Predictive Analytics Techniques in Education by Artificial Intelligence Tools for Enhancing Academic Assessment: Systematic Review

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Abstract:

This systematic review examines the impact of AI tools in predictive analytics to enhance academic assessment, AI-powered predictive analytics are gaining momentum rapidly in the education sector, where applications of predictive analytics in education include: predicting academic performance and identifying at-risk students, customizing learning, adapting education to the individual needs of learners, enabling early detection of learning difficulties, improving academic advising to help students make informed decisions about their educational paths, as well as enhancing The research also discusses the role of AI in enhancing academic assessment that includes automated correction and adaptive feedback, plagiarism detection, learning data analytics, and the development of new assessment methods, and discusses challenges related to the application of these tools across different educational contexts, including ethical considerations, data quality, algorithmic bias, privacy concerns, and accountability.

The PRISMA 2020 model was used, where the previous literature and studies related to the research topic were reviewed from 2020 to 2024, and various databases such as Scopus, Springer, Google Scholar were used to identify the most relevant literature within this time frame, the 47 studies, then the best and most relevant studies were selected for further analysis, 7 studies, a comparative analysis of these studies was performed, followed by a final report to conclude the results and answer the research questions, the results of this research concluded the need to expand In the use of artificial intelligence tools for predictive analytics in evaluating students starting from primary to university, it was proposed to develop the educational system starting from kindergarten to twelfth grade, and to cancel the quarterly and final tests and replace them with modern evaluation methods such as electronic projects and scientific research in addition to weekly and monthly tests, and rely on predictive analysis in determining the student's field of specialization based on predictive analysis of the student's big data according to his tendencies.

Keywords: Artificial Intelligence, AI Tools, Education, Educational Technology, Predictive Analytics, Academic Assessment, Systematic Review.

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تقنيات التحليلات التنبؤية في التعليم بواسطة أدوات الذكاء الاصطناعي لتعزيز التقييم الأكاديمي: مراجعة منهجية

مستخلص البحث:

هذه المراجعة المنهجية تدرس تأثير أدوات الذكاء الاصطناعي في التحليلات التنبؤية لتعزيز التقييم الأكاديمي، فالتحليلات التنبؤية المدعومة بالذكاء الاصطناعي تكتسب زخمًا سريعًا في قطاع التعليم، حيث تشمل تطبيقات التحليلات التنبؤية في التعليم: التنبؤ بالأداء الأكاديمي وتحديد الطلاب المعرضين للخطر، وتخصيص التعلم، وتكيف التعليم مع الاحتياجات الفردية للمتعلمين، وتمكين الكشف المبكر عن صعوبات التعلم، وتحسين الإرشاد الأكاديمي لمساعدة الطلاب على اتخاذ قرارات مستنيرة بشأن مساراتهم التعليمية، بالإضافة إلى تعزيز استمرار الطلاب في التعليم وتقليل معدلات التسرب، ويناقش البحث أيضًا دور الذكاء الاصطناعي في تعزيز التقييم الأكاديمي الذي يشمل التصحيح الآلي والتغذية الراجعة التكيفية، والكشف عن الانتحال، وتحليلات بيانات التعلم، وتطوير أساليب تقييم جديدة، كما يناقش التحديات المتعلقة بتطبيق هذه الأدوات عبر مختلف السياقات التعليمية، وتشمل الاعتبارات الأخلاقية، وجودة البيانات، والتحيز الخوارزمي، ومخاوف الخصوصية، والمساءلة.

تم استخدام نموذج PRISMA 2020، حيث تمت مراجعة الأدبيات والدراسات السابقة المتعلقة بموضوع البحث في الفترة من ٢٠٢٠ إلى ٢٠٢٤، وتم استخدام قواعد بيانات مختلفة مثل(Scopus,Springer,Google Scholar) لتحديد الأدبيات الأكثر صلة ضمن هذا الإطار الزمني وعددها ٤٧ دراسة، ثم تم اختيار أفضل الدراسات وأكثرها صلة لمزيد من التحليل وعددها ٧ دراسات، تم إجراء تحليل مقارن لهذه الدراسات، تلاه إعداد تقرير نهائي لاستنتاج النتائج والاجابة على أسئلة البحث، خلصت نتائج هذا البحث إلى ضرورة التوسع في استخدام أدوات الذكاء الاصطناعي للتحليلات التنبؤية في تقييم الطلاب بدءًا من المرحلة الابتدائية وحتى الجامعية، وتم اقتراح تطوير النظام التعليمي بدءاً من رياض الأطفال وحتى الصف الثاني عشر، وإلغاء الاختبارات الفصلية والنهائية واستبدالها باساليب التقييم الحديثة مثل المشاريع الإلكترونية والأبحاث العلمية بجانب الاختبرات الأسبوعية والشهرية، والاعتماد على التحليل التنبؤي في تحديد مجال تخصص الطالب بناءً على التحليل التنبؤي للبيانات الضخمة للطالب طبقاً لميوله.

الكلمات المفتاحية: الذكاء الاصطناعي، أدوات الذكاء الاصطناعي، التعليم، تكنولوجيا التعليم، التحليلات التنبؤية، التقييم الأكاديمي، مراجعة منهجية.

1- Introduction:

Artificial Intelligence (AI) is revolutionizing various sectors, and education is no exception. AI-powered tools and technologies are being integrated into classrooms and learning platforms to enhance the educational experience for both students and teachers. AI can personalize learning by adapting to individual students' needs and pace, providing tailored content and feedback. Intelligent tutoring systems offer real-time support and guidance, while AI-powered assessment tools can automate grading and provide insightful analytics. Additionally, AI can assist teachers in administrative tasks, freeing their time to focus on student engagement and interaction. Predictive analytics in education relies on analyzing available educational data using various statistical and machine-learning techniques to predict future events. These events range from student performance and the likelihood of dropping out to identifying at-risk students and providing them with necessary support. Its main goal is to enable educational institutions to make proactive, data-driven decisions to improve student learning and success.

The field of education is undergoing a profound transformation through the deliberate integration of new technologies and approaches. This is being driven by the aim to proactively address students' evolving needs and demands (UNESCO, 2020; Sipică, Toma, 2022). The educational sector has significantly transformed in recent years due to advancements in predictive analytics and artificial intelligence (AI). These technologies use AI tools to analyze large-scale educational data and provide accurate predictions regarding student performance and potential risks, such as dropout rates or academic underachievement (Jia et al., 2023). Predictive analytics has become essential in developing more effective assessment systems, enabling educational institutions to identify at-risk students and offer timely interventions before it is too late (Apparition & Economides, 2014).

