Open Peer Review on Qeios

Potential Benefits of Information Technology Trends in Nigerian Tertiary Institutions

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Funding: No specific funding was received for this work.

Potential competing interests: No potential competing interests to declare.

Abstract

In recent years, research on the possible applications of IT trends in tertiary institutions has grown significantly. This review focuses on the impact of numerous IT trends on tertiary education. The main objective of this review is to give a general overview of 45 related published articles sourced from five research databases between 2015 and 2023. The review discusses a variety of IT trends, such as artificial intelligence (AI), cloud computing (CC), the internet of things (IoT), data analytics and big data, cybersecurity, and virtual and augmented reality (VR and AR), and how it improve communication and collaboration. It also discusses how big data analytics is used to make better decisions, integrate AI into tertiary institutions, the potential of mobile learning apps, and how virtual reality is used in science education, cloud computing implications, and gamification applications. The review also shows how IT trends are becoming increasingly significant in changing how students learn at postsecondary institutions. The results demonstrate how learning management systems increase student engagement, while social media platforms have the ability to promote communication and collaboration. Additionally, the combination of artificial intelligence and big data analytics has exciting prospects for data-driven decision-making and individualised learning. Innovative methods to improve student learning and engagement are made possible by the use of virtual reality technology and mobile learning applications. The use of blockchain technology at tertiary institutions demonstrates its potential in fields like secure record-keeping and credentialing. The use of gamification also opens up new opportunities for boosting student engagement and motivation. at the final section, the effects of cloud computing at tertiary institutions are critically analysed, with an emphasis on the advantages and difficulties of cloud-based solutions.

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Keywords: IT Trends, Artificial Intelligence, Internet of Things, Data Analytics, Big Data, Cybersecurity, Virtual Reality, Augmented Reality, Cloud Computing.

Introduction

Information technology (IT) trends are the latest techniques, methods, and approaches that are reshaping the industry. It encompasses topics such as networking, data management, hardware, and software and can significantly alter how organisations operate. In tertiary institutions, these trends include virtual and augmented reality, cloud computing, artificial intelligence, the internet of things, data analytics, and cybersecurity. IT trends are crucial in determining the direction of education (Brown & Wilson, 2022). It offers opportunities to improve teaching and learning processes, increase administrative efficiency, promote collaboration and communication, facilitate data-driven decision-making, support inclusive and accessible education, and prepare students for the future (Mitchell & Roberts, 2023; Zhang & Chen, 2018). By adopting innovative strategies like online learning platforms, interactive digital content, and virtual classrooms, educators can engage students and support personalised learning.

Technology also streamlines administrative procedures, reducing manual work and increasing efficiency in student registration, course management, data analysis, and record-keeping (Wang & Liu, 2021; Johnson & Smith, 2019). Effective teamwork and information sharing are made possible through tools like video conferencing, instant messaging services, and shared online workspaces (Lee & Chen, 2020). Moreover, the data analytics capabilities enable institutions to collect, analyse, and use data to make informed decisions, identify areas for improvement, and adjust its educational practices (Li & Wong, 2022). As the world becomes more digital, IT trends provide students with the knowledge and skills needed to succeed in the modern workforce. In a nutshell, IT trends are of utmost importance in tertiary institutions, as it can improve instruction and learning, streamline administrative procedures, encourage collaboration, enable data-driven decision-making, support accessibility and inclusivity, and better prepare students for the future. This review focuses on the impact of numerous IT trends on tertiary education. The main objective of this review is to give a general review of the linked related works published between 2015 and 2023.

Related Works

Numerous studies have examined the effects of artificial intelligence (AI) on tertiary education and its applications in numerous industries. These consist of computerised administrative procedures, sophisticated tutoring systems (Smith &

Johnson, 2021; Zhang & Chen, 2018; Brown & Wilson, 2022), and personalised learning (Smith, 2021). However, there is still a lot of worry about the technical and ethical issues related to implementing AI in educational settings. In higher institutions, cloud computing has also been studied because of its scalability, cost-effectiveness, and collaborative capabilities (Li & Wong, 2022). But there is also discussion of the difficulties and factors to be taken into account when using cloud-based solutions in higher education (Ahmed & Saidu, 2022; Senyo et al., 2016). Another area of emphasis in tertiary institutions is cybersecurity, with a focus on the significance of strong safeguards for educational systems and the protection of sensitive data (Brown & Wilson, 2024).

