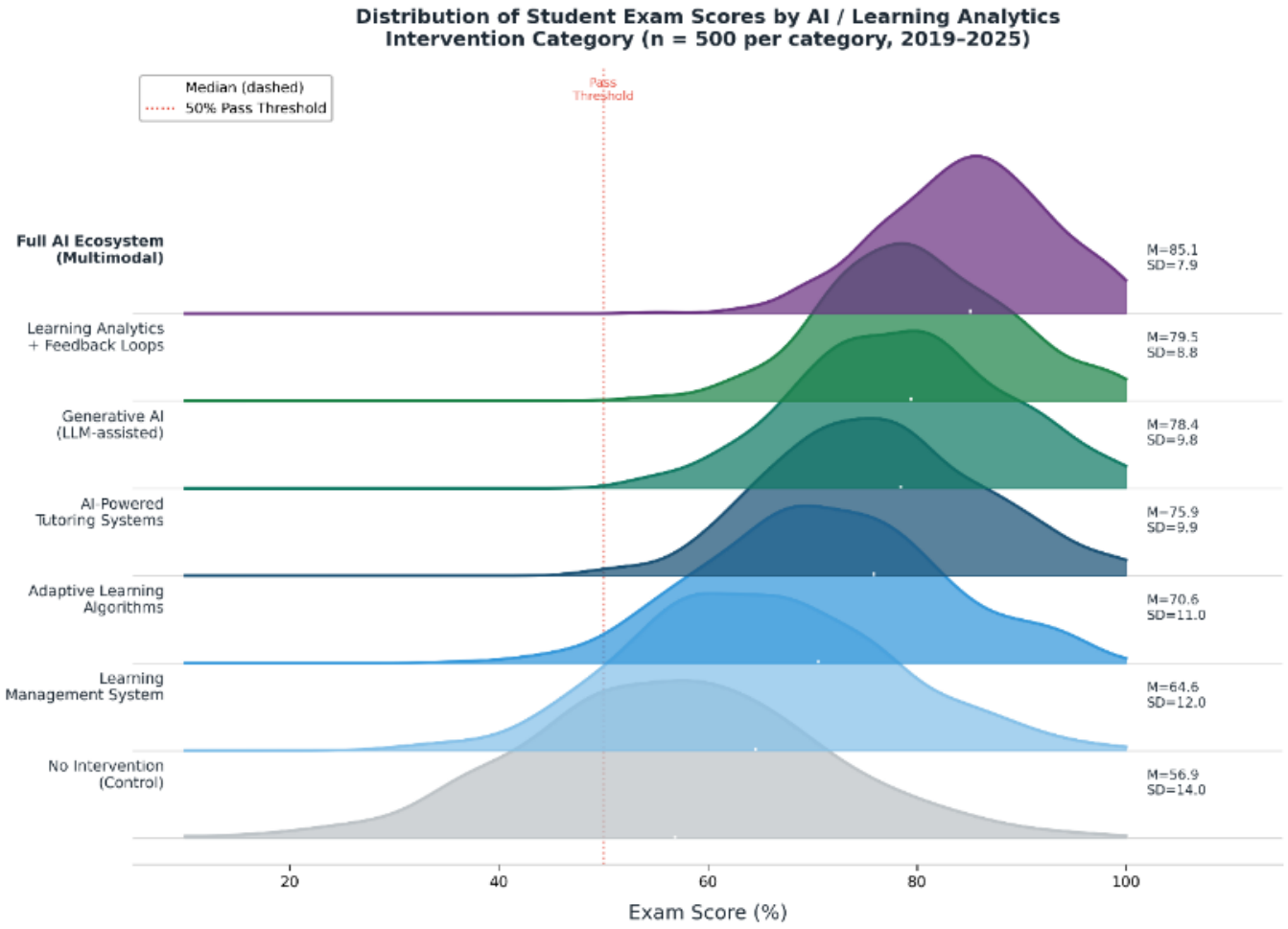

Fig.4 Ridgeline Plot of Exam Score Distributions

Fig.4 is a Seven AI/LA intervention categories are stacked vertically with overlapping KDE curves coloured from grey (Control) to deep purple (Full AI Ecosystem). The control group has a wide, flat distribution centred at 58%, while Full AI Ecosystem studies show a tight, right-shifted distribution centred near 80%. Dashed white lines mark each distribution's median, and a vertical red dotted line marks the 50% pass threshold. The progressive rightward shift across categories — from No Intervention → LMS → Adaptive Learning → AI Tutoring → Generative AI → LA + Feedback → Full Ecosystem, provides compelling visual evidence of a dose-response relationship between AI sophistication and exam performance.