Additionally, AI contributes to personalizing the learning process, enhancing education's efficiency and effectiveness (Nguyen et al., 2019). However, adopting these technologies faces technical and ethical challenges related to the accuracy of predictions and the protection of students' data (Peña-Ayala, 2014). Therefore, further research is required to develop and implement these tools safely and effectively across diverse educational contexts.

This systematic review is a comprehensive search and evaluation process of tools and techniques used in academic assessment (Gough et al., 2012). This process includes:

- Defining search criteria: Defining the scope of the review and setting inclusion and exclusion criteria for studies.
- Searching for studies: Searching relevant scientific databases and conferences to obtain relevant studies.
- Selecting studies: Review the selected studies and evaluate their quality and relevance to the review.
- Analyzing data and concluding: Analyzing the data extracted from the selected studies and summarizing the main findings.

• Writing the report: Preparing a comprehensive report presenting the review results and recommendations.

1-1 Justification, Aims, and Research Questions: In the era of data-driven decision-making, the education sector is increasingly leveraging predictive analytics powered by artificial intelligence (AI) tools to enhance academic assessment. Predictive analytics, which utilizes historical data and statistical algorithms to forecast future outcomes, allows educators to identify at-risk students, personalize learning experiences, and improve overall academic performance (Campbell & Oblinger, 2007). With its capacity to simulate human intelligence and perform complex tasks, AI is crucial in refining predictive models and generating actionable insights from vast educational datasets (Lucking et al., 2016). Both predictive analytics techniques and tools for enhancing academic assessment are important research areas in education. These techniques and tools improve the learning and teaching process, providing students with a more effective and inclusive learning environment.

1-2 These systematic reviews aim to:

- Explore the current landscape of predictive analytics techniques in education, specifically focusing on how AI is utilized to improve academic assessment.
- Evaluate the effectiveness of different tools: Identify tools that have proven effective in enhancing the academic assessment process.
- Identify strengths and weaknesses: Analyze the advantages and disadvantages of each tool and its potential uses.
- Provide recommendations: Suggest best practices for using different tools in academic assessment.
- By synthesizing existing research, this review and artificial intelligence (AI). This article comprehensively explains the potential and challenges of leveraging predictive analytics and artificial intelligence in the educational sector. It explores how these technologies are revolutionizing various aspects of education, from student assessment and personalized learning to resource allocation and institutional decision-making, and the potential and challenges of predictive analytics and AI in shaping the future of academic evaluations.

1-3 Main Research Question: How influential are Artificial Intelligence (AI) tools in enhancing academic assessment using predictive analytics techniques based on existing research evidence?

Sub-Questions:

1. What AI-powered predictive analytics techniques are currently employed in educational assessment?
2. What are the key benefits and challenges of using AI for predictive analytics in academic assessment?
3. How do AI-based predictive analytics tools impact the accuracy and fairness of academic assessments?

4. What are the ethical considerations surrounding the use of AI in academic assessment, particularly concerning predictive analytics?

2- Background:

2-1 Define predictive analytics and its significance in education: Predictive analytics is the process of predictive analytics that Utilizes historical data through statistical algorithms and machine learning techniques to predict future outcomes. And trends. (Finlay, 2014), while the Data is The raw information, both historical and current, that is used as input for predictive analytics models. This data can include various types such as numerical, categorical, or even textual (Provost & Fawcett, 2013). The Statistical Algorithms are Mathematical techniques and models used to analyze and interpret the data. These algorithms help identify patterns, trends, and relationships within the data that can be used for predictions (Hastie et al., 2009). Machine learning techniques are sophisticated algorithms that allow a system to learn from data and improve its predictive capabilities over time without being explicitly programmed. These techniques are often used for complex predictions and can adapt to new data as it becomes available (Mitchell, 1997). The Future Outcomes are The events or situations that predictive analytics aims to anticipate. These outcomes can be anything from customer churn and sales forecasts to fraud detection and equipment failures (Shmueli, 2010).

Predictive Analytics Techniques in Education use historical data, Statisticalmodelingand machine learning to predict future events related to students or educational institutions (Almarabeh & Abu Al-Rub, 2021). This is the process of analyzing educational patterns and trends in the data to help make forecasts. Student outcomes or make informed decisions about educational practices (Romero & Ventura, 2017). It is the application of big data techniques, statistical algorithms, and machine learning to educational data to generate actionable predictive insights about student learning and success (Baker & Inventado, 2014).

Predictive analytics techniques in education: Artificial intelligence uses AI and machine learning models to analyze large amounts of educational datasets to predict future events or outcomes (Zawacki-Richter et al., 2019). These techniques encompass various methods such as:

- Regression models: Used to predict continuous numerical outcomes, such as students' expected grades (Luan, 2018).
- Decision trees: Classify students based on specific attributes to predict their success or failure in a particular course (Kotsiantis, 2013).
- Neural networks: Capable of modeling complex relationships between different variables and used to predict student outcomes or recommend suitable educational pathways (Oladokun et al., 2008).
- Cluster analysis: Helps identify groups of students with similar characteristics, providing appropriate support for each group (Romero & Ventura, 2013).

2-2 Artificial Intelligence (AI) in education: As the use of AI technologies in education expands, there's been a parallel rise in research on this topic. For instance, Chiu et al. (2023) outlined four critical functions of AI in education: enhancing learning, training, assessment, and management. They found that AI can:

- Assign tasks based on individual abilities.
- Enable human-machine interactions.
- Assess student work and provide constructive feedback.
- Improve adaptability and interactivity in digital learning.
- Offer adaptive teaching strategies.
- Enhance teachers' instructional skills.
- Support teachers' professional development.
- Provide automated assessment.
- Predict student performance.
- Improve the management of educational platforms.
- Deliver convenient and personalized services.
- Support evidence-based decision-making in education.

Similarly, Mollick and Mollick (2023) highlighted the potential of AI tools to improve teaching and learning, emphasizing the need for their careful and thoughtful use. They argued that well-designed AI applications can empower teachers, enrich learning experiences, and support evidence-based teaching practices. Similarly, AI-powered chatbots offer promising opportunities for pre-service teachers to develop their teaching skills through personalized interaction and engagement in meaningful tasks (Lee & Yeo, 2022).

