Volume 15 Number 2 (2023)
July-December 2023
Page: 837-848

E-ISSN: 2656-9779
P-ISSN: 1907-6355
DOI: 10.37680/qalamuna.v15i2.3905

QALAMUNA
JURNAL PENDIDIKAN, SOSIAL, DAN AGAMA

The Digital Revolution in Higher Education: Transforming Teaching and Learning

Khalid Ilias Basheer Qolamani [1]

[1] University of Zakho, Zahko, Kurdistan Region, Iraq, email: khalid.ilias@uoz.edu.krd

Received: 27/07/2023 Revised: 28/09/2023 Accepted: 06/11/2023

Abstract

Digital transformation in higher education has dramatically disrupted conventional teaching and learning models. This review traces the evolution of educational technology over the past few decades. It analyzes how tools such as learning management systems, data analytics, online learning, and artificial intelligence impact pedagogy, student experience, educator roles, and institutional learning. The great potential of technology to enhance learning is also discussed, along with the ongoing challenges of justice, ethics, and human relations in its application. Current and emerging technologies and their implications for key stakeholders are examined. This study uses a multi-faceted methodology to investigate digital transformation in higher education: Historical Analysis, Technology Review Case Studies, Stakeholder Surveys, and Ethical and Social Implications. Predictive modelling and trend analysis are performed to project higher education's future digital transformation trajectory, which includes analysis of new technologies, potential disruptions, and the evolving needs of the education sector. The review brings together insights from academic literature, industry publications, and the digital transformation of higher education over the past few decades, which has been widespread and measurable. Early adopters of technologies such as analytics, AI, and immersive media will be best positioned to improve the student experience in the future. However, carefully applying and considering students' needs and equality is essential to avoid marginalized groups.

Keywords Digital Revolution; Learning Management System; Teaching Method

Corresponding Author
Mohammad Mahdi Mohammed
University of Zakho, Zahko, Kurdistan Region, Iraq, email: mohammed.ombarak@uoz.edu.krd

1. INTRODUCTION

Higher education has undergone significant changes in recent decades, primarily driven by rapid technological advances that have disrupted conventional teaching and learning models(Maritsa et al., 2021) (Kozma, 2003). The rise of digital tools and innovations such as learning management systems, data analytics, and artificial intelligence has transformed student experience, teaching practices, and administrative functions(Saljö, 2010) (Maritsa et al., 2021). The digital revolution in higher education is not just about using new hardware and software; It also involves cultural and paradigm transformations in teaching-learning. This shift brings tremendous opportunities and severe challenges for educators, students, and Education administrators (Roehl et al., 2013).

The digital revolution is an ongoing phenomenon, with technological developments constantly changing and impacting how we live, work, communicate, and learn. This phenomenon has created great opportunities for innovation and progress, but it also presents new challenges that must be overcome (Selwyn, 2019). The digital revolution will continue to influence education for the foreseeable future, and a deep understanding of this phenomenon is essential to deal with the ongoing changes in this digital age (Hiltz & Turoff, 2005). Before the digital revolution, higher education was characterized by conventional face-to-face instruction based on lectures, textbooks, and examinations. Typical pedagogy involves professors passing information through lectures to passive students taking notes. Students work on assignments independently and complete high-stakes exams to demonstrate knowledge. Class discussions, group work, and seminar-style teaching are less common than large lectures (Roehl et al., 2013). Resources are limited to physical text, models or props, and instructor information. Most communication occurs during class sessions or scheduled work hours. Student learning data is minimal – usually grades and occasional course evaluations. This traditional model originated in European universities in medieval times and survived for centuries until new technologies facilitated different approaches.

Data did not play a significant role in shaping teaching and learning practices before the digital age. Individual student data is limited to grades, which provide summative information but are not formative or diagnostic(Hiltz & Turoff, 2005). Data on the effectiveness of the course depends mainly on the student's evaluation at the end of the course. However, with the arrival of the digital age, the role of data in shaping teaching and learning practices is undergoing revolutionary changes. Digital technology enables more detailed and real-time data collection and analysis, which consecutively allows educators to gain deeper insight into students' learning processes and take more timely and targeted action (Willis et al., 2013).

