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ACADEMIC ANALYTICS AS A TOOL FOR MONITORING THE QUALITY OF PROFESSIONAL EDUCATION IN HIGHER EDUCATION INSTITUTIONS: INTERNATIONAL EXPERIENCE

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The article is devoted to the analysis of academic analytics as a tool for monitoring and improving the quality of vocational education in higher education institutions. **The purpose** of the article is to provide a theoretical and applied substantiation of academic analytics as a tool for monitoring the quality of vocational education in higher education institutions, taking into account international experience in its implementation and the adaptation of best practices to the national context. **Methods.** The study is based on the analysis of domestic and foreign scientific and methodological literature, a comparative analysis of academic analytics models in higher education institutions of the EU, the USA, and other countries, a systemic approach to the design of monitoring mechanisms, as well as the synthesis of results from empirical studies on the application of learning analytics and educational data mining in vocational training. **Results.** Key models and tools of academic analytics were analyzed, and typical indicators for assessing the quality of vocational training were identified, including learning outcomes, the formation of professional competencies, the effectiveness of practice-oriented components, and graduate employment indicators. The advantages of international approaches were revealed, such as data integration among stakeholders, the use of predictive models for early risk detection, transparent reporting systems, employer involvement in evaluation processes, and scalable solutions for inter-institutional cooperation. Typical challenges were also outlined, including personal data protection, ensuring system interoperability, and the need for human resources and digital literacy among academic staff. **Conclusions.** Academic analytics is an effective tool for monitoring the quality of vocational education, enabling the improvement of educational program effectiveness and the management of higher education institutions. It is recommended to develop inter-institutional data-sharing platforms, implement ethical standards for educational data processing (in compliance with ethical norms), ensure system interoperability, provide training for data analysis specialists, and strengthen partnerships with employers, which will enhance program adaptability and graduate competitiveness.

Keywords: *academic analytics, educational process analytics, benchmarking, educational data mining, international experience, quality monitoring, vocational education, higher education institutions.*

АКАДЕМІЧНА АНАЛІТИКА ЯК ІНСТРУМЕНТ МОНІТОРИНГУ ЯКОСТІ ПРОФЕСІЙНОЇ ОСВІТИ В ЗАКЛАДАХ ВИЩОЇ ОСВІТИ: МІЖНАРОДНИЙ ДОСВІД

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Стаття присвячена аналізу академічної аналітики як інструменту моніторингу та підвищення якості професійної освіти в закладах вищої освіти. **Метою** статті є теоретичне та прикладне обґрунтування академічної аналітики як інструменту моніторингу якості професійної освіти в закладах вищої освіти з урахуванням міжнародного досвіду її впровадження та адаптації кращих практик до національного контексту. **Методи.** Дослідження базується на аналізі вітчизняної та зарубіжної науково-методичної літератури, порівняльному аналізі моделей академічної аналітики у закладах ЄС, США та інших країн, системному підході до побудови моніторингових механізмів, а також синтезі результатів емпіричних досліджень щодо застосування learning analytics і educational data mining у професійній підготовці. **Результати.** Проаналізовано ключові моделі та інструменти академічної аналітики, ідентифіковано типові показники оцінювання якості професійної підготовки: навчальні досягнення, сформованість професійних компетентностей, ефективність практико-орієнтованих компонентів та випускні показники працевлаштування. Виявлено переваги міжнародних підходів: інтеграція даних між стейкхолдерами, використання прогнозних моделей для раннього виявлення ризиків, прозорі системи звітності, залучення роботодавців до оцінювання та масштабовані рішення для міжінституційної співпраці. Окреслено також типові виклики: захист персональних даних, забезпечення інтероперабельності систем і потреба у кадровому ресурсі й цифровій грамотності викладачів. **Висновки.** Академічна аналітика є ефективним інструментом моніторингу якості професійної освіти, який дозволяє підвищити результативність освітніх програм і управління закладами вищої освіти. Рекомендовано розвивати міжінституційні платформи обміну даними, впроваджувати етичні стандарти обробки освітніх даних (з урахуванням етичних норм), забезпечувати інтероперабельність систем, підготовку кадрів з аналізу даних та посилювати партнерство з роботодавцями, що підсилить адаптивність програм і конкурентоспроможність випускників.