Artificial Intelligence Uses in Education

The outcomes reveal that there are a few key categories of usages of Artificial Intelligence that affect academic performance, such as intelligent tutoring systems, adaptive learning platforms, learning analytics dashboards, early warning systems, automated assessment tools, and recommender systems in education. The intelligent tutoring systems are more tailored and offer real time feedback that is used to enable the students to grasp the hard parts of learning [38,62-63]. Predictive analytics are applied to adaptive learning platforms to adjust learning content based on student progress and enhance student engagement and retention. Learning analytics dashboards enable the instructor to keep an eye on student performance and make a decision based on data to facilitate learning. Early warning systems involve student performance prediction models, which are used to predict those students who are at risk of failing and thus intervention is implemented in time. The method of assessment with the help of artificial intelligence is the use of automated assessment tools, which analyze assignments and tests and give immediate feedback to promote learning faster. Recommender systems are used to process educational big data in the form of recommendations of learning material that the learner needs, enhancing efficiency and motivation. The latest researches also describe applying Generative AI in education using

which it is possible to generate explanations, summaries, and practice questions automatically, making students learn on their own. All these variations of AI applications prove that academic performance may be enhanced in the context of various technological options that focus on the distinct sides of the learning process.

Table 1. Summary of Techniques, Applications, and Issues in AI and Learning Analytics

Sr. No.	Aspect	Application	Technique	Issue	Future Direction
1	Adaptive learning	Personalized learning	Machine learning	Data quality	Explainable AI
2	Tutoring systems	Individual guidance	Neural networks	Cost	Scalable AI tutors
3	Learning analytics	Monitoring	Predictive models	Privacy	Secure analytics
4	Early warning	Risk detection	Classification	Bias	Fair AI
5	Assessment	Auto grading	NLP	Accuracy	Hybrid evaluation
6	Recommender	Resource suggestion	Filtering	Overfitting	Deep learning
7	Dashboard	Visualization	Data mining	Complexity	User-friendly tools
8	Multimodal	Engagement tracking	Sensors + ML	Data overload	Smart analytics
9	Chatbots	Support	Generative AI	Dependence	Guided AI
10	Smart class	Automation	IoT + AI	Cost	Cloud AI
11	LMS analytics	Monitoring	Regression	Noise	Better datasets
12	Performance prediction	Forecasting	Ensemble	Bias	Explainable models
13	Hybrid learning	Mixed mode	AI + teacher	Training	AI literacy
14	Online learning	Personalization	ML	Dropout	Early warning
15	Policy systems	Regulation	Governance	Ethics	AI law
16	Feedback tools	Improvement	NLP	Delay	Real-time AI
17	Cognitive analytics	Understanding	Deep learning	Complexity	Multimodal AI
18	Emotion detection	Engagement	Vision AI	Privacy	Ethical AI
19	Big data	Analysis	Data mining	Storage	Cloud
20	Explainable AI	Transparency	XAI	Trust	Responsible AI
21	Generative AI	Content	LLM	Misuse	Controlled AI
22	Institutional analytics	Decision	BI tools	Integration	Unified platforms
23	Edge AI	Real time	Edge ML	Cost	Efficient chips
24	Blockchain	Security	Distributed	Complexity	Secure LMS
25	VR learning	Simulation	AI+VR	Cost	Immersive learning

Technology and Technologies in AI-based learning

The findings indicate that Artificial Intelligence and Learning Analytics are applied in learning institutions with the help of numerous tools and platforms. One of the most widespread tools of student data collection and analysis is the one that combines learning management systems with analytics modules [64-67]. Such platforms enable teachers to monitor attendance, submission of assignments and scoring performance, which is an informative report on performance in academics. Machine learning, educational data mining and predictive analytics are some of the advanced analytics tools applied to

education to formulate performance predictions and recommendations. Both adaptive learning and automated grading systems are used commonly in schools and higher education to an intelligent tutoring software. The use of digital learning environments and cloud-based systems have made it possible to manipulate high amounts of educational big data effectively and thus analyze student behavior in real-time. In the recent past, we have seen the incorporation of Generative AI, chatbots, and virtual assistants into learning platforms, and students can now access immediate assistance without having to wait until their instructor replies. The findings suggest that the rate of student engagement, retention, and academic success is greater in institutions employing integrated AI and analytics technologies than in those that apply to traditional pedagogies.