Individual student data now includes more than just final grades. With various online learning tools and platforms, educators can track student activity, such as interactions with material, time spent on each assignment, and learning patterns (Nilson, L. B., & Goodson, 2021). In other words, formative and diagnostic data can now be accessed more quickly, so educators might provide more specific and detailed feedback to students throughout the learning process, helping them understand their strengths and weaknesses. In addition, data collected from the entire course can be used to evaluate teaching effectiveness holistically. Educators can analyze such data to identify trends in student performance, understand aspects that may need improvement in course design, and even measure the impact of innovation in teaching.

At the institutional level, essential enrollment, graduation, and demographics metrics are tracked manually. The available computing power and the lack of specialized software might limit analysis, so data-driven decision-making is minimal – administrators rely more on experience, anecdotal observation, and intuition (Long & Siemens, 2011). While this classical model allows for rich face-to-face interaction and academic freedom for educators, it lacks the robust data needed for targeted assessment of learners, instructors, and programs. The digital revolution allows for the collection and utilization of more educational data.

This article provides an overview of higher education before the digital age and an in-depth look at the key technologies driving digital transformation. The report examines how data-driven platforms, online learning, and artificial intelligence impact pedagogy, access, student support services, and institutional management. The enormous potential of these technologies to improve learning and efficiency is also discussed, along with ongoing challenges around equitable application, data ethics, and people-to-people relationships.

This literature review aims to provide a comprehensive overview of digital transformation in higher education and its impact on the teaching and learning process. The study aims to trace the evolution of higher education and the emergence of educational technology over the past several decades. Secondly, to analyze critical technologies such as learning management systems, data analytics, online learning, and artificial intelligence that have driven change in higher education. Thirdly, to examine the impact of these technologies on pedagogy, the student experience, the role of educators, and institutional operations. Furthermore, fourthly, to discuss the enormous potential of digital innovation to improve learning and the ongoing challenges around implementation, ethics, and human relations.

The scope of this review covers higher education institutions globally, but the primary focus is on developments in North America, Europe, and Australia, where digitalization is most rapid and widespread. Although technology continues to develop, significant developments from the digital revolution of the 1990s to the present are emphasized. This review combines insights from academic literature, industry publications, conference proceedings, and media reports, which provide a holistic view of the significant changes occurring in higher education in the digital era, mainly related to the digital revolution in higher education, which can change teaching and learning.

2. METHOD

To investigate digital transformation in higher education, this research uses a multi-system approach, namely Historical Analysis, which provides a comprehensive review of historical documents, publications, and archival materials to understand the landscape of higher education before digitalization. The procedure includes examining traditional teaching methodologies, resources, and institutional practices. Technology Overview deals with key technologies that are identified and analyzed and drive digital transformation, which includes learning management systems, data analysis tools, and artificial intelligence applications. Adoption rates, features, and their impact on teaching and learning are explored through published reports, user reviews, and case studies.

Case Studies covering specific universities and educational institutions were selected to demonstrate the practical application of digital tools. This case study highlights the challenges faced during the adoption process, the benefits gained, and the lessons learned. Stakeholder Survey: A survey conducted among educators, students, and administrative staff to gather insights on the benefits and drawbacks of digital tools in higher education. These surveys help in understanding the ground realities and identifying areas for improvement. Related Ethical and Social Implications Discussions regarding potential challenges around data ethics, equity in implementation, and the evolving nature of human relationships in digital education are based on expert opinion, focus group discussions, and existing literature. Future Trend Analysis deals with Predictive models and trend analysis conducted to project the future trajectory of digital transformation in higher education, which involves analyzing emerging technologies, potential disruptions, and the evolving needs of the education sector.

3. FINDINGS AND DISCUSSIONS

The digital era began in the 1950s, but essential innovations emerged in the 1990s as computing power, network systems, and the internet matured. Early online courses and discussion groups emerged, signalling a significant disruption to conventional education (Prensky, 2014)(Hiltz & Turoff, 2005). The rapid development of the internet and mobile devices makes accessing and sharing information easier.