Keywords: *академічна аналітика, аналітика освітнього процесу, бенчмаркінг, видобування даних з освітніх джерел, міжнародний досвід, моніторинг якості, професійна освіта, заклади вищої освіти.*

Introduction. In the current context of the digital transformation of higher education, academic analytics is considered one of the key tools for monitoring and ensuring the quality of professional training of future specialists. In the scientific discourse, the terms *learning analytics*, *educational data mining*, and *academic analytics* are most frequently used. These concepts are interrelated but have different scopes and applications.

Learning analytics is defined as the process of measuring, collecting, analyzing, and interpreting data about learners and their educational contexts with the aim of understanding and optimizing learning and educational environments (Siemens & Long, 2011; SoLAR, 2021).

Educational data mining, in turn, focuses on the application of statistical analysis and machine learning methods to uncover hidden patterns in large educational datasets, particularly for predicting academic success and modeling learning behavior (Baker & Yacef, 2009).

Academic analytics has a broader, institutional dimension and involves the integration of results from learning analytics and educational data mining into strategic management processes of higher education institutions, curriculum planning, and decision-making (Campbell, DeBlois, & Oblinger, 2007).

Within the quality assurance system of higher and professional education, academic analytics occupies an important role as a tool for internal monitoring and evidence-based management. Unlike traditional forms of assessment, which are primarily summative, educational data analytics

provides continuous analysis of learning outcomes, the dynamics of competence formation, and the effectiveness of educational programs. International studies and reports by the OECD (Organisation for Economic Co-operation and Development) and UNESCO (United Nations Educational, Scientific and Cultural Organization) demonstrate that the use of academic analytics contributes to increasing the transparency of the educational process, timely identification of learning risks, and informed improvement of professional training programs (OECD, 2020; UNESCO, 2021). Illustrative examples include foreign universities such as Purdue University and the Open University (UK), where analytical systems are used to predict learning difficulties and support students through targeted pedagogical interventions.

Theoretical substantiation of the problem Academic analytics has emerged as a key theoretical and practical framework for monitoring and enhancing the quality of vocational education in higher education institutions. It is grounded in the integration of learning analytics, educational data mining, quality assurance theory, and evidence-based educational management. Within contemporary higher education systems, academic analytics is viewed as a mechanism for transforming large volumes of educational data into meaningful indicators that support decision-making, quality monitoring, and continuous improvement of educational programs.

From a theoretical perspective, academic analytics is based on systems theory, according to which higher education institutions function as complex, open systems where learning outcomes, teaching processes, institutional resources, and external stakeholders are interconnected. The quality of vocational education depends on the coherence of these components and their alignment with labor market demands. Academic analytics enables the identification of patterns, trends, and risks within this system, providing a data-driven foundation for evaluating educational effectiveness and professional competency development. International research emphasizes that academic analytics supports key principles of quality assurance, including transparency, accountability, comparability, and continuous improvement. In the context of vocational education, it facilitates the assessment of students' academic performance, the formation of professional competencies, the effectiveness of practice-oriented learning, and graduate employability. Moreover, theoretical models developed in the EU, the USA, and other countries highlight the role of predictive analytics in early identification of academic risks and in supporting personalized learning pathways.

Thus, the theoretical substantiation of academic analytics as a monitoring tool lies in its capacity to integrate pedagogical, managerial, and technological approaches, ensuring a holistic evaluation of vocational education quality. Adapting international theoretical models to national higher education systems is essential for strengthening internal quality assurance mechanisms and improving the competitiveness of graduates.