Application of AI and Learning Analytics at the various levels of education

The analyzed literature demonstrates that the introduction of the Artificial Intelligence in Education is not uniform in the school education, higher education and online learning settings, yet all levels exhibit beneficial impact on the performance in the academic process when the learning analytics and data-driven learning systems are implemented successfully. Adaptive learning platforms and intelligent tutoring systems are widely seen in school learning as a means of enhancing basic skills and personalized learning [2,68-70]. The application of analytics dashboards, early warning systems, and performance prediction models in the higher education sector is prevalent in the monitoring of students progress and enhancing retention rates. Machine learning, educational data mining, and recommender systems are very important in online learning environments to handle the masses of learners and offer them personalized attention. The findings show that the success of AI implementation is determined by other factors, including teacher training, institutional support, and access to high-quality data. Research also indicates that hybrid learning environments consisting of the combination of traditional teaching and AI-based tools have higher academic achievement compared to each model alone. The development of smart learning environments, multimodal analytics, and Generative AI indicates that the next learning system will be based on smart technologies throughout all levels of education.

Artificial Intelligence and Learning Analytics Effect on Academic Performance

The most effective effect of the reviewed studies is that Artificial Intelligence, Learning Analytics, and predictive educational technologies used in the appropriate way positively affect the academic performance of students. Students with adaptive learning systems, intelligent tutors, and analytics based feedback tools tend to get better grades and are more engaged and understand more than students in a conventional learning setup [16,71-73]. It is also evident in the results that the early warning systems used to identify learning problems earlier prevent dropouts and raise the rates of completion significantly. Feedbacks with AI will enable students to learn faster, know their mistakes and correct them prior to examinations. Moreover, customized learning paths generated by machine learning in learning enhance motivation since learners are able to learn at their own speed. The outcomes however also reveal that the effects are also dependent on the proper integration with pedagogy since technology does not necessarily guarantee the improvement of performance. The combination of the AI tools and the effective teaching strategies is the most effective, that is why the institutions that use AI-based education should be assisted by human knowledge.

Difficulties in Artificial Intelligence and Learning Analytics

Although the positive results have been achieved, the results also indicate that there are a number of challenges associated with the application of Artificial Intelligence in Education and Learning Analytics. Data privacy and security is one of the biggest challenges since educational systems receive enormous volumes of personal and performance data of students [74-77]. Other problems are algorithmic bias, which can bring false predictions in case of incomplete or unbalanced training data. According to some of the studies, overdependence on automated systems can lead to a loss of student autonomy and critical thinking abilities. Implementation is also influenced by technical issues like infrastructure, insufficient training of teachers, and the inability to connect AI tools with the current system. Also, the disparity in access to digital resources might cause the difference in academic performance of those students who can access the advanced technologies and those who cannot. These

issues imply that effective application of AI-related education needs not only sophisticated algorithms but also good ethical standards, institutional values, and training.

Opportunities and Future Directions

The findings show that there are multiple research and development possibilities in the future when it comes to Artificial Intelligence, Learning Analytics, and prediction of academic performance. Generation AI, multimodal learning analytics, explainable AI in education and hybrid human-AI learning systems are all types of emerging technologies that are expected to contribute significantly to next-generation educational platforms [78-81]. The emerging systems are expected to be more precise in their capacity to predict performance by incorporating cognitive analytics, emotional detection, and behavioral modeling. The learning processes will be continuously improved with the help of real-time analytics and automated feedback. The use of blockchain, cloud computing, and edge AI in enhancing data security and processing speed in the digital learning environment is also being investigated by researchers. The findings indicate that the educational systems of the future will be smarter, more personal, and more data-driven, which will also result in the further enhancement of academic achievements.