Similarly, within education and training, ChatGPT demonstrates the potential for various applications, such as:

- Personalizing educational materials and lesson plans to meet individual learners' needs and preferences.
- Offering learners timely feedback and guidance throughout their learning process.
- Developing engaging educational materials, including quizzes, tests, collaborative activities, and multimedia content.
- Assisting instructors with grading, automated essay scoring, and providing constructive feedback to students.
- Creating adaptive learning environments tailored to each learner's performance and progress (Mizumoto & Eguchi, 2023; Ray, 2023).

2-3 Predictive Analytics Techniques in Education: Predictive analytics utilizes data mining, machine learning, and statistical algorithms to examine historical and current data to predict future outcomes. Or trends. This powerful tool is increasingly being leveraged in the education sector to improve student success, personalize learning experiences, and enhance institutional decision-making (Kumar & Vijayalakshmi, 2023).

2-4 Common Techniques:

1. **Regression Analysis**: This statistical method establishes relationships between a dependent variable (e.g., student performance) and one or more independent variables (e.g., attendance, prior grades, socioeconomic factors). It can help predict future student performance or identify factors influencing academic success (Al-Shayea, 2023).

2. **Decision Trees**: Flowchart-like models use if-then rules to classify data and make predictions. They can identify students at risk of dropping out or predict which students might benefit from specific interventions (Oladokun et al., 2022).

3. **Neural Networks**: Modeled on the human brain, these systems ' complex models can learn from large datasets and predict complex patterns. They have applications in areas such as personalized learning recommendations and early identification of learning difficulties (Al-Shayea, 2023).

4. **Clustering**: This technique groups similar data points together, helping to identify patterns or segments within a student population. It can be utilized to develop targeted interventions. Or tailor learning experiences to specific groups of students (Kumar & Vijayalakshmi, 2023).

2-5 Applications in Education: These techniques are employed in various educational applications, including The value of predictive analytics in education is multifaceted:

1. **Early Warning Systems**: Predicting student attrition or academic difficulties, allowing for timely interventions (Al-Shayea, 2023) ,predicting student dropout, Identifying students at risk of dropping out, and providing them with the necessary support (Ameri et al., 2016). Identifying at-risk students and providing timely interventions allows Predictive models can flag students who are likely to struggle academically or drop out, allowing for early interventions and support services (Campbell & Oblinger, 2007; Siemens & Baker, 2012). Early Identification of At-Risk Students and Timely Interventions: Predictive models, often referred to as early warning systems, analyze various data points such as attendance, grades, and engagement to identify students at risk of academic failure or dropping out (Ocumpaugh et al., 2023). This enables educators to implement timely interventions, such as personalized tutoring, educational support programs, or counseling services, to address potential challenges and keep students on track.
2. **Personalized Learning**: Recommending resources and learning pathways tailored to individual student needs and abilities (Al-Shayea, 2023) and providing customized learning experiences for each student based on their needs and abilities. Personalized learning experiences, student data analysis, and predictive analytics can help tailor instruction and learning materials to individual needs and preferences, fostering engagement and knowledge acquisition. Personalized Learning and Adaptive Pathways: Predictive analytics can create adaptive

learning environments where instructional content, pace, and support are tailored to each student's needs and learning styles (Luckin et al., 2016). This personalized approach enhances student engagement, motivation, and knowledge retention.

3. **Course Recommendation**: Suggest suitable courses based on student interests, past performance, and career goals (Al-Shayea, 2023). Evaluating educational programs' effectiveness allows for Measuring educational programs' impact on students and improving them (Pellegrino, 2014). Optimize resource allocation institutions can use predictive models to forecast enrollment trends, course demand, and resource needs, resulting in more efficient and effective resource allocation management (Lang et al., 2012).
4. **Resource Allocation**: Enhancing the distribution and utilization of resources and support services based on predicted student needs. (Al-Shayea, 2023). Predicting academic performance allows forecasting students' performance in different subjects and offering assistance to improve their level (Vandamme et al., 2013). Enhancing academic advising allows Predictive analytics can inform academic advisors about students' strengths, weaknesses, and potential challenges, enabling them to provide more targeted guidance and support (Kizilcec et al., 2013). Optimized Resource Allocation: By forecasting enrollment trends, course demands, and resource needs, institutions can make more informed decisions about resource allocation, staffing, and program development (Lang et al., 2012). This results in enhanced efficiency, decreased expenses, and superior outcomes. Alignment of resources with student needs.
5. **Institutional Planning**: Forecasting enrollment trends and student demand to inform strategic planning (Al-Shayea, 2023). Improve institutional decision-making: Predictive models can offer valuable insights into various aspects of institutional performance, such as student retention, graduation rates, and program effectiveness, aiding strategic planning and decision-making (Siemens & Long, 2011).
6. **Enhanced Academic Advising and Career Guidance**: Predictive models can provide advisors with valuable insights into students' academic strengths, weaknesses, and potential career paths (Kizilcec et al., 2013). This information allows advisors to offer more targeted and practical guidance, helping students make informed decisions about their educational and career goals.
7. **Data-driven decision-making at the Institutional Level**: Predictive analytics can empower institutional leaders to make informed decisions about strategic planning, policy development, and program evaluation based on evidence-based insights (Siemens & Long, 2011). This cultivates an environment of ongoing progress and groundbreaking ideas. Data-driven decision-making throughout the institution.

2-6 Important Considerations:

1. Data Privacy and Ethics: Ensure responsible data collection and usage, protecting student privacy and obtaining consent.
2. Model Transparency and Explainability: Strive for interpretable and explainable models, especially when making decisions that impact students.

3. Continuous Evaluation and Improvement: Regularly assess model performance and update models as new data becomes available (Kumar & Vijayalakshmi, 2023).

This cultivates an environment of ongoing progress and groundbreaking ideas. Additionally, predictive analytics can transform education by offering valuable insights, enabling data-driven decision-making, and enabling proactive interventions. However, it is crucial to implement these techniques ethically and responsibly, ensuring that they benefit all students and contribute to a fair and equitable learning environment.