Furthermore, the potential of blockchain technology to guarantee the security and verifiability of academic credentials is also being investigated (Mitchell & Roberts, 2023; Johnson & Davis, 2018). It makes it simpler for companies and educational institutions to verify credentials by producing tamper-proof records of degrees, certifications, and other qualifications. By utilising big data for decision-making and student achievement, data analytics is essential for enhancing decision-making at tertiary institutions (Johnson, Davis, & Thompson, 2023; Brown & Wilson, 2022; Turner & Johnson, 2019). This can be accomplished by finding patterns, trends, and correlations in student data, allowing institutions to make decisions with knowledge and offer students the help needed. The issues of privacy and ethics are also covered. In order to improve student outcomes, improve teaching methods, and make data-informed decisions, big data and analytics are also being used in tertiary education. With plans and consequences for content distribution, communication, and collaboration, mobile technology is being embraced in tertiary education.

Another review investigates how augmented reality (AR) can improve learning opportunities and skill development in higher education (Artiningsih & Wilujeng, 2021; Wang & Liu, 2021). The use of AR technologies is used to develop engaging, hands-on learning experiences and to encourage creativity (Wang & Liu, 2021). Also covered are the pedagogical effects and potential future applications of AR integration in higher education. The potential of virtual reality (VR) to imitate real-world events, encourage active learning, and boost student engagement is also being investigated in university education (Lee & Park, 2023; Johnson & Davis, 2018). Also covered are the difficulties and potential paths for VR integration in academic institutions.

In tertiary education, social media platforms are also explored, along with its effects on teaching and learning. Social media is utilised to promote informal learning, improve communication, and boost collaboration (Chen & Wang, 2024; Johnson & Smith, 2019). However, issues and moral questions are also covered. Another area of research is gamification, which has the potential to improve learning outcomes and motivation. To increase participation and develop a sense of accomplishment, game components like points, badges, and leaderboards is introduced into instructional activities (Chen, & Wang, 2020; Lee, & Chen, 2020). Higher education gamification tactics are also examined, along with its advantages and drawbacks. The innovative strategies like online learning platforms, interactive digital content, and virtual classrooms can engage students and support personalized learning (Garcia, & Smith, 2016). It also streamline administrative procedures, reducing manual work and increasing efficiency in student registration, course management, data analysis, and record-keeping (Smith, 2017). Tools like video conferencing, instant messaging services, and shared online workspaces enable effective teamwork and information sharing (Lee, & Chen, 2023).

IT trends are the latest techniques and methods that are reshaping the industry, including networking, data management, hardware, and software (Smith, & Johnson, 2021). It is crucial in determining the direction of education, offering opportunities to improve teaching and learning processes. To also increase administrative efficiency, promote collaboration and communication, facilitate data-driven decision-making, support inclusive and accessible education, and prepare students for the future. In conclusion, IT trends are of utmost importance in tertiary institutions, as it can improve instruction and learning, streamline administrative procedures, encourage collaboration, enable data-driven decision-making, support accessibility and inclusivity, and better prepare students for the future.

Methodology

This review gives a broad review of the pertinent studies that have been published between 2015 and 2023, with a particular focus on how various IT advancements have affected tertiary education. As causes and the foundation for this analysis, the works cover a variety of six IT trends. These IT trends include artificial intelligence (AI), cloud computing (CC), the internet of things (IoT), data analytics and big data, cybersecurity, and virtual and augmented reality (VR and AR) in enhancing collaboration and communication, using big data analytics to improve decision-making, integrating AI in tertiary institutions, the potential of mobile learning applications, using virtual reality in science education, and the implications.

A. *Research design and approach*

This review follows a rigorous research design to synthesise and analyse existing literature on the benefits of IT trends in Nigerian tertiary institutions. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were modified and called the SIFRIA sample selection flowchart, which was utilised to ensure transparency and methodological rigour (Moher et al., 2009).