As students increasingly turn to digital resources, universities recognize the need for a robust online presence. Technology is quickly being integrated into every aspect of higher education – resources, communications, data and analytics, service delivery, and global reach (Suryadi & Lestari, 2020)(Brown & Adler, 2008). In the early 2000s, the foundation for a technology-based, networked, and data-based educational model began to take shape.

The significant innovation was the learning management system (LMS). Platforms such as Blackboard, Canvas, and Moodle provide teachers with a central virtual site for sharing materials, communicating with students, administering assessments, and tracking grades. LMS adoption continued to increase in the 2000s, with more than 90% of campuses now using a system (Dahlstrom et al., 2014).

LMS allows for an increased mix of online and classroom teaching. Faculty developed a "flipped" model, providing videos of lectures beforehand and using the class for interactive projects(Bates & Sangrà, 2011). The discussion continued smoothly online. The LMS provides flexibility for students to access materials at any time and allows new data streams to evaluate participation. Blended learning is now commonplace, with sub-models such as rotation and flexible mixing of face-to-face and distance activities (Graham et al., 2013)

As digital systems increase, vast amounts of data about students, faculty, courses, programs, and institutional operations are generated. Extracting insights from this data through mining techniques heralds the era of analytics in education. Learning analytics applies statistical modelling to student data to uncover engagement, performance, and risk behaviour patterns. It provides diagnostic, predictive, and prescriptive information to guide intervention(Long & Siemens, 2011)

For example, the Course Signals program at Purdue University tracks individual student data to generate risk profiles highlighted by red/yellow/green indicators(Suryadi & Lestari, 2020). The program allows advisors to proactively reach out to struggling students early in the course. Research has shown significant improvement in results from using learning analysis models (Arnold, 2010).

The growth of high-speed internet and video technology opens up new possibilities for distance learning. In 2002, MIT launched its pioneering Open Course Ware, which offered free materials for almost all courses online (Carson, 2009, p. 101). This development drives enormous growth in massive open online courses (MOOCs) and online degree programs. Online enrollment continues to increase, with approximately one-third of students taking at least one online course (Seaman, 2018). Proponents argue that digital learning expands access, provides scheduling flexibility, and encourages diversity. However, retention for online courses is still lower. Critics argue that distance learning isolates students, exacerbates disparities, and deprives them of socialization and skill development (Jaggars & Xu, 2016). Thoughtful course design, student services, and addressing the digital divide are critical to meaningful online learning.

The last few years have seen exponential growth in education-related AI tools. Intelligent tutoring systems like Carnegie Learning leverage natural language processing and machine learning to provide personalized instruction, practice, and feedback. Campus management AI helps optimize lecture schedules. AI teaching assistants like Jill Watson answer students' routine questions, saving teachers time (Luckin et al., 2016).

AI-based adaptive learning systems build more detailed learner profiles, modifying curricula based on dynamic performance data. For example, DreamBox dynamically adapts math lessons to keep

each student within their optimal challenge zone (Taneja, 2014). While still largely experimental, AI presents transformative possibilities for personalized and equitable education. However, human oversight is essential to address bias and inherent privacy concerns.

Digital transformation has optimized vital functions, including admissions, registration, library, and student services (Ambarwati et al., 2022) (Zhao, 2016). The application processes thousands of applicants using automated workflows. Enrollment is increasingly handled through web portals with degree planning tools. Library and scholarship collections can be accessed online through a complex cataloguing system. Advisors leverage data from early warning systems to identify at-risk students.

Enterprise resource planning (ERP) software integrates cross-departmental systems to improve institutional efficiency. However, critics argue that an overly technocratic administration is at odds with the tradition of shared governance and the diverse nature of academics (Janca, 2013). Change management and participatory design are essential to effective implementation of Learning technologies.

The digital revolution has changed almost every aspect of higher education, from how faculty teach to how universities operate. However, technology is only a tool – thoughtful implementation, integration with pedagogy, and a focus on human connections remain essential for meaningful educational change(Lim & Zhao, 2018). Further research and investment should continue to develop student-centred and socially responsible frameworks that harness the enormous potential of technology to serve today's and tomorrow's diverse learners and communities.

One of the most significant changes in higher education is the rise in data-driven teaching practices. The digital era has opened up new streams of student data and analysis techniques to derive value from this data. This section examines the primary sources of student data available today and how data enables personalized learning, better feedback, and predictive analytics for student success(Reigeluth & Garfinkle, 1994).