2-7 Tools for Enhancing Academic Assessment: Academic assessment is a cornerstone of education, providing insights into student learning and informing instructional decisions. However, traditional assessment methods often face challenges such as subjectivity, time constraints, and limited feedback opportunities. Various innovative tools powered by artificial intelligence (AI) have emerged to address these limitations to enhance academic assessment (Jena & Panigrahi, 2023). There are many critical tools for Enhancing the Assessment, such as:

- **Automated Essay Scoring (AES):** AES This cultivates an environment of ongoing progress and groundbreaking ideas. Additionally, predictive analytics can transform education by offering valuable insights and enabling data-driven decision-making. Furthermore, these systems utilize natural language processing and machine learning algorithms to evaluate and understand vast amounts of textual data. And score written responses. They offer benefits such as faster grading, increased objectivity, and the potential to provide immediate feedback to students (Chen & Cheng, 2023).
- **Adaptive Testing**: Adaptive assessments adjust the difficulty of questions based on a student's real-time performance, providing a more accurate measure of their abilities. This method has the potential to boost student involvement and enthusiasm. At the same time, they are offering personalized learning experiences (Vellukunnel & Sharma, 2023).
- **Learning Analytics Dashboards**: These interactive platforms visualize student data, providing educators with real-time insights into student progress, engagement, and areas of difficulty. This information can inform targeted interventions and personalized support (Ifenthaler & Widanapathirana, 2023).
- **Virtual Reality (VR) and Augmented Reality (AR.) Simulations**: Immersive technologies like VR and AR can create realistic and interactive learning environments, allowing for authentic assessments of skills and knowledge application. These tools can be precious in science, engineering, and healthcare (Radu, 2022).
- **Peer Assessment Tools**: Online platforms facilitate peer feedback and evaluation, promoting self-reflection and collaborative learning. Peer assessment can enhance student engagement and provide valuable insights into their understanding of concepts (Liu & Tsai, 2023).

2-8 Benefits of Utilizing Technology in Assessment:

- ✓ Increased efficiency and objectivity in grading.

- ✓ Personalized and adaptive learning experiences.
- ✓ Real-time feedback and progress monitoring.
- ✓ Enhanced student engagement and motivation.
- ✓ Data-driven insights to inform instructional decisions.

2-9 Challenges and Considerations:

- ✓ Ensuring equitable access to technology for all students.
- ✓ Addressing potential biases in AI algorithms.
- ✓ Maintaining data privacy and security.
- ✓ Balancing the use of technology with traditional assessment methods.

2-10 These tools are used in various areas of academic assessment, such as:

- Formative assessment: Offering ongoing feedback to students throughout their learning journey (Black & Wiliam, 2009).
- Summative assessment: Evaluating students' performance at the end of a course or program (Harlen & James, 1997).
- Self and peer assessment: Encouraging students to assess themselves and their peers (Falchikov & Boud, 1989).
- Assessment of projects and practical work: Evaluating Learners' capacity to utilize their knowledge and skills in practical scenarios. Contexts (Darling-Hammond et al., 1995).

3- Methodology:

This section offers a clear rationale for conducting a systematic literature review and outlines the rigorous methodology employed to generate the findings and insights presented in this research article.

3.1 Methodological Framework: A systematic literature review followed the PRISMA guidelines to address the research questions and achieve the stated objectives. (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) to ensure methodological rigor and transparency. They were ensuring transparency and methodological rigor. Given the variety of experimental studies, reports, evaluations, proposals, and theoretical investigations on AI in education, a meta-synthesis approach was adopted. PRISMA 2020 (**Figure 1**) was chosen not only for its stringent standards and principles but also for its established use in various fields, including education, to offer comprehensive insights (Moroianu et al., 2023).

Google Trend was utilized to identify and quantify the number of research studies conducted globally that addressed the three key terms central to this research: artificial intelligence, predictive analytics, and academic assessment. (Figure 2) provides a visual comparison of the number of studies associated with each term. Google Trend revealed that the quantity of research in this area between 2020 and 2024 was remarkably scarce, a finding corroborated by database searches using these terms. This observation underscores the need for this systematic review to investigate the most significant AI tools employed in predictive analytics to enhance academic assessment.

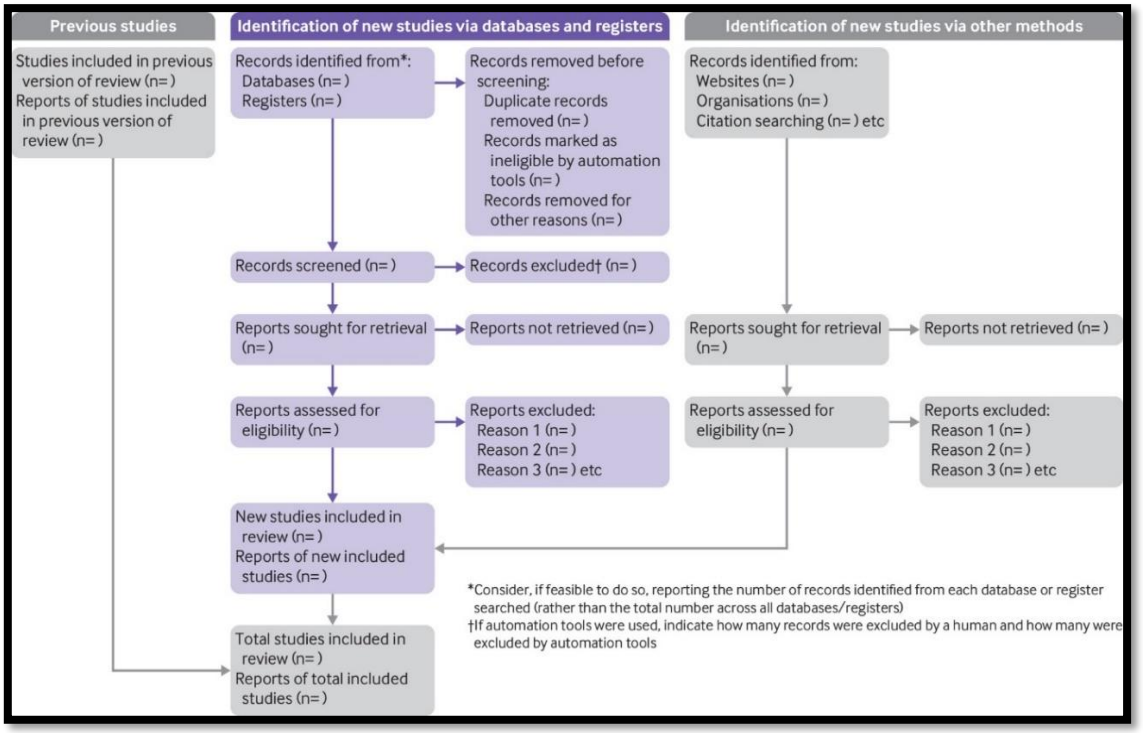

Figure 1: PRISMA 2020 flow diagram template for systematic reviews (Page et al., 2021)

