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Navigating Digital Transformation in Nigerian Engineering Education

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ABSTRACT : *This study examines the integration of Digital technologies in engineering education in Nigeria, highlighting the historical context, current practices, and potential advancements. Historically, Nigerian engineering education lagged behind other disciplines, and contemporary curricula have seen limited updates to incorporate modern technological advances, leading to a skills mismatch in the job market. The study emphasizes the importance of integrating digital tools to enhance entrepreneurship, safety, and sustainability in engineering education. Key digital technologies identified include CAD software, simulation software, VR/AR, 3D printing, IoT, and various programming tools. The research utilized a quantitative survey at the University of Nigeria Nsukka, achieving an 86.3% response rate from students and lecturers. Results indicated high integration of mobile applications, CAD tools, and online resources, while tools like LMS and simulation software showed lower adoption levels. The findings suggest targeted faculty training, improved resource allocation, and curriculum development support as strategies to enhance technology integration. The study concludes that while there are areas needing improvement, the proactive adoption of certain digital technologies demonstrates a readiness to evolve, providing students with essential skills for a digitally-driven engineering landscape.*

KEYWORDS: *Curriculum Development, Digital Technologies Integration, Engineering Education, Learning*

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I. INTRODUCTION

Up until the middle of the 19th century, engineering education in Nigeria had been neglected compared to other subjects of study [1]. However as time has passed on, there appears to be a decline in the quality of engineering education in Nigeria, which worries the industry greatly, resulting in a mismatch between what graduates can achieve and the skills demanded by the job markets [2]. This prompts a request for enhancement of the current traditional course delivery approaches in order to satisfy the demands of the labor market [1]. As a result of engineering advancements, the world has witnessed the development of vast information technology, innovative technological concepts, and developmental initiatives over time. In Nigeria, there have been no significant changes to the curriculum, delivery method, or attitude of engineering education in the same period of time. Notwithstanding these obstacles, some Nigerians continue to maintain that the system is not as flawed because some engineering students continue to achieve some degree of success while working or pursuing higher education, both domestically and abroad [1].

To address these gaps, integrating entrepreneurship, safety, and sustainability into engineering education is critical. Engineers can make valuable contributions in business and market contexts by acquiring skills in product design, prototyping, technology trends, and market analysis through entrepreneurship education [3]. Students with entrepreneurial training who join established firms are better equipped to become effective team members and managers and can better support their employers as innovators. These skills are just as relevant for success in established enterprises as they are in startups [4].

It is important that safety education adopts a new strategy that incorporates the intricate subject of initialization [5]. The choices an Engineer makes with respect to design are more and more being influenced by social, environmental, and techno-economic factors [6]. In its 1987 report titled Our Common Future, the U.N. World Commission on Environment and Development addressed these concerns in its definition of sustainable development as meeting the needs of the present without compromising the ability of future generations to meet their own needs [7]. For both students and working professionals, determining the fundamental concepts that characterize sustainable engineering competency will be instructive for establishing the future course of process and product design [8].

The role of digital technologies in this transformation cannot be overstated. These technologies impact and reshape all aspects of social and economic activity. When applied, they can interfere with current activities in some situations or have a more gradual effect and enhance them in others [9]. They complement current jobs and technology in some situations, but they also replace them in others. They occasionally lead to the development of fresh ventures, services, inventions, and commercial prospects. A surge of invention has been spurred by the ability to digitally mimic the analog world [9]. Numerous digital technologies are reshaping engineering education, offering tools to bridge the gap between theoretical learning and practical application. Computer-Aided Design (CAD) software, such as AutoCAD, SolidWorks, Fusion 360, and CATIA, enables students to create and modify detailed 2D and 3D designs of objects, buildings, and systems [10]. Simulation software like MATLAB, ANSYS, COMSOL, and Simulink allows learners to conduct virtual experiments, analyze system behavior, and simulate real-world scenarios [9]. Virtual Reality (VR) and Augmented Reality (AR) technologies, including tools like Oculus Rift, HTC Vive, and Microsoft HoloLens, provide immersive experiences that help students visualize and interact with complex engineering concepts [11]. Hands-on learning is further enhanced by 3D printing and rapid prototyping, which let students transform digital designs into physical models [12].