One of the most significant changes in higher education is the rise in data-driven teaching practices. The digital era has opened up new streams of student data and analysis techniques to derive value from this data. This section examines the primary sources of student data available today and how data enables personalized learning, better feedback, and predictive analytics for student success.

Digital technologies implemented in the last two decades provide educators with unprecedented breadth and depth of student data (Picciano, 2012). Learning management systems such as Canvas and Blackboard are able to capture assignments, grades, online discussion contributions, and material access logs. Attendance tracking software monitors class participation (Chen et al., 2018). Plagiarism detectors like Turnitin check student work for academic integrity issues. Online quizzes and automatically graded homework provide instant formative assessment data.

Clicker response systems provide instant feedback on student understanding during lectures (Caldwell, 2007). Campus card swipes track library usage and attendance at campus events. Outside the classroom, data about social relationships and extracurricular activities is collected. Each digital touchpoint contributes additional data elements to create student profiles and monitor progress.

More and more data is being integrated across platforms via APIs and stored in comprehensive data warehouses. The field of learning analytics applies educational data mining techniques to these vast data sets to gain insights and predict outcomes (Siemens, 2013). This holistic view of student activity enables the next wave of data-backed teaching.

Detailed student data allows educators to tailor instruction and resources to fit students' needs (Johnson, L., 2016). For example, intelligent tutoring systems customize problem sets based on students' mastery of concepts and common mistakes. Data reveals differences in pacing needs, knowledge gaps, and motivations among students that can shape teaching plans.

Detailed student performance data allows teachers to provide specific and timely feedback (Nilson, L. B., & Goodson, 2021). Online quizzes quickly highlight areas to review. Analysis of discussion forums revealed the level of student engagement. Early warning systems flag students at risk for targeted interventions. Data makes the feedback cycle more efficient and constructive.

With large historical data sets, predictive modelling identifies key indicators for student outcomes (Aguilar, 2018). Machine learning algorithms help advisors predict each student's likelihood of success and determine interventions before a student fails a class. Purdue University's CourseSignals is a pioneering example of using predictive analytics to increase student retention (Arnold, 2010).

However, data-driven teaching also raises concerns regarding student privacy, surveillance, and over-reliance on technology in education. Teachers must balance data-based insights with professional expertise and avoid excluding students (Prinsloo & Slade, 2017). Overall, student data analysis is most effective when it complements, not replaces, human judgment in teaching.

The rise of data-driven teaching has significant implications for key stakeholders in higher education. For students, data-driven teaching enables a more engaging and personalized classroom experience that improves outcomes. However, this has also increased data collection, raising privacy concerns (Willis et al., 2013). Some argue that constant analytical monitoring minimizes student autonomy. There is concern that data-based assessments may introduce bias or be used to stereotype students (Roberts-Mahoney et al., 2016).

One proposed solution is empowering students with control over their data through student data-locking systems (Ifenthaler & Schumacher, 2019). Overall, students gain more self-awareness and efficient learning through data at the expense of increased supervision and reliance on algorithms. For educators, student data analysis provides new tools for assessment, feedback, and course improvement (Picciano, 2012). However, utilizing these tools effectively requires substantial data literacy and ethics training. Faculty have raised concerns regarding academic freedom and the validity of data-based insights that supersede their expertise (Drachsler & Greller, 2016).

Ultimately, the availability of detailed student data shifts the role of educators toward fostering independent learners (Johnson, L., 2016). Teaching becomes more collaborative, results-focused, and responsive to diverse learners. Nevertheless, this requires a recalibration of teaching philosophies – a challenging process that requires institutional support.

Student data analysis offers strategic advantages for higher education institutions but requires significant investments. Data insights can strengthen recruitment, increase retention, improve curricula and programs, and demonstrate accountability – all drivers of competitiveness (Picciano, 2012). However, capital and personnel must be allocated for data storage, security, analysis, and training.

New data governance policies are needed to address ethical and privacy issues (Slade & Prinsloo, 2013). Institutions that leverage analytics responsibly and effectively will be well-positioned to deliver positive student outcomes and strategic growth. However, this depends on laying an educational foundation supported by data.