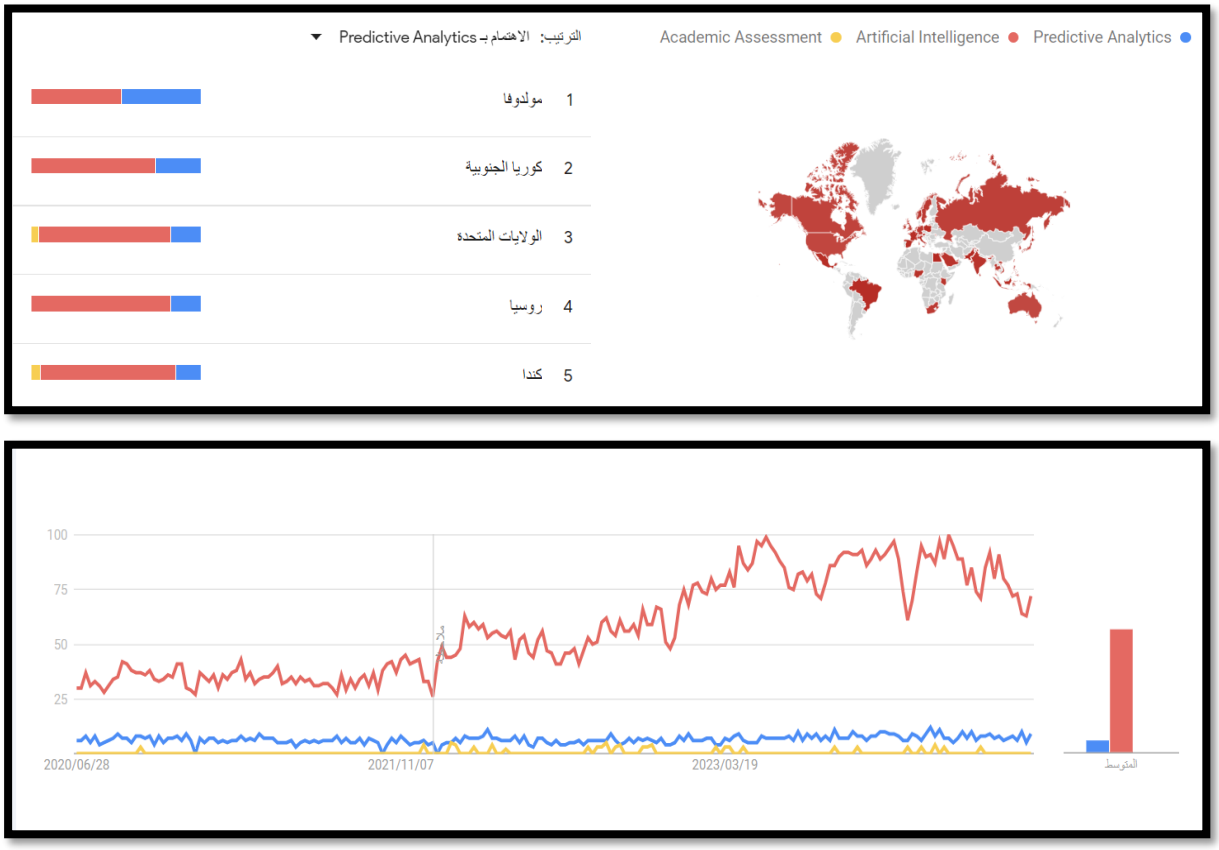

Figure 2: "Predictive Analytics Techniques" (in blue), "Artificial Intelligence Tools" (in red), and "Academic Assessment" (in yellow) search trends, 2020–2024. Data source: Google Trends (https://www.google.com/trends)

For scientific rigor, a comprehensive search strategy was implemented, using a combination of keywords across five significant databases, which are known as high-impact scientific databases, yielded the most relevant and accurate documents:

- ✓ SCOPUS
- ✓ Google Scholar
- ✓ Springer Link

3.2 Meta-analysis Process: Data were collected from 2020 to 2024 to capture public policies related to Predictive analytics techniques in education and Artificial Intelligence tools for enhancing academic assessment. A relevant and comprehensive search query was utilized to explore the literature, considering various educational levels and topics. Given the multidisciplinary nature of the subject, the following search string was employed: "Predictive Analytics" And "Education," And "Artificial Intelligence," and " Academic Assessment".