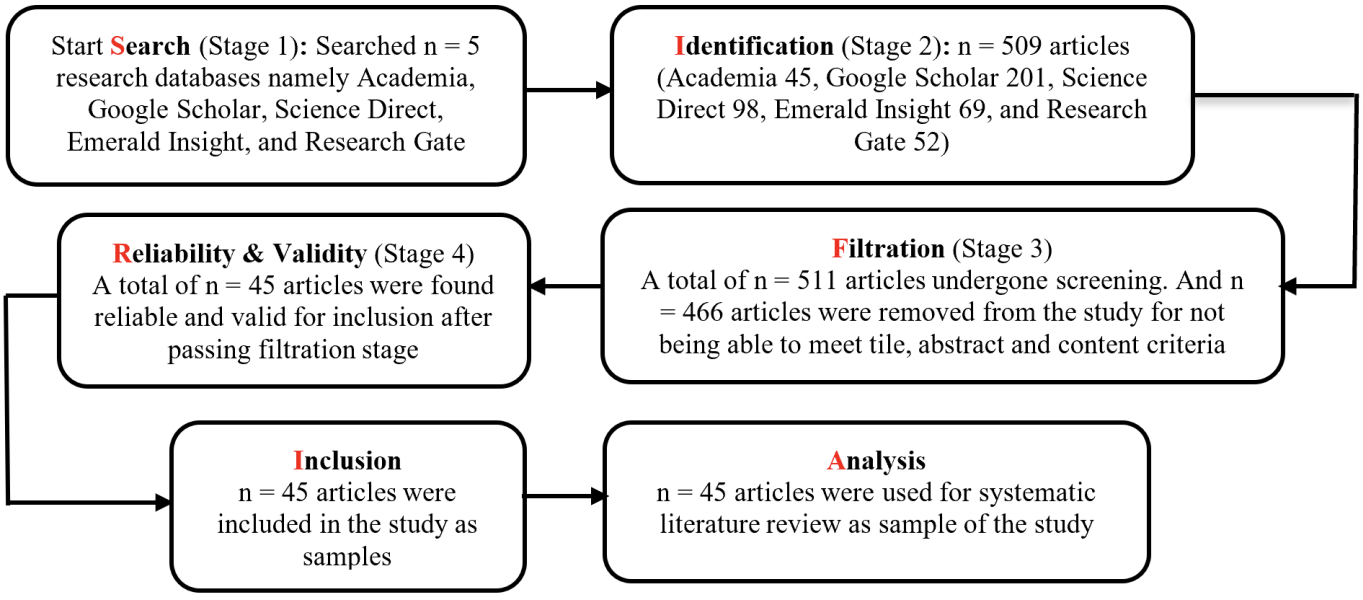

Figure 1. SIFRIA sample selection flowchart; Source: Adapted from (Ahmed et al., 2022b)

B. *Inclusion and exclusion criteria for selecting studies*

Inclusion criteria were established to ensure the relevance and quality of the studies included in this systematic review. Studies were included if it met the following criteria, as shown in Table 1. Studies that focused on the following: benefits, roles, advantages, and challenges were eligible for inclusion. Exclusion criteria were also applied to maintain the focus and rigour of the review as well.

Table 1. Inclusion and Exclusion Criteria

SN	Inclusion	Exclusion	
1	Any study that highlighted benefits, roles, advantages and disadvantages or challenges	Studies were excluded if it did not meet the inclusion criteria mentioned above, were duplicates, or were not accessible in full-text format.	
2	Studies from 2015 - 2023		
3	Published in peer-reviewed journals		
4	Available in English		

C. *Search strategy and databases used*

A comprehensive search strategy was developed to identify relevant studies. Electronic databases, including Academia, Google Scholar, Science Direct, Research Gate, and Emerald Insight (see Figure 2), were searched using a combination of relevant keywords such as (technology trends OR (information technology trends)), and then (benefits OR (roles OR (advantages AND (disadvantages)). The search was limited to articles published from 2015 to 2023 to ensure the inclusion of recent research.