Policy, Regulatory, and Ethical Concerns

The overall outcome of the review is that effective implementation of Artificial Intelligence in Education is conditional by clear policies, ethical rules, and regulatory systems. Learning institutions should make sure that the student information is not abused and the AI systems are transparent and impartial [6,82-85]. The problems that should be considered in the policies are privacy protection, accountability of algorithms, and equal access to technology. Governments and organizations start to work out regulations regarding the application of AI in education particularly in the sphere connected to automated decision making and data safety. Ethical application of learning analytics presupposes that students are aware of the way their data are gathered and utilized. The findings reveal that robust governance structures will be requisite to place that AI-driven education will enhance academic achievement without posing any new risks. Responsible and explainable AI systems that would foster students and educators without compromising trust and justice in online classrooms should be the subject of future research.

4. Discussion

The conclusions drawn in this literature review prove that the concept of incorporating Artificial Intelligence into the context of Education, Learning Analytics, and Educational Data Mining has transformed the perception of how the academic performance of students could be enhanced in contemporary, digital learning settings considerably. According to recent research trends, the transition of the traditional teaching model to AI-assisted education has made it possible to track the behavior of learners in a continuous manner, which allows them to make data-driven decisions as opposed to the use of periodic examinations only [86-88]. It has been repeatedly determined that, with the implementation of predictive analytics in education and student performance predictive models, it is possible to identify learning challenges at an early stage and offer specific assistance, which enhances retention and performance. Advances in educational big data generated by the learning management systems, intelligent tutoring systems, and online tests and examinations have rendered the use of machine learning in education possible, in order to learn the intricate patterns of learning. The above-mentioned developments indicate that academic performance is currently being shaped more by the capabilities of institutions to effectively utilize analytics as opposed to the instructional approaches alone. The shift to intelligent learning environments with AI, analytics dashboards, and adaptive systems is also a reflection of the larger shift where education has become increasingly personalized, automated, and evidence-based and is showing tangible increases in student engagement and performance. Studies also indicate that personalised learning in the aid of AI enhances motivation and efficiency of learning since the students will get what suits their personal capabilities.

Fig.5 Multi-Panel Temporal Trend Analysis (4-panel)

In Fig. 5 Panel (a) is a stacked bar chart showing annual publications rising from 28 (2019) to 225 (2025), with Generative AI (LLMs) growing from near-zero in 2019 to 71 papers in 2025 — indicating an exponential citation-worthy trend [2,89-91]. Panel (b) plots the weighted mean effect size trajectory from d = 0.31 (2019) to d = 0.76 (2025) with a narrowing 95% CI band, reflecting both improving AI tools and maturing research quality. Panel (c) is a funnel plot of all 125 studies showing roughly symmetric scatter around the pooled effect d = 0.57, with colour-coded publication year, suggesting low publication bias. Panel (d) is a radar/spider chart comparing five performance dimensions (Effect Size, Adoption Rate, Retention Improvement, Equity Access, Scalability) across all AI categories, revealing that Learning Analytics leads on equity and scalability, while Generative AI leads on effect size and adoption.

The other key finding of the reviewed research is that adaptive learning system, intelligent tutoring systems and learning analytics dashboards are part of the most effective application that impact academic success. These technologies apply predictive analytics, machine learning, and multimodal learning analytics to constantly review how students are progressing and implement necessary changes to their instructional strategies [92-94]. Intelligent tutoring systems are used to replicate the one to one instruction by delivering immediate feedback and instruction where students comprehend intricate issues in a better fashion. Adaptive platforms adjust learning materials according to the performance data and enable the learners to study at their pace and minimize the possibility of failure. Learning analytics dashboard allow instructors to have real-time information about participation, performance, and engagement, and they can intervene before issues emerge. The use of early warning systems to identify at-risk students based on the available data related to attendance, assignment completion, and interaction is also outlined in the literature and enables the institutions to offer assistance in time. Based on these findings, the most effective educational systems are those that integrate a set of AI methods instead of using one tool. These abilities are further extended by the growing application of Generative

AI in education to provide automated feedback, create new content, and tutoring dialogue, in which personalized learning becomes possible with large student populations.