For data-driven decision-making, tools like Excel, MATLAB, Tableau, and Python libraries (e.g., NumPy, Pandas) are widely used to analyze and visualize engineering data [13]. The Internet of Things (IoT), through sensors, actuators, and connectivity, supports the creation of smart systems and real-time data collection [14]. Programming languages such as Python, MATLAB, Java, C++, and JavaScript, along with Integrated Development Environments (IDEs) like PyCharm, MATLAB IDE, Eclipse, and Visual Studio, form the backbone of coding and software development in engineering curricula [15]. Online learning platforms and Learning Management Systems (LMS), including Moodle, Canvas, and Blackboard, streamline course delivery, resource sharing, and student-instructor interaction [16]. Collaborative tools like Google Drive, Microsoft OneDrive, and Dropbox enable real-time teamwork on documents and projects [17], while cloud computing services such as AWS, Microsoft Azure, and Google Cloud Platform provide scalable infrastructure for storage, computation, and application hosting [18].

Emerging fields like robotics and automation leverage platforms such as Arduino, Raspberry Pi, and LEGO Mindstorms to teach students how to build and program robots [19]. Open Educational Resources (OER)—including Khan Academy, MIT Open Course Ware, Coursera, and edX—expand access to supplementary lectures and courses for self-directed learning [20]. These technologies collectively span industries from manufacturing and agriculture to healthcare, driving innovation across sectors [9].

The transformative potential of digital tools has sparked significant academic and public discourse. Their disruptive implications include new business models, product types, customer experiences, and organizational structures [9]. For businesses and employees to adapt, they may need to overhaul existing practices or embrace incremental changes that eventually lead to profound shifts. For instance, the ability to programmatically replicate human tasks reshapes the skills and roles available in the workforce [21]. As skill demands evolve globally—rendering some obsolete and creating new ones—educational systems must prioritize agility to prepare learners for an unpredictable digital landscape [21].

Additionally, educators, education counselors, and education planners in Nigeria have been advocating more and more for the use of digital technology in classrooms [22]. This is so because the utilization of digital technology has been considered as an effective medium in contributing towards the advancement of education. Students at universities are using digital technology in ways that are increasingly praiseworthy of their learning experience. There is no denying that the information and communication technology (ICT) revolution has given students the simplest way to access educational resources for their studies [23]. These days, it's not unusual to see students searching the internet for resources for their research projects, lectures, and assignments [22]. Because of the indispensable nature of digital technology, its use in Nigerian universities has grown in popularity. For example, the majority of universities now have electronic libraries, and more lecturers and students have access to a variety of computer hardware and devices that allow them to search the web for educational resources [24].

Integrating digital technologies into engineering education offers transformative benefits, equipping students with the skills and knowledge necessary to thrive in the modern workforce. These tools foster proficiency in entrepreneurship, safety, and sustainability while preparing learners for dynamic professional environments. One key advantage is improved skill development. Digital tools like CAD software, 3D printing, and simulation platforms enable students to master essential technical skills in design, prototyping, and analysis [25]. Interactive simulations and virtual environments further cultivate problem-solving abilities by immersing students in realistic, complex engineering scenarios [26]. Additionally, project-based learning using digital collaboration tools—such as online platforms and shared documents—enhances communication and teamwork skills, critical for interdisciplinary projects [27].

Digital technologies also enhance learning experiences by making education more immersive and adaptable. Tools like 3D modeling, augmented reality (AR), and virtual reality (VR) provide interactive visualizations that deepen understanding of abstract or intricate concepts [28]. Online courses and digital resources offer flexibility in learning styles and schedules, allowing students to progress at their own pace [6]. Simulations and case studies incorporating real-world data further bridge the gap between theoretical knowledge and practical application, ensuring students are prepared for on-the-job challenges [29]. These technologies also increase access and engagement in engineering education. Remote learning opportunities, facilitated by digital tools, expand access for geographically dispersed students [28]. Gamification strategies—integrating game mechanics into learning modules—boost motivation and engagement by making the learning process more interactive and enjoyable [30]. Personalized learning paths, enabled by digital platforms, cater to individual student needs and learning styles, fostering more effective outcomes [28].

Finally, digital integration prepares students for the future workforce. Graduates with proficiency in industry-standard software and digital literacy gain a competitive edge in employability [31]. Exposure to evolving technologies cultivates adaptability and innovation, empowering students to drive advancements in engineering [26]. Collaborative tools also instill a teamwork mindset, enabling students to work effectively in diverse teams—a necessity for modern engineering projects [32]. Collectively, these benefits ensure graduates are not only technically adept but also agile, collaborative, and ready to address global challenges in entrepreneurship, safety, and sustainability. The integration of digital technologies offers a wealth of benefits for engineering education. By developing essential skills, enhancing learning experiences, increasing accessibility, and preparing students for the future workforce, these technologies are transforming the way engineers are educated. This study seeks to analyze the extent of adoption of these digital technologies in Engineering Education in Nigeria and recommend future directions that will improve the integration of these technologies in the engineering educational system.