Methodology and methods. The methodological framework of the study is based on an interdisciplinary approach that combines principles of pedagogy, educational management, data analytics, and quality assurance in higher education. The research relies on the concepts of learning analytics and educational data mining as theoretical foundations for monitoring and evaluating the quality of vocational education in higher education institutions.

The study employs a set of general scientific and specific research methods. Theoretical methods include analysis, synthesis, generalization, and systematization of domestic and international scientific sources to clarify the conceptual apparatus of academic analytics and its role in quality monitoring. A comparative method is used to analyze and contrast models of academic analytics implemented in higher education institutions in the European Union, the United States, and other countries, identifying common features and distinctive practices.

A systemic approach underpins the design of monitoring mechanisms, enabling the examination of vocational education quality as a multidimensional phenomenon that encompasses learning outcomes, professional competencies, teaching and learning processes, institutional resources, and labor market relevance. Elements of content analysis are applied to policy documents, analytical reports, and institutional case studies related to the implementation of academic analytics.

In addition, the study synthesizes the results of empirical research presented in international publications on the application of learning analytics and educational data mining in vocational and professional training. This methodological combination ensures the validity of conclusions and supports the formulation of evidence-based recommendations for adapting international experience to the national context. According to Campbell et al. (2007), academic analytics serves as a strategic tool for institutional decision-making, which is highly relevant to the monitoring of professional education quality in higher education institutions. Umer, R. et al. (2021) reviewed the use of predictive analytics in higher education, identifying opportunities, limitations, and future research priorities. Vemula, S. R., & Moraes, M. (2024) reviewed learning analytics dashboards for academic advisors, highlighting their role in student support and retention. Wachter, S., Mit-

telstadt, B., & Russell, C. (2017) contributed to the ethical and legal foundations of analytics by proposing explainable and GDPR-compliant automated decision-making. Wilson, A. et al. (2017) identified challenges and limitations of learning analytics, including data quality, interpretation risks, and institutional readiness. Popova, L. (2025) analyzed benchmarking as a mechanism of educational quality assurance, focusing on challenges and best practices relevant to the Ukrainian higher education context. Riordan, A. et al. (2023) conducted a systematic review of human-centred learning analytics and AI, emphasizing ethical, inclusive, and user-oriented analytical approaches.

Results and discussion. Academic analytics gains particular significance in the context of competence-based and outcome-oriented approaches, which dominate modern professional education. Competence-based training models require the assessment not only of the volume of knowledge but also of learners' ability to apply it in professional contexts.

Academic analytics enables the combination of quantitative and qualitative indicators (learning outcomes, portfolios, data from industrial internships, employer evaluations) to form a comprehensive view of the level of professional competence development. Within the outcome-oriented approach, analytics ensures the tracking of learning outcomes, their compliance with standards and labor market requirements, and provides an evidence base for managerial decisions aimed at improving the quality of professional education.

Monitoring the quality of professional education in HEIs (higher education institutions) relies on systematic collection and analysis of diverse educational data. These data sources include *academic performance records*, such as grades, course completion rates, and examination results; *student engagement metrics*, including attendance, participation in LMS (learning management systems), and interactions in online learning environments; *practical training and internship reports*, documenting students' performance in real-world professional settings; and *feedback from instructors, peers, and employers*, providing qualitative assessments of competence formation. In addition, HEIs increasingly utilize digital traces from online platforms, such as e-learning logs, digital portfolios, and learning analytics dashboards, which allow tracking the dynamics of knowledge acquisition and skill development over time (Siemens & Long, 2011; Baker & Yacef, 2009). Combining these heterogeneous data sources enables a comprehensive assessment of both cognitive and practical dimensions of professional preparation (Table 1).

The evaluation of professional training quality requires clear, measurable criteria and indicators aligned with competency-based and outcome-oriented approaches.