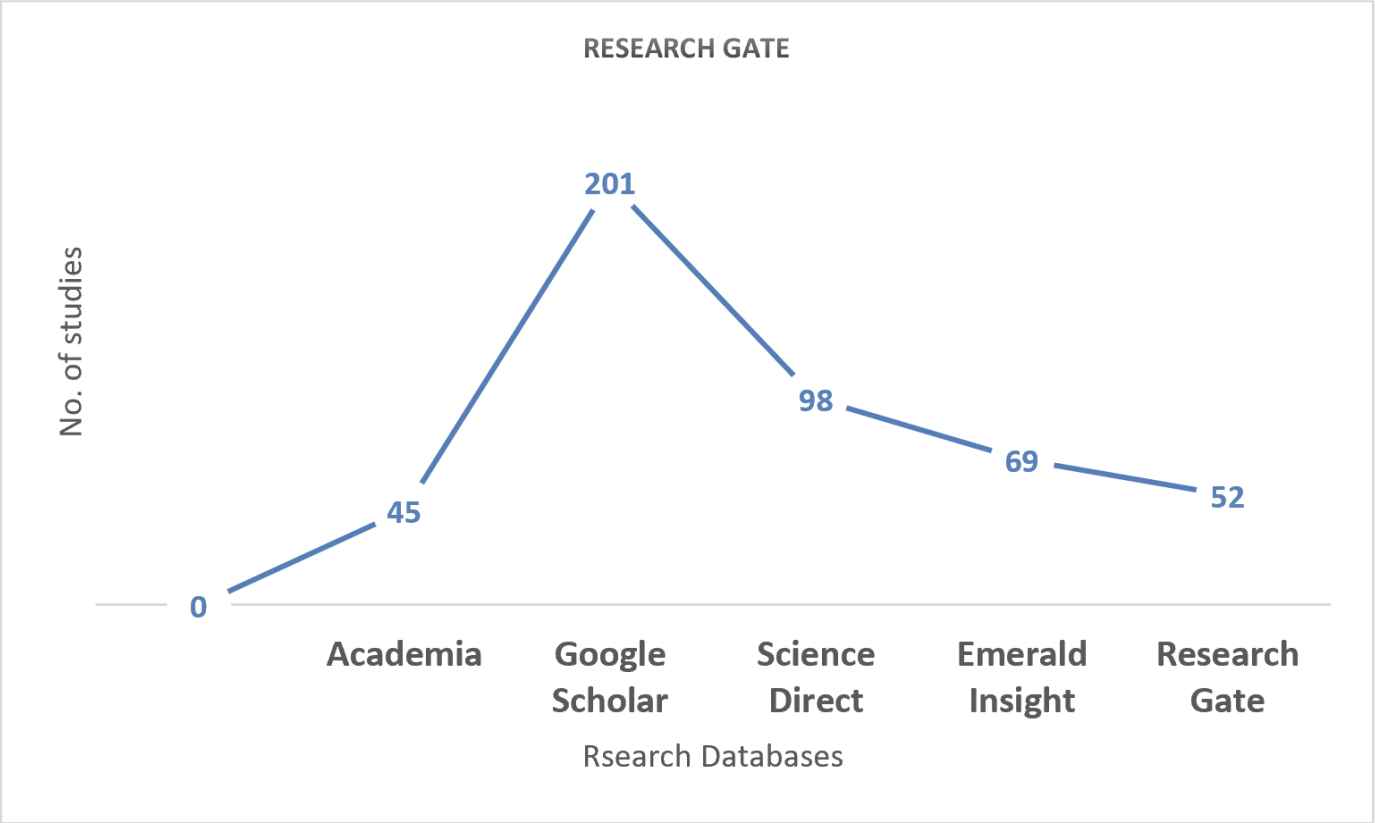

Figure 2. Distribution of study samples

D. *Data extraction and analysis procedures*

Data extraction was conducted systematically to gather relevant information from the 45 selected studies. Information extracted included author(s), year of publication, study design, sample characteristics, technology trends, or information technology trends, and then benefits, roles, advantages, disadvantages examined, outcomes measured, and key findings. After data extraction, a narrative synthesis approach was utilised to analyse and summarise the findings. Themes and patterns across the studies were identified and organised to provide a comprehensive overview of the impact of social media on mental health outcomes in Nigeria.

Discussion and Findings

Education is only one of several sectors that artificial intelligence (AI) is revolutionising. The development of computer systems with artificial intelligence (AI) can carry out activities that would ordinarily need human intelligence (Smith, & Johnson, 2021). AI has the potential to improve educational processes, automate administrative work, and offer students individualised help (Smith, 2021). The creation of intelligent tutoring systems is one of the key uses of AI in education. These programmes analyse student performance, spot areas of weakness, and offer tailored advice using AI algorithms (Brown & Williams, 2022). AI-powered instructors can assist students in better understanding difficult subjects by adjusting to its specific learning styles and rates (Zhang & Chen, 2018). AI is used to build online learning environments (Smith &

Johnson, 2021). These settings offer students an immersive learning experience by simulating real-world situations. For instance, before joining a real-life situation, medical students can practice surgical operations in a virtual operating theatre, giving them the opportunity to develop practical skills. AI can also completely change the evaluation process. Traditional tests and evaluations may take a lot of time and be subjective. Assessment tools with AI capabilities can automate grading, producing quicker and more precise findings. This gives educators more time to concentrate on other facets of teaching and learning.