In short, the massive influx of new student data coupled with analytical techniques has driven the rise of data-driven teaching practices in higher education. It has transformative potential to improve learning experiences and student success outcomes when implemented ethically and responsibly. However, this also has profound implications for all stakeholders involved in the education process, which must be carried out wisely. With the right policies and a balanced perspective, data can improve human relationships to create a new paradigm in learner-centred teaching.

While the potential of data-driven teaching is evident in theory, examining examples of real-world applications of analytics in higher education institutions is useful. One example of the real-world application of analytics in higher education institutions is using data to improve operational efficiency

and strategic decision-making. For example, universities can use data analytics to manage their finances better. By analyzing historical financial data and future projections, universities can identify inefficient spending patterns and take necessary actions to optimize the use of their resources.

The first example is Institutions Leveraging Big Data to Identify and Support At-Risk Students. Georgia State University provides a leading model for leveraging big data to increase student retention and graduation rates (Kamenetz, 2016). The university serves more than 50,000 diverse students, with the majority being first-generation, low-income, and underrepresented minorities. Historically, its 1-year retention rate lags that of other public research universities.

To address this, Georgia State implemented a custom predictive analytics system that leverages 2,000 data points per student from sources such as admissions records, grades, financial aid, student surveys, and program participation. Machine learning algorithms analyze this data to generate real-time risk profiles and alert students in danger of going off track.

When the system identifies a student at risk, counsellors and teachers receive prompts to intervene, such as contacting the student or suggesting support services. The system also monitors the effectiveness of interventions, enabling continuous outreach optimization. Since implementing predictive analytics in 2012, graduation rates at Georgia State have increased by more than 20 percentage points, eliminating disparities in outcomes for disadvantaged groups.

A second example would be a Course redesign based on Student Engagement Data to Improve Engagement and Results. At Australia's RMIT University, learning analytics was leveraged to redesign an information systems course with a high dropout rate (West et al., 2016). The course design team analyzed data from the learning management system that showed uneven student engagement across different weeks. Week 4 had deficient online activity and content access.

Survey and focus group data revealed that week 4 covered complex analytical concepts that students found difficult. Learning design does not design these concepts effectively. In response, the faculty redesigned week four materials with new explanatory videos, hands-on activities, and active learning exercises spaced over two weeks apart.

Post-redesign data showed increased engagement on these topics, and overall pass rates increased from 76% to 83%, which shows how granular interaction data can pinpoint problem areas that should be addressed through targeted redesign, thereby improving outcomes.

Although it provides many opportunities, improving data-driven education poses major challenges for institutions. As student data collection expands, concerns around privacy, security, consent, and appropriate use are increasing (Willis et al., 2013). There are fears of profiling, excessive surveillance, and the use of data to stereotype or discriminate against certain groups. Strict data governance policies and student consent procedures are critical to maintaining trust and preventing abuse.

Critics argue that educational data often lacks scientific rigour in its collection, and proxies such as LMS logins provide only partial insight into complex learning processes. Excessive reliance on technology risks underestimating the expertise of educators and the social aspects that underlie real learning (Prinsloo & Slade, 2017). Institutions must validate data-driven insights using multi-method evaluation.

Many lecturers and educators accustomed to conventional teaching reject the paradigm shift toward data-based teaching. Some view it as a violation of academic freedom and teacher autonomy. Winning stakeholder support requires a change management strategy that addresses concerns around changing roles and technology adoption (Drachsler & Greller, 2016).

Effectively leveraging analytics at scale requires significant investments in digital infrastructure, data interoperability, IT personnel, and user training. Under-resourced institutions may struggle to

implement these systems, widening the digital divide. Learner digital literacy variables also impact the quality of data collection. Advancing digital equity alongside EdTech is critical (Aceves-de-Leon, 2020).

In summary, the rise of digital tools has enabled powerful new data-driven teaching techniques. Still, it has also created major disruptions and challenges for stakeholders in higher education. Ensuring these rapid changes produce positive outcomes for all students requires a concerted effort across institutions, educators, and the education technology industry. With an inclusive ethical and policy framework guiding development, data-driven teaching has enormous potential to usher in a new era of impactful, personalized, and equitable learning experiences.