Key indicators include: *learning outcomes and academic achievements*, reflecting the acquisition of disciplinary knowledge; *formation of professional competencies*, including practical, cognitive, and social skills; *effectiveness of practice-oriented components*, such as laboratory work, internships, and project-based activities; and *graduate employment outcomes*, including job placement rates, career advancement, and employer satisfaction.

These indicators allow institutions to assess not only the attainment of knowledge but also the readiness of graduates to meet the requirements of the labor market (OECD, 2020; UNESCO, 2021). International best practices highlight the importance of integrating predictive and diagnostic indicators, enabling early identification of students at risk of underperformance and providing targeted pedagogical interventions (Campbell, DeBlois, & Oblinger, 2007).

The rapid digitalization of higher education has facilitated the use of *advanced analytical tools and platforms* for processing educational data. Learning analytics platforms, such as Blackboard Analytics, Moodle Learning Analytics, Brightspace Insights, and specialized software for educational data mining, allow for *automated data aggregation, visualization, and predictive modeling*. These tools provide administrators and educators with actionable insights regarding student progress, program effectiveness, and the alignment of learning outcomes with professional standards. Additionally, cloud-based and interoperable systems support inter-institutional data exchange, promoting benchmarking and collaborative quality assurance initiatives across HEIs.

Table 1

Theoretical Foundations of Academic Analytics

Concept	Definition	Scope
Learning Analytics (LA)	Measurement, collection, analysis, and reporting of data about learners to optimize learning and environments	Individual & course-level learning
Educational Data Mining (EDM)	Application of statistical and machine learning methods to discover patterns in large educational datasets	Predictive modeling & student behavior
Academic Analytics (AA)	Institutional-level integration of LA & EDM for strategic decision-making and quality assurance	Institutional governance, curriculum planning, management

Despite their advantages, the deployment of these digital solutions requires careful attention to data privacy, system interoperability, and digital literacy of faculty and staff (SoLAR, 2021; Siemens & Long, 2011). When implemented systematically, analytical tools contribute to *evidence-based decision-making, continuous program improvement, and enhanced transparency* in the management of professional education.

The adoption of academic analytics in domestic higher education institutions (HEIs) offers substantial potential to enhance the quality of professional education. Key advantages include evidence-based decision-making, early identification of at-risk students, and improved alignment of curricula with labor market needs (Giannakos, 2022; Schwendimann et al., 2024). Analytics tools allow administrators and educators to monitor students' engagement, performance, and competency development, supporting targeted interventions and continuous program improvement. However, risks accompany these benefits.

Challenges include data privacy concerns, insufficient digital literacy among faculty, and potential misinterpretation of predictive models, which may lead to inequitable outcomes or over-reliance on quantitative metrics (Wachter, Mittelstadt, & Russell, 2017; Wilson et al., 2017).

Furthermore, implementing analytics systems requires significant infrastructural investment, interoperability of platforms, and institutional readiness, which may limit their immediate applicability in some domestic contexts. The methodological framework includes a systems approach, which considers professional education as a complex interaction of learning outcomes, competency development, teaching and learning processes, institutional resources, and external stakeholder requirements. A competency-based approach is applied to assess the alignment of educational outcomes with professional standards and labor market needs. In addition, a benchmarking approach is used to compare institutional indicators with national and international best practices (Table 2).

Effective implementation of academic analytics in national HEIs requires systematic organizational, technical, and pedagogical conditions.

First, institutional commitment to data-driven decision-making and quality assurance must be ensured, including the development of governance frameworks and clear policies regarding data collection, processing, and ethical use (Riordan et al., 2023).

Second, technical infrastructure must support reliable integration of learning management systems, student information systems, and analytics platforms to enable comprehensive monitoring of learning outcomes.