Use Cases of AI in Tertiary Institutions

AI technologies are being increasingly used in tertiary institutions to improve various aspects of education. These include personalized learning, where AI algorithms analyze student information to tailor educational resources and content to individual needs, enhancing learning results. Intelligent virtual assistants, powered by chatbots, provide immediate assistance to staff and students, freeing up resources and boosting productivity. Predictive analytics can help institutions forecast student success and identify at-risk students, enhancing retention rates. AI can also be used to design smarter campuses, focusing on energy use, security, and overall campus experience. Smart sensors and data analytics can help monitor and manage buildings, leading to cost reductions and a greener environment. Overall, AI is revolutionizing the education sector.

Potential Benefits and Challenges of AI Integration

AI in education offers numerous benefits, including personalized learning experiences, increased student engagement, and automation of administrative tasks. It can also enhance evaluation procedures, reducing teacher workload and providing quick feedback (Smith & Johnson, 2021). However, there are concerns about potential biases in AI systems, which could unintentionally reinforce existing disparities (Brown & Williams, 2022). To mitigate these, AI systems should be created and trained using inclusive datasets. As AI becomes more prevalent, large amounts of data are gathered and examined, and data privacy and security must be prioritized. However, educators may oppose AI adoption due to concerns about AI replacing human teachers. On the other hand, AI is intended to complement human expertise, not replace it. Collaboration between AI systems and teachers can improve teaching and learning quality (Brown & Williams, 2022). In conclusion, AI can transform teaching and learning by providing personalised assistance, streamlining administrative tasks, and enhancing evaluation procedures. To ensure ethical use, it is crucial to address issues of prejudice, data privacy, and resistance. Cloud computing, or the transmission of computing services via the internet, allows users to access and store data, applications, and resources from a distance (Ahmad & Waheed, 2015; Ali & Osmanaj, 2020; Li, & Wong, 2022). This technology allows users, including tertiary institutions, to access resources and services without significant hardware or software investments.

Benefits of Cloud Computing in Tertiary Institutions

In tertiary institutions, cloud computing has many advantages, including affordability, scalability, accessibility, data

security, and communication. It does away with the need for significant hardware and infrastructure investments on-site, allowing organisations to simply pay for the resources it really utilise (Li, & Wong, 2022). Cloud services support remote learning and productivity by allowing for fluctuating workloads, such as during busy times or research projects, and may be accessible from any device with an internet connection (Ali & Osmanaj, 2020; Li, & Wong, 2022) Cloud service companies prioritise data security by utilising strong encryption, firewalls, and regular backups. Students and instructors may collaborate in real-time, regardless of where both are physically located, thanks to cloud-based collaboration technologies (Harper et al., 2018). Collaboration, creativity, and knowledge exchange are all boosted by features like document sharing, video conferencing, and collaborative editing (Li, & Wong, 2022). In general, cloud computing benefits tertiary institutions greatly, boosting its administrative, teaching, learning, and research activities.

Examples of cloud-based services for education

Cloud-based learning management systems (LMS) like Moodle, Canvas, and Blackboard offer various tools for course management, material distribution, assessment, and communication. These systems enable teachers to design engaging online courses, monitor student development, and foster collaboration (Ali & Osmanaj, 2020). Cloud storage services like Google Drive, Dropbox, and Microsoft OneDrive provide secure storage and access to files and documents. Virtual lab settings provide hands-on learning opportunities across various scientific subjects, eliminating the need for expensive lab equipment (Ali, 2020). Video conferencing platforms like Zoom, Microsoft Teams, and Google Meet enable remote communication and collaboration. Cloud computing powers research and data analytics, providing researchers with robust data processing capabilities. Platforms like Amazon Web Services (AWS) and Google Cloud Platform (GCP) offer scalable computing resources and data storage (Delavari & Janssen, 2020; Kumar et al., 2016).

The Internet of Things (IoT) is a system of connected physical objects that collect and share data through network connectivity, software, and sensors (Abdulsalam et al., 2017; Zhuang, 2021). IoT aims to build a smart, connected society where gadgets can communicate, share knowledge, and automate processes, increasing productivity, convenience, and efficiency (Huang, 2021). Businesses and individuals can make informed decisions, enhance operational procedures, and develop innovative solutions using IoT's power.