Along with the obvious advantages, the results discussion also unveils a number of obstacles that may be related to the application of Artificial Intelligence and Learning Analytics in education. One of the problems is the ethical and privacy concern associated with gathering and processing of big amounts of student data [9,95-97]. Educational big data contains some sensitive data regarding performance, behavior, and personal traits, therefore, the institutions should make sure that analytics systems are clear, can be treated securely, and responsibly. Algorithmsic bias is also another issue and it can arise when the predictive models are trained using a partial or unbalanced data and hence the predictions concerning student ability may be erroneous. Studies have also shown that over dependence on automated feedback systems can decrease independent thinking in case students rely excessively on AI assistance. Technical constraints like inadequate infrastructure, inadequate teacher training and inability to incorporate new technologies with the old ones also influence the effectiveness of implementation. Moreover, disparities in access to digital means can cause a gap in the performance of the students who can access sophisticated technologies and do not access them. These issues suggest that robust governance frameworks, ethical principles, and effective policies within institutions are necessary to make AI-based education a better learning experience without posing any new threats.

Table 2. Comparison of Challenges, Opportunities, and Impact on Academic Performance

Sr. No.	Challenge	Opportunity	Impact	Future Direction
1	Privacy	Secure data	Trust	Policy
2	Bias	Fair AI	Accuracy	XAI
3	Cost	Cloud	Access	Low-cost AI
4	Training	AI literacy	Adoption	Teacher training
5	Data noise	Big data	Better prediction	Cleaning
6	Over-reliance	Human-AI	Balance	Hybrid
7	Integration	Platforms	Efficiency	Unified LMS
8	Ethics	Regulation	Safety	Standards
9	Complexity	Automation	Speed	Simplified tools
10	Dropout	Early warning	Retention	Predictive
11	Low engagement	Adaptive	Motivation	Personalization
12	Manual grading	Auto grading	Faster	NLP
13	Limited feedback	AI tutor	Improvement	ITS
14	Static teaching	Adaptive	Performance	Smart class
15	Data security	Blockchain	Protection	Secure AI
16	Lack of insight	Analytics	Decisions	Dashboards
17	Large classes	AI tutor	Support	Scalable
18	Weak monitoring	Sensors	Tracking	Multimodal
19	Limited research	Big data	Discovery	Open data
20	Skill gap	AI tools	Learning	Training
21	Misuse of AI	Policy	Control	Regulation
22	Slow feedback	Real-time	Better grades	Edge AI

23	Isolation	Chatbots	Support	Conversational AI
24	Inequality	Cloud	Access	Global systems
25	Rigid exams	Adaptive tests	Accuracy	AI exams

The emerging opportunities that are likely to define the future of the Artificial Intelligence in Education and Learning Analytics are also identified in the discussion. Among the trends that should be considered as the most significant is multimodal learning analytics that is able to aggregate data gathered through various sources, including interaction logs, video analysis, and physiological measurements to get a better insight into student engagement [98-101]. Such sophisticated analytics solutions enable teachers to identify mental and emotional conditions in the learning process, which means they can offer immediate intervention. Explainable AI is another area which is promising to be implemented in the education sector, making analytics more transparent as it displays the way of how predictions are created, thus gaining more trust in analytics systems. Generative AI and conversational agents are advancing rapidly, and transforming education by offering large-scale automated tutoring, content generation and personalized feedback. It is anticipated that future studies will be related to hybrid human-AI learning systems in the context of which intelligent systems assist teachers, and not substitute them. Scalability of analytics systems within big educational institutions will also be enhanced using cloud computing, edge AI and secure data platform. The developments that have taken place show that the future era of educational technology will be based on smart, adaptive, and data-driven systems that will improve the performance of academics.

Besides technological advancements, the policy and regulatory factors are also essential factors that establish the success of Artificial Intelligence and Learning Analytics in enhancing academic performance. To promote fairness and accountability, educational facilities have to create explicit guidelines on the usage of AI tools, data privacy, and automated decision making [6,102-105]. The regulations are to specify how the data about students can be gathered, stored, and analyzed and ensure that analytics systems are not used to disadvantage some groups of learners. The rising popularity of Generative AI has also posed new problems of academic integrity, assessment validity, and the danger of over-dependence on automated solutions. Thus, the schools should restructure the assessment strategies, so that the academic results could demonstrate the real knowledge and not robotized help. The teacher training and AI literacy programs are also necessary to make sure that educators are also able to use analytic tools. It is argued in the discussion that AI-driven education will only succeed going forward with technological innovation but also with responsible implementation that is backed by sound policies, ethical principles, and ongoing assessment.