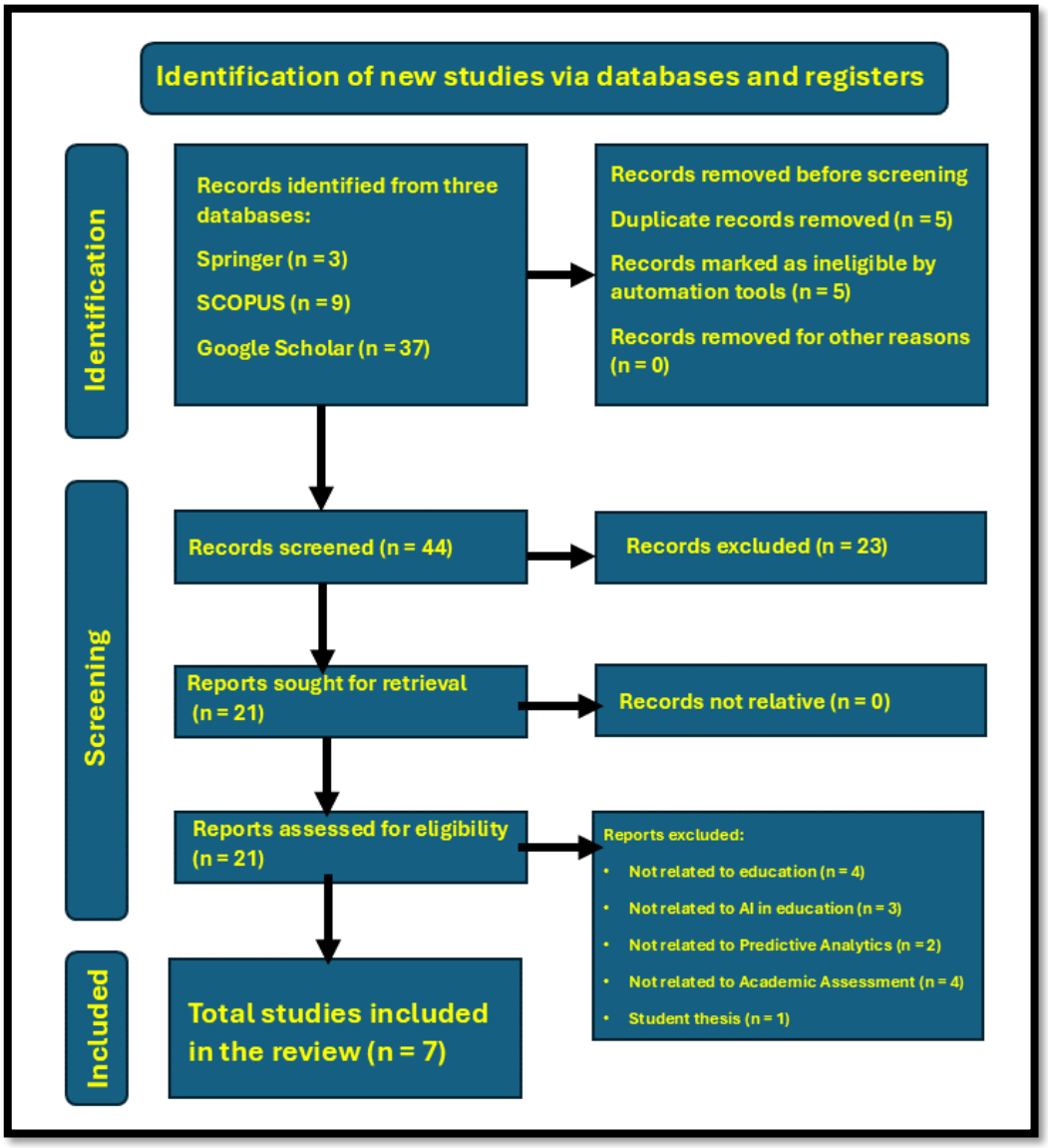

Figure 3: Our Flow diagram template for this systematic review

Table 1: Descriptive data from 7 studies were carefully examined and thoroughly analyzed

Author(s) Year	Country	Article Title	Research Aims	Research Design	Participant(s)	AI tools	Predictive Analytics Techniques	Academic Assessment
Denes, G. 2023	United Kingdom	A case study of using AI for General Certificate of Secondary Education (GCSE) grade prediction in a selective independent school in England	Explore the feasibility of AI as a replacement for traditional exam-based grading systems. Gauge the effectiveness of machine learning models in predicting student grades. Analyze variations in model accuracy across different subjects and their connection to teachers' grading methods.	Case study, quantitative evaluation using machine learning models.	Students in a selective, independent secondary school in England.	N/A (The study applies various machine learning models, not specific AI tools.)	Linear Regression, Logistic Regression, Bayesian Ridge Regression, Gaussian Process Regression, Random Forest (Regression & Classification), Multi-Layer Perceptron Classifier	GCSE grade prediction
Harry, A., and Sayudin 2023	France and Indonesia	Role of AI in Education	Explore the role of AI in education and how it is changing the face of learning.	Qualitative descriptive method, library study technique.	N/A (The study is a literature review, not empirical research involving participants.)	Personalized learning platforms, intelligent tutoring systems, chatbots, automated grading and assessment systems.	N/A (The study focuses on the broad applications of AI in education, not specific predictive analytics techniques.)	The study discusses AI's potential benefits and challenges in education, including personalized learning, increased efficiency, improved student engagement, and better data analysis. It also highlights the need to address privacy and security concerns, lack of trust, cost, and potential bias in AI-based education systems.
González-Calatayud, V., Prendes-Espinosa, P., and Roig-Vila, R. 2021	Spain	Artificial Intelligence for Student Assessment: A Systematic Review	Analyze the use of AI for student assessment. Identify the primary studies around student assessment based on AI. Analyze the impact that education and/or technology have on this field of research. Analyze the type of educational assessment that is being improved with AI.	A systematic review using the PRISMA Statement.	N/A (The study is a literature review, not empirical research involving participants.)	Diverse AI techniques mentioned in the reviewed studies, including fuzzy-logic systems, machine learning, and computerized adaptive testing (CAT).	Formative assessment and automatic grading are the primary uses of AI in the analyzed studies.	Most research concentrates on AI's technological facets rather than pedagogical models. Formative evaluation is the primary use of AI in assessment. There is an increase in studies focusing on automatic grading using AI.
Wang, T. et al. 2023	USA and Greece	Exploring the Potential Impact of Artificial Intelligence (AI) on International Students in Higher Education: Generative AI, Chatbots, Analytics, and International Student Success	Examine how AI influences the learning experiences of international students. Explore how AI can Enhance multiple facets of educational operations, from administrative tasks and curriculum design to instructional methods and the overall student learning experience for international students.	Research essay, comprehensive literature review.	International students in higher education.	Personalized learning experiences, adaptive testing, predictive analytics, chatbots for learning and research, language translation tools, AI-powered writing and revision assistants, and AI-based English language learning applications.	Predictive analytics for identifying at-risk students, personalized learning experiences, and adaptive testing.	N/A (The study focuses on the broad applications of AI in education for international students, not specific academic assessments.)
Doleck, T. et al. 2020	USA and Canada	Predictive analytics in education: a comparison of deep learning frameworks	Assess the utility and applicability of deep learning for educational data mining and learning analytics. Compare the predictive accuracy of popular deep learning frameworks/libraries.	Empirical research, comparative study using two educational datasets (MOOC and CEGEP).	Students in a MOOC and CEGEP students.	N/A (The study applies various deep learning frameworks, not specific AI tools.)	Deep learning frameworks/libraries: Keras, Theano, TensorFlow, fast.ai, Pytorch. Machine learning algorithms: Support Vector Machines, Naïve Bayes, Logistic Regression, K-Nearest Neighbors.	Classification tasks: predicting MOOC performance and college-level honors science program enrollment.
Susnjak, T. 2023	New Zealand	Beyond Predictive Learning Analytics Modelling and onto Explainable Artificial Intelligence with Prescriptive Analytics and ChatGPT	Present a novel prescriptive analytics framework for supporting LA aims to identify and initiate timely and effective interventions with at-risk students.	Case study, development of a prescriptive learning analytics framework.	Undergraduate students who commenced studies from 2018 through 2022 and who either completed or abandoned their studies during this period.	SHAP, Anchors, Diverse Counterfactual Explanations (DiCE), ChatGPT	ChatBoost, Random Forest, SVM, Logistic Regression, Decision Tree, Gradient Boosting, kNN, Naive Bayes	Program/qualification completion prediction.
Shafiq, DA et al. 2022	Malaysia	Student Retention Using Educational Data Mining and Predictive Analytics: A Systematic Literature Review	Provide insights to forthcoming researchers looking to resolve student retention using learning analytics and predictive models. Highlight the features that significantly predict student performance and the less significant ones. Conduct a comparative study of existing literature and their strengths and limitations to induce a valuable research gap. Summarize the existing work using three learning environments: traditional, online, and blended. Present a taxonomy of current Machine Learning and Deep Learning algorithms used for predictive models.	Systematic literature review.	N/A (The study is a literature review, not empirical research involving participants.)	The reviewed studies mentioned various machine learning and deep learning algorithms, including Random Forest, Decision Tree, Logistic Regression, Naive Bayes, Artificial Neural Network, and Multi-layer Perceptron Neural Network.	Student retention and performance prediction.	Supervised machine learning (ML) and deep learning (DL) methods are widely utilized in Student Retention efforts. Furthermore, ensemble and unsupervised learning clustering techniques are also prevalent in addressing student retention challenges. It is generally lacking. Conventional, unchanging features are frequently employed in student performance analysis, neglecting crucial factors related to educators, cognitive abilities, and personal information.