Third, capacity-building for faculty and staff is essential, including training in data literacy, interpretation of analytics dashboards, and evidence-based instructional design. Finally, stakeholder engagement including students, employers, and accreditation bodies is crucial to ensure that analytics insights translate into actionable improvements and align with national educational standards (Vemula & Moraes, 2024). To successfully adapt international experience, domestic HEIs should adopt a phased, context-sensitive approach. Recommendations include:

Selective adoption of analytics tools that have demonstrated effectiveness in comparable institutional contexts, prioritizing dashboards for student engagement, competency tracking, and early-warning systems.

Development of ethical and legal frameworks tailored to national regulations while incorporating principles from international best practices, such as transparency, fairness, accountability, and learner consent (Wachter et al., 2017).

Pilot projects and collaborative initiatives with international partners to test analytics applications, collect evidence on effectiveness, and adapt tools to local curricular and cultural contexts.

Integration with employer feedback mechanisms to enhance graduates' employability and ensure that analytics insights inform curriculum improvement and professional training programs (Giannakos, 2022; Schwendimann et al., 2024).

Table 2

Methodology and Tools for Monitoring Professional Education

Data Source	Type of Data	Use in Analytics	Example Tools / Platforms
LMS (e.g., Moodle, Canvas)	Logins, participation, assignment submissions	Engagement monitoring, early warning	Blackboard Analytics, Moodle Analytics
Student Information Systems (SIS)	Grades, course enrollments, attendance	Performance tracking, competency measurement	PowerSchool, Banner Analytics
Assessments / Exams	Scores, rubrics, peer reviews	Learning outcome evaluation	Turnitin, Gradescope
Practical Training / Internship	Employer evaluations, skill checklists	Competency development & employability assessment	Custom dashboards, Tableau

Continuous professional development for faculty and administrators, emphasizing data interpretation, predictive analytics literacy, and ethical decision-making.

Adapting international experience in academic analytics to domestic HEIs offers a strategic opportunity to enhance transparency, effectiveness, and relevance of professional education programs. In recent years, the integration of academic analytics into higher education institutions (HEIs) in Ukraine has become a priority for improving the quality of professional education. Ukrainian universities are increasingly exploring international experiences in learning analytics, educational data mining, and institutional-level academic analytics to enhance decision-making, monitor student performance, and align educational programs with labor market requirements (Popova, 2025). International models, particularly from the European Union and the United States, provide concrete examples of how dashboards, predictive analytics, and data-driven interventions can support students and faculty. EU HEIs have successfully implemented *learning analytics dashboards* to monitor engagement and provide early warnings for at-risk students, while U.S. institutions employ predictive models to reduce attrition and optimize curriculum design (Schwendimann et al., 2024; Umer et al., 2021). Ukraine's national initiatives aim to adapt these practices within local HEIs, focusing on *benchmarking systems* and the integration of analytics for internal quality assurance (Popova, 2025) (Table 3).

This study has examined the theoretical foundations, methodological approaches, and international practices of academic analytics in higher education, with a focus on its role in monitoring and enhancing the quality of professional education. The analysis demonstrates that academic analytics integrates data from multiple sources including learning management systems, student information systems, assessment results, practical training reports, and employer feedback to provide a comprehensive, evidence-based view of students' learning progress and competency development. By combining learning analytics, educational data mining, and institutional-level academic analytics, higher education institutions can adopt a *systematic and continuous approach to quality assurance*, moving beyond traditional summative assessment methods.

The research highlights the *significant benefits* of implementing academic analytics in professional education. These include improved monitoring of learning outcomes, early identification of at-risk students, data-informed curriculum design, and enhanced alignment of educational programs with labor market demands. International experience from the EU, the USA, and other countries demonstrates that analytics dashboards, predictive modeling, and stakeholder engagement can significantly increase theeffectiveness,transparency,andresponsiveness of higher education institutions (Schwendimann et al., 2024; Giannakos, 2022; Umer et al., 2021).

At the same time, successful implementation requires attention to ethical and legal considerations, data privacy, faculty training, and technical infrastructure to ensure reliable and responsible use of educational data (Wachter, Mittelstadt, & Russell, 2017; Riordan et al., 2023).