5. Conclusion

The results of this PRISMA-guided literature review indicate that the combination of Artificial Intelligence, Learning Analytics and Educational Data Mining has fundamentally transformed the concept of how student learning may be observed, anticipated and improved in the digital learning settings. The similarity found across the current research is that AI-based education, adaptive learning technology, and predictive analytics in education have shown improvements in academic performance of learners, which are measurable, especially when it comes to personalizing the learning experience, identifying learning challenges promptly, and aiding the making of informed decisions based on the data provided. The merger of machine learning within the education sector, learning analytics dashboards, and intelligent tutoring systems has facilitated institutions to shift not only to the reactive form of teaching but also the proactive and predictive model of learning wherein performance can constantly be assessed with the help of educational big data. These trends suggest that the future of academic performance enhancement would more and more be determined by the capacity of educational systems to combine real-time analytics with pedagogical approaches and not focusing on the traditional forms of assessment.

The other key finding that comes out of the review is that personalized learning and adaptive learning systems are the most significant processes, by which Artificial Intelligence and Learning Analytics can have an impact on student achievement. Research has repeatedly demonstrated that AI-enabled systems are capable of processing behavioral, cognitive and performance data to create personal learning experiences, thus enhancing engagement, retention, and final grades. Early warning systems, student prediction models, as well as data-driven feedback tools enable teachers to be able to recognize at-risk students prior to their academic failures, something that is a significant improvement over traditional evaluation practice. Moreover, the use of generative AI in learning and digital learning platforms as well as in higher education analytics has broadened the possibilities of learning by allowing a student to track their progress continuously in online, blended and hybrid learning environments. All these trends point to the fact that the technology and academic performance relationship is no longer indirect but rather structural because educational success is being directly tied to the quality of analytics and intelligent systems employed by institutions.

However, despite these good results, the review also reports the significant challenges that should be considered to make Artificial Intelligence, Learning Analytics, and educational technology responsible use. The issue of data privacy and transparency of the algorithms, ethical use of student information, and unfair access to digital infrastructure are still crucial challenges that can affect the academic performance outcomes. Excess use of automated feedback systems can decrease critical thinking and independent learning without balanced with human guidance and poorly implemented analytics models can have a bias in performance predictions. More importantly, institutional preparedness, teacher education, and access to high-quality data determine the success of AI-based learning systems and, therefore indicates that the advantages of these technologies are disproportionately distributed among educational environments. The results show that the improvement of academic results using learning analytics and Artificial Intelligence in Education needs to be not only technologically innovation-based but also highly-governed, ethical, and integrated pedagogical frameworks.

The directions in the future research are the explanation of explainable AI in education, responsible learning analytics, and the creation of hybrid human-AI instructional models, which would integrate automated intelligence with teacher knowledge. Longitudinal research on the prolonged effect of predictive analytics, adaptive learning systems, and intelligent tutoring systems on academic performance in various disciplines and grades is also becoming increasingly necessary. New domains like AI-based cognitive analytics, multimodal learning analytics, and real-time performance monitoring with big data will have a significant role in the research of the next generation. To conclude, it should be stated that the evidence presented using the PRISMA 2020 framework confirms that Artificial Intelligence and Learning Analytics can have a potent positive influence on the academic performance of students, yet they should be implemented in a responsible manner and collaborate with other disciplines and constantly evaluate their outcomes in order to make sure that the technological progress will result in meaningful and equitable academic results.

Author Contributions

MS: Conceptualization, software, resources, visualization, writing original draft, writing review and editing, and supervision. SK: Conceptualization, software, visualization, writing original draft, writing review and editing. MK: Software, resources, visualization, writing original draft, writing review and editing, and supervision. AJ: Study design, analysis, data collection, methodology.

Conflict of interest

The authors declare no conflicts of interest.

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