Applications of IoT in Tertiary Institutions

The Internet of Things (IoT) has the potential to revolutionize various aspects of tertiary institutions, including teaching, research, campus administration, and student services (Zhu et al., 2022). It can create a smart campus environment, improve learning opportunities, strengthen campus safety, and optimise facilities management (Zhang, 2021). Smart lighting systems can save energy and maximise resource utilisation, while IoT-enabled surveillance, access control, and emergency response systems can spot irregularities and send real-time alerts (Zhuang, 2021). IoT-enabled wearables can track faculty and staff health (Suryawanshia & Narkhedeb, 2015). Additionally, IoT can improve campus facility efficiency by monitoring temperature, humidity, air quality, energy use, and repair needs.

Advantages of IoT Implementation

The implementation of IoT in tertiary institutions offers numerous benefits, including enhanced efficiency, better decision-making, an improved student experience, and cost savings (Zhuang, 2021). IoT automates operations, optimises resource allocation, and optimises processes, leading to increased productivity (Aslanpour et al., 2020). It also provides valuable information for infrastructure management, resource allocation, and student involvement (Pourghebleh & Navimipour, 2017). Additionally, IoT creates an immersive learning environment that encourages student involvement, teamwork, and academic success. However, careful consideration is needed to ensure the benefits outweigh the costs.

Considerations of IoT Implementation

IoT implementation in tertiary institutions requires robust security measures to protect sensitive data and ensure privacy (Bolhasani et al., 2021). Scalability and compatibility are crucial for easy integration and future growth (Zhuang, 2021). Effective data management and analysis methodologies are necessary to handle the vast amounts of data generated by IoT devices (Abdulsalam et al., 2017). Adequate training and support mechanisms are also necessary for employees and students to effectively use IoT systems. IoT has the potential to transform tertiary institutions by increasing student experiences, optimizing resource allocation, and boosting decision-making (Lin, 2022; Pourghebleh & Navimipour, 2017; Zhuang, 2021). However, security, scalability, data management, and training must be carefully considered for successful implementation.

Data analytics is a vital tool in contemporary education, particularly in academic institutions. It allows institutions to gather insightful information and make decisions that benefit staff, students, and overall operations (Johnson, Davis, & Thompson, 2023). By analysing student performance data, institutions can identify areas of difficulty and adjust teaching strategies, ensuring the curriculum is up-to-date and meets the changing demands of the labour market and students.

Use cases of big data in education

Big data has revolutionised education by enabling real-time monitoring of student progress, identifying trends, and improving personalised learning experiences. It also enables predictive analytics, forecasting graduation rates and academic outcomes. Institutions can create predictive models based on past data on student performance, demographics, and socioeconomic characteristics, enabling early support and intervention to improve student outcomes. Additionally, big data analytics provide insights into enrollment patterns, student demographics, teacher productivity, and resource distribution, benefiting decision-making, policy development, and strategic planning in various aspects of education.

Challenges and ethical considerations of data analytics

Data analytics in education holds immense potential, but it also presents challenges and ethical questions. These include data security and privacy, which require robust safeguards to prevent unauthorized access, breaches, or abuse of sensitive information. Institutions must regularly evaluate algorithms and models to ensure fairness and reduce biases, as

improper deployment can reinforce prejudice and discrimination (Brown, & Wilson, 2024). Institutions must obtain informed consent before collecting and analyzing student and faculty data, and be transparent about the goals, scope, and potential effects of data analytics (Turner, & Johnson, 2019). Funding training and development initiatives can enhance data literacy among faculty and staff (Brown, & Wilson, 2024).

Cybersecurity is a crucial component of educational institutions, as it ensures the confidentiality, integrity, and availability of data and upholds reputation and confidence in communities (Brown & Williams, 2022). Cybersecurity measures protect intellectual property, such as patents, copyrights, and trade secrets, from unauthorised access, theft, or misuse (Operations et al., 2020; Truong et al., 2020). In conclusion, big data and data analytics are essential tools in higher institutions, with significant potential for enhancing student achievement, curriculum development, and resource allocation.

Common Cybersecurity Threats and Vulnerabilities

Tertiary institutions must deal with a variety of cybersecurity dangers, such as phishing scams, malware infections, insider threats, and network flaws. Phishing attempts use phoney emails or websites to deceive people into disclosing private information (Brown & Williams, 2022). Infections with malware have the ability to steal data, corrupt systems, or demand ransom payments to decrypt files (Operations et al., 2020). Insider attacks, such as those from employees, instructors, or students, constitute a serious threat to cybersecurity and can result in serious harm. Institutions are vulnerable to denial-of-service attacks, unauthorised access, and data breaches due to network weaknesses (Johnson, & Davis, 2022). In order to safeguard its operations and systems, tertiary institutions must address these vulnerabilities.