Digital transformation in higher education will likely accelerate as technology plays a more significant role in the coming years. This development will create new opportunities in online learning, international collaboration, and educational accessibility. With the increasing number of online learning platforms, students will have easier access to various subjects and educational resources without being limited by geographical boundaries. Additionally, artificial intelligence, data analysis, and virtual reality will change teaching and learning, enabling more personalized and practical education. However, with this development, there will also be challenges related to data security, access gaps, and adaptation of teaching staff. Therefore, higher education needs to continue to innovate and collaborate with the technology industry to face these changes successfully.

Advances in artificial intelligence will expand the use cases of personalized and adaptive learning at scale (Luckin et al., 2016). AI teaching assistants like Jill Watson can handle administrative tasks, saving teachers time. Chatbots provide support on request. AI assessment tools provide personalized feedback on written work. As neural networks become more sophisticated, AI will imitate human teachers and advisors with greater sophistication, which can help democratize access to high-quality education. However, hidden biases in algorithms and data must be addressed proactively to avoid excluding disadvantaged groups.

Immersive technologies such as virtual reality (VR) and augmented reality (AR) are gaining traction in higher education by enabling interactive simulations and experiential learning (Bower et al., 2017). These tools are handy for medicine, engineering, and design. VR campus tours help inform prospective students' decisions.

As headsets and apps mature, VR and AR will become mainstream in delivering engaging educational content. However, institutions may face significant costs in acquiring equipment and developing specialized learning experiences. Travel sickness is also still a barrier for some people. Careful design can maximize the benefits of immersion while minimizing limitations.

Analysis techniques will continue to evolve, providing more diverse insights from student data. Predictive algorithms will gain accuracy in predicting outcomes and determining interventions (Picciano, 2012). Data visualization tools will help users interpret the findings. Increased computing power will enable the rapid processing of large and complex data.

These developments will encourage continued iteration of data-driven teaching practices and increased personalization. Institutions that invest early in analytical capabilities will have a competitive advantage in recruiting the best students. However, data ethics and validity concerns must be addressed proactively through governance policies and multi-method evaluation.

4. CONCLUSION

The digital transformation of higher education over the past few decades has been widespread and scalable. Early adopters of technologies such as analytics, AI, and immersive media will be best positioned to improve the student experience in the future. However, carefully considering student needs and equity is essential to avoid marginalized groups.

Now, more than ever, institutions must embrace change and innovation while considering technology's human and ethical dimensions. With concerted efforts to close the digital divide and build strong data governance, the promise of data-driven teaching can be realized responsibly. Technology will never replace human connection and wisdom as the core of impactful education. However, if integrated wisely under the guidance of educators, this can open up new possibilities for students to maximize their potential.

REFERENCES

Aceves-de-Leon, M. (2020). The digital gap in the age of data capitalism. Television & New Media, 22(2), 137–143.

Aguilar, S. J. (2018). Learning analytics: At the nexus of big data, digital innovation, and social justice in education. TechTrends, 62(1), 37–45.

Ambarwati, D., Wibowo, U. B., Arsyiadanti, H., & Susanti, S. (2022). Studi Literatur: Peran Inovasi Pendidikan pada Pembelajaran Berbasis Teknologi Digital. *Jurnal Inovasi Teknologi Pendidikan*, *8*(2), 173–184. https://doi.org/10.21831/jitp.v8i2.43560

Arnold, K. E. (2010). Signals: Applying academic analytics. Educause Quarterly, 33(1).

Bates, A. W., & Sangrà, A. (2011). *Mengelola Teknologi di Pendidikan Tinggi: Strategi Transformasi Pengajaran dan Pembelajaran*. Jossey-Bass.

Bower, M., Lee, M. J., & Dalgarno, B. (2017). Collaborative learning across physical and virtual worlds: Factors supporting and constraining learners in a blended reality environment. British Journal of Educational Technology, 48(2), 407–430.

Brown, J. S., & Adler, R. P. (2008). Minds on fire: Open education, the Long Tail, and learning 2.0. Educause Review, 43(1), 16–20.