The study also emphasizes the *prospects for further research* in this field. Future studies may explore the adaptation of international

Table 3

International Experience in Academic Analytics

Region / Country	Key Practices	Benefits	Challenge	References
USA	Predictive models for retention, Course Signals system	Improved graduation rates, targeted interventions	Ethical concerns, model accuracy	Umer et al., 2021
EU	Learning analytics dashboards in universities, predictive tools for engagement & retention	Data-informed teaching, early intervention	Data integration, faculty training	Schwendimann et al., 2024; Giannakos, 2022
Ukraine (national adaptation)	Benchmarking and analytics integration in HEIs	Aligns programs with quality standards, supports evidence-based improvements	Legal & ethical considerations, digital literacy, interoperability	Popova, L., (2025)
Other countries (Australia, Kenya)	Blended learning analytics, student performance dashboards	Engagement monitoring, curriculum adaptation	Infrastructure, local adaptation	Vemula & Moraes, 2024; Riordan et al., 2023
Employer collaboration	Dashboards integrating employer feedback	Aligns education with labor market needs	Data privacy, feedback integration	Giannakos, 2022

Table 4

Opportunities For Adapting International Experience in National HEIs

Aspect	Opportunities	Risks / Challenges	Recommendations
Implementation	Evidence-based decisions, early detection of at-risk students	Data privacy, insufficient digital literacy	Pilot projects, selective tool adoption
Technical Infrastructure	Integration of LMS, SIS, analytics dashboards	High cost, interoperability issues	Phased adoption, scalable platforms
Faculty & Staff Training	Data interpretation, predictive analytics literacy	Resistance to change, lack of expertise	Continuous professional development programs
Employer Collaboration	Competency tracking, curriculum alignment	Limited engagement or feedback loops	Formal partnerships, dashboards linking HEIs and employers
Ethics & Legal	GDPR compliance, transparent algorithms	Risk of bias, misuse of data	Develop ethical frameworks, ensure consent and transparency

best practices to national contexts, the development of interoperable analytics platforms for inter-institutional collaboration, the integration of employer feedback into learning analytics, and the long-term impact of analytics-driven interventions on graduates' employability and professional competencies. Additionally, research on ethical frameworks, predictive model validation, and AI-driven analytics in higher education can further strengthen the scientific foundation of academic analytics and support evidence-based improvements in professional education. In the context of academic analytics, benchmarking complements data-driven approaches by providing *reference points* that contextualize the interpretation of student performance metrics, learning outcomes, and institutional KPIs (Key Performance Indicators). For instance, comparing graduation rates, competency development, and employability indicators across peer institutions can inform curriculum design, allocation of resources, and pedagogical interventions (OECD, 2020).

Moreover, benchmarking fosters *strategic alignment and accountability*, enabling institutions to meet accreditation requirements and respond to labor market demands more effectively. It supports evidence-based decision-making by highlighting performance trends, uncovering systemic inefficiencies, and guiding policy formulation. International experience demonstrates that combining benchmarking with learning analytics and predictive modeling enhances the *effectiveness of interventions*, as institutions can prioritize actions based on comparative insights and historical trends (Table 4).

In the context of higher education and academic analytics, KPIs are *measurable values that indicate how effectively an institution, program, or process is achieving its objectives.* They provide a way to monitor progress, evaluate performance, and support evidence-based decision-making.

Conclusions. In conclusion, academic analytics represents a *powerful instrument for enhancing the quality and relevance of professional education*, offering a data-driven, transparent, and adaptive approach that aligns student learning outcomes with institutional goals and labor market requirements. Its continued development and implementation hold significant promise for both educational institutions and society as a whole. The Ukrainian experience in academic analytics reflects a gradual and selective adaptation of international best practices, with a strong focus on aligning educational quality monitoring with national priorities. Continued research and pilot implementations are essential to optimize these systems, expand capacity-building for faculty, and strengthen partnerships with employers, ultimately improving the overall quality and competitiveness of professional education in Ukraine.