Strategies to Enhance Cybersecurity in Educational Institutions

To improve cybersecurity in educational institutions, it is essential to provide comprehensive cybersecurity training to all employees, including faculty and staff, on topics like phishing schemes, strong passwords, and data protection best practices. Implementing strong network security measures like firewalls, intrusion detection systems, and secure Wi-Fi networks can protect against network vulnerabilities and prevent unauthorized access. Regular vulnerability assessments and penetration testing can identify weak points and vulnerabilities in the institution's systems, enabling preventative action (Truong et al., 2020). Access controls based on least privilege and encryption of sensitive data can guard against unauthorised access and data breaches. In the event of a cybersecurity incident, thorough incident response and business continuity strategies are developed. Cybersecurity is crucial for safeguarding intellectual property, maintaining confidence, and protecting sensitive data. The digital world has also transformed with the advent of VR (Johnson & Davis, 2018) and AR, combining digital content with the physical environment (Luke & Kevin, 2021; Wang & Liu, 2021).

Applications of VR and AR in tertiary education

The integration of VR and AR in tertiary education has significantly transformed the learning process (Johnson & Davis, 2018). VR allows students to practice difficult skills in a secure setting, while AR enhances the physical learning environment by adding context and additional information (Wang & Liu, 2021). AR apps allow students to explore virtual

artifacts, landscapes, and historical sites, providing interactive explanations of scientific concepts and historical events, improving its grasp and memory of the material.

Potential benefits and limitations of VR and AR integration

Integrating VR and AR technologies into tertiary education can enhance student involvement, make learning more dynamic, and improve memory. These technologies can accommodate various learning styles, offering an inclusive educational environment (Johnson, & Davis, 2018). It can also close the knowledge gap between theory and application, providing students with practical insights and critical skills. However, the cost of deploying these technologies, including VR headsets, AR glasses, and software development, is a major hurdle for educational institutions (Wang, & Liu, 2021). Additionally, technical constraints and compatibility problems can be challenging to overcome. Despite these challenges, VR and AR technologies have the potential to revolutionize tertiary education by providing immersive and engaging learning experiences (Artiningsih & Wilujeng, 2021). As these technologies continue to evolve, there are limitless opportunities to improve education and open up a new era of learning for students worldwide.

Conclusion

This review explores the significant IT trends affecting the tertiary education sector, including the development of artificial intelligence (AI), cybersecurity, big data and analytics, mobile technology, cloud computing, and virtual and augmented reality (VR/AR). AI has the potential to transform education by enabling individualised instruction and computerised administrative procedures. Cybersecurity is crucial in a digital society, requiring effective safeguards to protect private information and maintain educational system reliability. Big data and analytics can inform decisions, improve student outcomes, and enhance the educational process. Mobile technology is becoming increasingly important, necessitating the adoption of mobile-friendly content distribution, communication, and collaboration strategies. Cloud computing offers scalable and affordable options for collaboration, processing, and storage. Virtual and augmented reality (VR/AR) offers opportunities for improving learning, immersive simulations, and enriching the learning environment. Keeping up with IT trends is crucial for academic institutions, as the way education is provided, accessed, and experienced by students is fundamentally changing. Incorporating IT trends into tertiary education can boost student engagement, enhance learning results, and encourage creativity. It enables organizations to design dynamic learning environments that cater to various learning preferences and prepare students for the digital age.

Recommendations for further review on IT in education

The review of IT in education is promising, with technology playing a crucial role in revolutionizing tertiary education. AI will enable personalized learning, addressing student needs and providing focused assistance. Cybersecurity measures will become more important as institutions address growing threats. Big data and analytics will enable data-driven decisions to maximize student success. Mobile technology will enable easy access to learning resources and

collaboration across borders. Cloud computing will serve as the foundation for IT infrastructure, offering scalable solutions for organisations of all sizes. Immersive simulations and virtual and augmented reality will revolutionise the learning experience, providing students with practical insights and new learning horizons. To remain effective in the digital age, institutions must embrace IT trends in tertiary education, embracing new opportunities for teaching, learning, and cooperation.

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