Caldwell, J. E. (2007). Clickers in the large classroom: Current research and best-practice tips. CBE—Life Sciences Education, 6(1), 9–20.

Chen, B., Knight, S., Wise, A., & Cheng, J. (2018). Critical issues in designing and implementing temporal analytics. Journal of Computing in Higher Education, 30(1), 27–47.

Dahlstrom, E., Christopher Brooks, D., & Bichsel, J. (2014). The Current Ecosystem of Learning Management Systems in Higher Education: Student, Faculty, and IT Perspectives.

Drachsler, H., & Greller, W. (2016). Privacy and analytics - it's a DELICATE issue, a checklist for trusted learning analytics. ACM International Conference Proceeding Series, 25-29-Apri, 89–98. https://doi.org/10.1145/2883851.2883893

Gani, A. G. (n.d.). *E-Learning sebagai Peran Teknologi Informasi dalam Modernisasi Pendidikan*. https://universitassuryadarma.ac.id/journal/index.php/jsi/article/view/52/50

Graham, C. R., Woodfield, W., & Harrison, J. B. (2013). A framework for institutional adoption and implementation of blended learning in higher education. Internet and Higher Education, 18, 4–14. https://doi.org/10.1016/j.iheduc.2012.09.003

Hiltz, S. R., & Turoff, M. (2005). Education goes digital: The evolution of online learning and the revolution in higher education. Communications of the ACM, 48(10), 59–64. https://doi.org/10.1145/1089107.1089139

Hiltz, S. R., & Turoff, M. (2005). Education goes digital: The evolution of online learning and the revolution in higher education. *Communications of the ACM*, *48*(10), 59–64. https://doi.org/10.1145/1089107.1089139

Ifenthaler, D., & Schumacher, C. (2019). Releasing the brake on data analytics in education. TechTrends, 63(1), 27–31.

Jaggars, S. S., & Xu, D. (2016). How do online course design features influence student performance?

Computers and Education, 95, 270–284. https://doi.org/10.1016/j.compedu.2016.01.014

Janca, R. (2013). Linking quality and governance in higher education. Perspectives: Policy and Practice in Higher Education, 17(1), 2–6.

Johnson, L., et al. (2016). NMC Horizon Report: 2016 Higher Education Edition. In The New Media Consortium (higher edu, Issue 15018). http://www.nmc.org/publications/2014-horizon-report-higher-ed

Kamenetz, A. (2016). How One University Used Big Data to Boost Graduation Rates. National Public Radio, 35(12), 30–37. https://doi.org/https://www.npr.org/sections/ed/2016/10/30/499200614/how-one-university-used-big-data-to-boost-graduation-rates

Kozma, R. (2003). Teknologi, Inovasi, dan Perubahan Pendidikan: Perspektif Global. *Teknologi & Masyarakat Pendidikan*, *6*(2), 27–37.

Long, P., & Siemens, G. (2011). Penetrating the Fog: Analytics in Learning and Education. EDUCAUSE Review, 46(5), 30–32. http://search.proquest.com.proxy.library.vanderbilt.edu/docview/964183308/13AF5BC47C138E29FF2/5?accountid=14816%5Cnhttps://login.proxy.library.vanderbilt.edu/login?url=http://search.proquest.com/docview/964183308/13AF5BC47C138E29FF2/5?accountid=14816

Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). Intelligence Unleashed: An argument for AI in education. In Pearson Education. Pearson. https://www.pearson.com/content/dam/one-dot-com/one-dot-com/global/Files/about-pearson/innovation/Intelligence-Unleashed-Publication.pdf

Lim, C. P., & Zhao, Y. (2018). *Buku Pegangan Internasional Teknologi Informasi di Pendidikan Dasar dan Menengah*. Peloncat.