ЛІТЕРАТУРА:

1. Baker, R. S., & Yacef, K. (2009). The state of educational data mining in 2009: A review and future visions. *Journal of Educational Data Mining*, 1(1), 3–17. Retrieved from https://doi.org/10.5281/zenodo.3554658

2. Campbell, J. P., DeBlois, P. B., & Oblinger, D. G. (2007). Academic analytics: A new tool for a new era. *EDUCAUSE Review*, 42(4), 40–57. Retrieved from https://er.educause.edu/articles/2007/7/academic-analytics-a-new-tool-for-a-new-er

3. Giannakos, M. (2022). Educational Data, Learning Analytics and Dashboards. In *Experimental Studies in Learning Technology and Child–Computer Interaction. Springer.* Retrieved from https://link.springer.com/chapter/10.1007/978-3-031-14350-2_4?utm_source=chatgpt.com

4. OECD. (2020). *Education in the Digital Age*. Paris: OECD Publishing. Retrieved from https://www.oecd.org/education/

5. Popova L. (2025). Benchmarking in the System of Educational Quality Assurance: Key Principles and Challenges in Ukraine. Abstracts of XIV International

Scientific and Practical Conference. Krakow, Poland. Pp. 138–144. Retrieved from https://eu-conf.com/en/events/learning-technology-and-inventions-problem-sof-moder n-education

6. Riordan,A.,Echeverria,V.,Jin,Y.,Yan,L.,Swiecki,Z., Gašević, D., & Martinez-Maldonado, R. (2023). Human-centred learning analytics and AI in education: A systematic literature review. arXiv. Retrieved from https://arxiv.org/abs/2312.12751?utm_source=chatgpt.com

7. Schwendimann, B. A., Rodriguez-Triana, M. J., Vozniuk, A., Prieto, L. P., Boroujeni, M. S., Holzer, A., Gillet, D., & Dillenbourg, P. (2024). Learning analytics dashboards are increasingly becoming about learning and not just analytics: A systematic review. *Education and Information Technologies*, 29, 14279–14308. Retrieved from https://link.springer.com/article/10.1007/s10639-023-12401-4?utm _source=chatgpt.com

8. Siemens, G., & Long, P. (2011). Penetrating the fog: Analytics in learning and education. *EDUCAUSE Review*, 46(5), 30–40. Retrieved from

9. SoLAR. (2021). What is Learning Analytics. *Society for Learning Analytics Research*.

10. Umer, R., Susnjak, T., Mathrani, A., & Suriadi, L. (2021). Current stance on predictive analytics in higher education: Opportunities, challenges and future directions. Interactive Learning Environments. Retrieved from https://educationaltechnologyjournalspringeropen.com/articles/10.1186/s41239-021-00313-7?utm_source=-chatgpt.com

11. UNESCO. (2021). *Reimagining our futures together: A new social contract for education*. Paris: UNESCO. Retrieved from https://unesdoc.unesco.org/

12. Unpacking student engagement in higher education learning analytics: a systematic review. (2024). *International Journal of Educational Technology in Higher Education*, 21, Article 63. Retrieved from https://educationaltechnologyjournal.springeropen.com/articles/10.1186/s41239-024-00493-y?utm_source=chatgpt.com

13. Vemula, S. R., & Moraes, M. (2024). Learning analytics dashboards for advisors – A systematic literature review. arXiv. Retrieved from https://arxiv.org/abs/2402.01671?utm_source=chatgpt.com

14. Wachter, S., Mittelstadt, B., & Russell, C. (2017). Counterfactual explanations without opening the black box: Automated decisions and the GDPR. *SSRN Journal.* Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3063289

15. Wilson, A., Watson, C., Thompson, T. L., Drew, V., & Doyle, S. (2017). Learning analytics: Challenges and limitations. *Teaching in Higher Education*, 22(8), 991–1007.