Figure 3 outlines the process of finding relevant scholarly literature through database searches, following the steps and recommendations of the PRISMA 2020 Checklist. Initially, 49 studies were found across three databases (SCOPUS, Springer, and Google Scholar). After removing duplicates, 44 articles remained for screening. The critical inclusion criteria focused on the combined use of artificial intelligence applications and tools in the learning process, along with empirical studies, development of educational AI tools, research syntheses, or theoretical contributions. Twenty-three documents didn't fit these criteria and were excluded. The remaining 21 papers underwent further scrutiny, excluding 14 more studies that didn't meet the research criteria. Ultimately, seven studies were included in the review and analyzed in detail in **Table 1**.

4- Results:

In reality, when searching using the three search terms together (Predictive Analytics- Artificial Intelligence- Academic Assessment) in various scientific databases, the results sometimes showed zero, and most of the results appeared in marketing, industry, and medicine. This indicates that predictive analytics using artificial intelligence tools to enhance academic assessment is a topic that has not received due attention in education. This is the main reason for the scarcity of research that has addressed these terms in the context of teaching and learning.

Table 1 Descriptive data from 7 studies were incorporated into the review and subjected to a thorough analysis, including Author(s), Year, Country, Article Title Research, Aims Research, Design Participant(s), AI tools, Predictive Analytics, and Academic Assessment. The Main Research Question was, "How effective are Artificial Intelligence (AI) tools in enhancing academic assessment using predictive analytics techniques based on existing research evidence?"?. To answer this question, we have first to answer the Sub-Questions:

1. What AI-powered predictive analytics techniques are currently employed in educational assessment?

The table provides information about the AI-powered predictive analytics techniques used in the listed studies. The methods mentioned include:

- ✓ Linear Regression: Used for predicting GCSE grades (Denes, 2023).
- ✓ Logistic Regression: Also used for GCSE grade prediction and mentioned in other studies for various classification tasks (Denes, 2023; Doleck et al., 2019; Susnjak, 2023; Shafiq et al., 2022).
- ✓ Bayesian Ridge Regression: Another technique employed for GCSE grade prediction (Denes, 2023).
- ✓ Gaussian Process Regression: Used in the same study for GCSE grade prediction (Denes, 2023).

- ✓ Random Forest (Regression & Classification): Utilized for GCSE grade prediction and mentioned in other studies for classification and prediction tasks (Denes, 2023; Susnjak, 2023; Shafiq et al., 2022).
- ✓ Multi-Layer Perceptron Classifier: Applied in GCSE grade prediction (Denes, 2023).
- ✓ Deep learning frameworks/libraries: Keras, Theano, TensorFlow, fast.ai, Pytorch (Doleck et al., 2019).
- ✓ Machine learning algorithms: Support Vector Machines (SVM), Naïve Bayes, K-Nearest Neighbors (kNN) (Doleck et al., 2019; Susnjak, 2023).
- ✓ CatBoost, Decision Tree, Gradient Boosting (Susnjak, 2023).
- ✓ Artificial Neural Network, Multi-layer Perceptron Neural Network (Shafiq et al., 2022).
- ✓ The table also highlights that predictive analytics is used for identifying at-risk students and providing personalized learning experiences (Wang et al., 2023). Additionally, computerized adaptive testing (CAT) is mentioned as an AI technique used in student assessment (González-Calatayud et al., 2021).

Overall, the studies showcase a range of AI-powered predictive analytics techniques employed in educational assessment, spanning from traditional machine learning algorithms to more advanced deep learning frameworks. These techniques are leveraged for various purposes, including grade prediction, student performance prediction, identifying at-risk students, and providing personalized learning experiences.

2. What are the key benefits and challenges of using AI for predictive analytics in academic assessment?

The table highlights several key benefits and challenges associated with using AI for predictive analytics in academic assessment:

Benefits:

- ✓ Accurate Prediction of Student Performance: AI models, particularly in STEM subjects where grading subjectivity is less prevalent, can accurately predict student grades, often within one grade of actual results (Denes, 2023). This can help educators identify at-risk students early and provide timely interventions.
- ✓ Personalized Learning and Support: AI can enable customized learning experiences and adaptive testing, catering to the individual needs and learning styles of students, including international students (Wang et al., 2023).
- ✓ Improved Efficiency and Automation: AI can automate various aspects of assessment, such as grading and feedback, saving educators time and resources (González-Calatayud et al., 2021).
- ✓ Enhanced Decision-Making: Predictive analytics can provide valuable insights into student progress and performance, informing educators' decision-making regarding curriculum development, teaching strategies, and student support (Susnjak, 2023).

Challenges:

- ✓ Grading Subjectivity and Model Accuracy: In subjects where grading is more subjective, AI models may face challenges in accurately predicting student performance (Denes, 2023).
- ✓ Interpretability and Explainability: The complexity of some AI models, bottomless learning models, can make it challenging to interpret and explain their predictions, hindering their acceptance and adoption in educational settings (Doleck et al., 2019).
- ✓ Privacy and Security Concerns: The use of AI in education involves collecting and processing student data, raising concerns about privacy and data security (Wang et al., 2023).
- ✓ Potential Bias and Fairness: AI models can perpetuate or even amplify existing biases in data, leading to unfair or discriminatory outcomes for certain groups of students (Wang et al., 2023).
- ✓ Lack of Trust and Acceptance: Educators and students may hesitate to adopt AI-based assessment tools due to concerns about their reliability, validity, and impact on teaching and learning practices.