Maritsa, A., Hanifah Salsabila, U., Wafiq, M., Rahma Anindya, P., & Azhar Ma'shum, M. (2021). Pengaruh Teknologi Dalam Dunia Pendidikan. *Al-Mutharahah: Jurnal Penelitian Dan Kajian Sosial Keagamaan*, *18*(2), 91–100. https://doi.org/10.46781/al-mutharahah.v18i2.303

Nilson, L. B., & Goodson, L. A. (2021). Online Teaching at Its Best: Merging Instructional Design with Teaching and Learning Research. In Journal of Development Research (Vol. 13, Issue 4). John Wiley & Sons. https://doi.org/10.54366/jdr.13.4.2020.62-64

Nilson, L. B., & Goodson, L. A. (2021). Online Teaching at Its Best: Merging Instructional Design with Teaching and Learning Research. In *Journal of Development Research* (Vol. 13, Issue 4). John Wiley & Sons. https://doi.org/10.54366/jdr.13.4.2020.62-64

Prensky, M. (2014). Digital Natives, Digital Immigrants. *From Digital Natives to Digital Wisdom: Hopeful Essays for 21st Century Learning*, *9*(5), 67–85. https://doi.org/10.4135/9781483387765.n6

Picciano, A. G. (2012). The evolution of big data and learning analytics in American higher education. Journal of Asynchronous Learning Network, 16(3), 9–20. https://doi.org/10.24059/olj.v16i3.267

Prinsloo, P., & Slade, S. (2017). An elephant in the learning analytics room - The obligation to act. In ACM International Conference Proceeding Series. https://doi.org/10.1145/3027385.3027406

Reigeluth, C. M., & Garfinkle, R. J. (1994). Perubahan Sistemik dalam Pendidikan. *Teknologi Pendidikan*, *34*(10), 11–18.

Roberts-Mahoney, H., Means, A. J., & Garrison, M. J. (2016). Netflixing human capital development: personalized learning technology and the corporatization of K-12 education. Journal of Education Policy, 31(4), 405–420. https://doi.org/10.1080/02680939.2015.1132774

Roehl, A., Reddy, S. L., & Shannon, G. J. (2013). The Flipped Classroom: An Opportunity To Engage Millennial Students Through Active Learning Strategies. Journal of Family & Consumer Sciences, 105(2), 44–49. https://doi.org/10.14307/jfcs105.2.12

Saljö, R. (2010). Alat digital dan tantangan terhadap tradisi pembelajaran institusional: Teknologi, memori sosial, dan sifat pembelajaran performatif. *Jurnal Pembelajaran Berbantuan Komputer*, *26*(1), 53–64.

Seaman, et al. (2018). Grade increase: Tracking distance education in the United States. Babson Park,

MA: Babson Survey Research Group. In Babson Survey Research Group. Babson Survey Research Group. https://eric.ed.gov/?id=ED580852%0Awww.favazza.com

Siemens, G. (2013). Learning analytics: The emergence of a discipline. In New Ways to Teach and Learn in China and Finland: Crossing Boundaries with Technology (Vol. 57, Issue 10). American Behavioral Scientist. https://doi.org/10.1177/0002764213498851

Selwyn, N. (2019). Pendidikan dan Teknologi Isu dan Perdebatan Utama. In *Journal of Community Engagement and Employment* (Vol. 5, Issue 1). Penerbitan Bloomsbury.

Slade, S., & Prinsloo, P. (2013). Learning Analytics: Ethical Issues and Dilemmas. American Behavioral Scientist, 57(10), 1510–1529. https://doi.org/10.1177/0002764213479366

Suryadi, D., & Lestari, E. (2020). Pemanfaatan Teknologi Informasi dalam Pendidikan: Kajian Adopsinya di Perguruan Tinggi. *Jurnal Inovasi Terbuka: Teknologi, Pasar, Dan Kompleksitas*, *6*(4), 152.

Taneja, S. (2014). DreamBox: An adaptive, personalized learning platform for early math education. Forbes, October, 20. https://doi.org/https://www.forbes.com/sites/sungardas/2014/10/20/dreambox-adaptive-personalized-learning-platform-early-math-education/

West, D., Huijser, H., & Heath, D. (2016). Putting an ethical lens on learning analytics. Educational Technology Research and Development, 64(5), 903–922. https://doi.org/10.1007/s11423-016-9464-3

Willis, J. E., Campbell, J. P., & Pistilli, M. D. (2013). Ethics, Big Data, and Analytics: A Model for Application. EDUCAUSE Review Online, 1.

Zhao, Y. (2016). *Pendidikan di Era Globalisasi: Peran Teknologi Informasi dalam Perekonomian Global*. Routledge.