REFERENCES:

1. Baker, R. S., & Yacef, K. (2009). *The state of educational data mining in 2009: A review and future visions*. Journal of Educational Data Mining, 1(1), 3–17. Retrieved from https://doi.org/10.5281/zenodo.3554658

2. Campbell, J. P., DeBlois, P. B., & Oblinger, D. G. (2007). *Academic analytics: A new tool for a new era*. EDUCAUSE Review, 42(4), 40–57. Retrieved from https://er.educause.edu/articles/2007/7/academic-analytics-a-new-tool-for-a-new-er

3. Giannakos, M. (2022). Educational Data, Learning Analytics and Dashboards. In Experimental Studies in Learning Technology and Child–Computer Interaction. Springer. Retrieved from https://link.springer.com/chapter/10.1007/978-3-031-14350-2_4?utm_source=chatgpt.com

4. OECD. (2020). *Education in the Digital Age*. Paris: OECD Publishing. Retrieved from https://www.oecd.org/education/

5. Popova L. (2025). Benchmarking in the System of Educational Quality Assurance: Key Principles and Challenges in Ukraine. Abstracts of XIV International Scientific and Practical Conference. Krakow, Poland. Pp. 138-144. Retrieved from https://eu-conf.com/en/events/learning-technology-and-inventions-problemsof-moder n-education

6. Riordan, A., Echeverria, V., Jin, Y., Yan, L., Swiecki, Z., Gašević, D., & Martinez-Maldonado, R. (2023). Human-centred learning analytics and AI in education: A systematic literature review. arXiv. Retrieved from https://arxiv. org/abs/2312.12751?utm_source=chatgpt.com

7. Schwendimann, B. A., Rodriguez-Triana, M. J., Vozniuk, A., Prieto, L. P., Boroujeni, M. S., Holzer, A., Gillet, D., & Dillenbourg, P. (2024). Learning analytics dashboards are increasingly becoming about learning and not just analytics: A systematic review. Education and Information Technologies, 29, 14279–14308. Retrieved from https://link.springer.com/article/10.1007/s10639-023-12401-4?utm _source=chatgpt.com

8. Siemens, G., & Long, P. (2011). *Penetrating the fog: Analytics in learning and education*. EDUCAUSE Review, 46(5), 30–40. Retrieved from

9. SoLAR. (2021). *What is Learning Analytics*. Society for Learning Analytics Research. URL:

10. Umer, R., Susnjak, T., Mathrani, A., & Suriadi, L. (2021). Current stance on predictive analytics in higher education: Opportunities, challenges and future directions. Interactive Learning Environments. Retrieved from https://educational technologyjournalspringeropen.com/articles/10.1186/s41239-021-00313-7?utm_source=chatgpt.com

11. UNESCO. (2021). *Reimagining our futures together: A new social contract for education*. Paris: UNESCO. Retrieved from https://unesdoc.unesco.org/

12. Unpacking student engagement in higher education learning analytics: a systematic review. (2024). *International Journal of Educational Technology in Higher Education*, 21, Article 63. Retrieved from https://educationaltechnologyjournal.springeropen.com/articles/10.1186/s41239-024-00493-y?utm_source=chatgpt.com

13. Vemula, S. R., & Moraes, M. (2024). Learning analytics dashboards for advisors — A systematic literature review. arXiv. Retrieved from https://arxiv.org/abs /2402.01671?utm_source=chatgpt.com

14. Wachter, S., Mittelstadt, B., & Russell, C. (2017). Counterfactual explanations without opening the black box: Automated decisions and the GDPR. *SSRN Journal*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3063289

15. Wilson, A., Watson, C., Thompson, T. L., Drew, V., & Doyle, S. (2017). Learning analytics: Challenges and limitations. Teaching in Higher Education, 22(8), 991–1007.

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