Overall, while AI offers significant potential for improving academic assessment through predictive analytics, it is crucial to address the associated challenges to ensure its ethical, effective, and equitable implementation. It was finding an equilibrium between leveraging AI's advantages and ensuring ethical considerations. Transparency, fairness, and human judgment in educational assessment are essential.

3. How do AI-based predictive analytics tools impact the accuracy and fairness of academic assessments?

The table provides insights into how AI-based predictive analytics tools can impact the accuracy and fairness of academic assessments:

Impact on Accuracy:

- ✓ Improved accuracy in specific subjects: AI models have demonstrated high accuracy in predicting grades, especially in STEM subjects where grading tends to be more objective (Denes, 2023). This suggests AI can enhance the accuracy of assessments in specific domains.
- ✓ Potential for early identification of at-risk students: Predictive analytics can help identify students who might be struggling, allowing for timely interventions and support to improve their academic outcomes (Wang et al., 2023). This preemptive strategy can result in more precise. Assessments of student potential and progress.
- ✓ Limitations in subjective subjects: The accuracy of AI predictions can be affected by grading subjectivity, as observed in non-STEM subjects (Denes, 2023). This highlights the need for caution and potentially combining AI with human judgment in such areas.

Impact on Fairness:

- ✓ Potential for bias and discrimination: AI models can inadvertently adopt biases inherent in their training data, leading to unfair or discriminatory outcomes for certain groups of students (Wang et al., 2023). Ensuring fairness requires careful data selection and algorithm design.

- ✓ Addressing individual needs: AI-powered personalized learning and adaptive testing can cater to diverse learning styles and needs, potentially leading to fairer assessments that accurately reflect individual student capabilities (Wang et al., 2023).
- ✓ Transparency and explainability concerns: The lack of transparency in some AI models, bottomless learning models, can raise concerns about fairness and potential bias. Ensuring explainability is crucial for building trust and guaranteeing equitable assessment practices (Doleck et al., 2019).

Overall, AI-based predictive analytics tools have the potential to enhance the accuracy and fairness of academic assessments by providing objective predictions, enabling early interventions, and supporting personalized learning. However, it is crucial to tackle challenges associated with bias, transparency, and the limitations of AI in subjective assessment areas. Careful implementation, ongoing monitoring, and a combination of AI with human judgment are crucial for ensuring fair and accurate assessments that benefit all students.

4. What are the ethical considerations surrounding using AI in academic assessment, particularly concerning predictive analytics?

The table highlights several ethical considerations surrounding the use of AI in academic assessment, particularly concerning predictive analytics:

- ✓ Privacy and Data Security: AI-powered predictive data privacy, security, and the possibility of misuse. Predictive analytics often depend on gathering and analyzing vast amounts of student information, raising concerns about safeguarding this sensitive data and preventing its unauthorized use or breaches. Of sensitive information (Wang et al., 2023). It is imperative to guarantee robust data protection measures and obtain informed consent from students or guardians before collecting or using personal information. Obtain informed consent from students or guardians.
- ✓ Bias and Fairness: AI models can inherit and perpetuate biases present in the training data, leading to discriminatory outcomes or unfair treatment of certain groups of students. Discriminatory outcomes for certain groups of students (Wang et al., 2023). Addressing potential bias in algorithms and data is crucial to ensure equitable assessment practices.
- ✓ Transparency and Explainability: Complex AI models, such as Deep learning models, while powerful, can be inherently opaque and difficult to explain. And explainThis lack of transparency can lead to Apprehensions regarding responsibility and unforeseen outcomes are valid. Potential for unintended consequences. The fairness and accountability of AI-based assessments (Doleck et al., 2019). Ensuring that AI models are explainable and transparent decision-making processes are crucial for building trust and guaranteeing ethical use.
- ✓ Clarity and Ownership: Defining clear lines of accountability and responsibility. when using AI in academic assessment is essential. Who is responsible for developing, deploying, and monitoring AI models and addressing any potential negative consequences or biases should be clear.

- ✓ Impact on Human Judgment and Teacher-Student Relationships: Over-reliance on AI-powered predictive analytics could diminish the role of human judgment and the importance of teacher-student relationships in assessment. Balancing AI and human involvement is crucial to ensure holistic and meaningful assessment practices.
- ✓ Student Agency and Self-Determination: Using AI in assessment should not undermine student agency and self-determination. Students should have a voice in how AI is used in their assessments and be given opportunities to understand and challenge AI-generated predictions or recommendations.
- ✓ Addressing these ethical considerations requires a multifaceted approach involving collaboration among educators, AI developers, policymakers, and students. It is crucial to establish moral guidelines, promote transparency and explainability, and prioritize the well-being and agency of students in the development and deployment of AI-powered predictive analytics in academic assessment.

5- Conclusion:

In conclusion, predictive analytics is not merely a buzzword in a data-informed approach to teaching and learning. By harnessing the power of data and AI, educators can unlock the full potential of every student and create more equitable and effective learning environments. Integrating technology in academic assessment presents many opportunities to enhance learning and teaching. By leveraging innovative tools, educators can gain deeper insights into student progress, provide personalized feedback, and create more engaging and compelling learning experiences. However, it is crucial to implement these tools thoughtfully and address potential challenges to ensure equitable and meaningful assessment practices.

Based on the results and systematic studies presented, we recommend employing predictive analysis and big data to be used in predictive assessment for students in all primary, middle, and secondary educational levels and employing these predictive results and predictive evaluation to dispense with the high school test, And quarterly and final tests for all stages, and replace them with modern evaluation methods such as electronic projects, scientific research, classroom, and extracurricular activities, in addition to weekly and monthly tests, and relying on predictive analysis in determining the student's field of specialization based on the predictive analysis of the student's big data throughout the years of study and according to his tendencies and trends. This proposal has many benefits, including:

1. Removing the psychological and moral burden of students and parents from the end-of-secondary exam.
2. Eliminate private lessons that represent a significant financial burden on parents.
3. Eliminate electronic fraud that has begun to spread in an unprecedented way.
4. Providing a massive budget for the state (high school exams, semester, and final exams for all stages) and exploiting this budget to support the teacher financially and increase the material and moral incentives for the teacher.
5. Eliminating the problem of coordination and unfair distribution to universities based on a single test and ignoring the years of study that precede it.

6. Expanding the role of the educational institution in raising young people and rooting values by staying away from non-educational private tutoring centers and the non-educational values they contain.
7. Consolidate the role of the teacher, respect him in society, and emphasize his pivotal role in raising young people.

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