II.. METHODOLOGY

A quantitative survey was designed for this research due to its effectiveness in gathering data on specific skills and perceptions from a large number of participants. Close-ended questionnaires were utilized, offering standardized response options that facilitate data analysis and comparison. The targeted respondents for this study consisted of students and working professionals in the Faculty of Engineering, University of Nigeria Nsukka. The response rate for the survey was 302 out of 350 distributed questionnaires (86.3%). The questionnaire was meticulously developed to gather reliable data on the various digital technologies perceived to be of importance in Engineering Education. The instrument was designed to be user-friendly and completed within approximately 10 minutes. The first page of the questionnaire provided an informed consent statement explaining the purpose of the study, the voluntary nature of participation, and the option to withdraw at any stage. It also emphasized the anonymity of the respondents' identities. Questions were carefully crafted to ensure clearness and avoid revealing any personal information. The questionnaire was split into two sections. The first section focused on collecting demographic information of the respondents. The second section addressed the core objective of the study, which was to ascertain the level of integration of various digital technologies into engineering education.

Based on a thorough review of existing literature, a list of 11 essential digital technologies was compiled. The questionnaire presented these digital technologies to respondents using a clear and concise format. Data collection was facilitated through Google Forms. The questionnaire link was distributed via email invitations to the pre-selected sample of construction professionals. To ensure data security and participant anonymity, Google Forms' built-in security measures were utilized. These measures included encryption of data transfer, secure storage of responses, and prevention of unauthorized access. Additionally, the questionnaire design avoided collecting any personally identifiable information from the respondents. Data analysis employed descriptive statistics. Descriptive statistics, such as frequencies and percentages, were used to summarize the demographic data of the respondents.

For analyzing the integration level of the digital technologies, a 5-point Likert scale was employed within the questionnaire. This scale ranged from 1 (Not Used) to 5 (Very Extensively Used), allowing respondents to rate their level of agreement with statements regarding the extent of adoption of each technology in Engineering Education. Two key metrics were derived from the Likert scale responses: Mean Item Score (MIS) and Relative Importance Index (RII). The MIS represents the average rating for technology, providing an overall picture of its level of integration. The RII, calculated using a specific formula, helps to rank the technologies based on their level of adoption as shown in Table 1 below.

III. RESULTS AND DISCUSSION

This section presents the findings on the level of digital technology adoption in Engineering Education in Nigeria and discusses their implications.

A. Ranking of Digital Technologies

Table 1 displays the ranking of 11 digital technologies based on the Relative Importance Index (RII), calculated by averaging the mean rating for each technology. Mobile applications (DT-5) received the highest RII (3.619), indicating their extensive use in engineering education. This is likely due to the ubiquity of smartphones and their diverse functionalities, including accessing online resources, communication, and potentially using discipline-specific engineering apps. Following Mobile Applications were Computer-aided design (CAD) tools (DT-10), Programming languages (DT-6), and Online Resources (DT-11), all with RIIs exceeding 0.628, signifying a high level of integration in the curriculum.

Table 1: Ranking of Use of Digital Technologies According to Relative Importance Index

Code	Description	Mean Rating	R11	RANK
DT -5	Mobile Applications: apps like chrome, google, LinkedIn, brave, kiwi browser, WhatsApp, Facebook, Pinterest etc.	3.619	0.724	1
DT -10	Computer-aided design (CAD) tools: Examples; AutoCAD, Fusion 360, integrated CAD, CAM, and CAE platform.	3.546	0.709	2
DT -11	Online Resources and Open Educational Resources (OER): Platforms like Khan Academy, MIT OpenCourseware, Coursera, and edX provide video lectures and tutorials	3.430	0.686	3
DT -6	Programming languages and development environment: Python, MATLAB, and Java etc.	3.189	0.638	4
DT -9	Data analysis and visualization tools; they include tools like; Microsoft Excel, Tableau, and MATLAB	2.745	0.549	5
DT -4	Collaborative Tools: Tools like Google Drive, Microsoft OneDrive, and Dropbox facilitate collaborative work among students and instructors.	2.642	0.528	6
DT -7	Augmented reality (AR) or virtual reality (VR) applications; Tools like Oculus Rift, HTC Vive etc.	2.606	0.521	7
DT -8	Internet of Things (IoT) devices; Examples of IoT platforms include Microsoft Azure IoT, AWS IoT Core, and Google Cloud IoT Core.	2.573	0.515	8
DT-2	Simulation software like MATLA, and ANSYS, 2D and 3D models	2.493	0.499	9
DT -3	3D modeling software; Popular 3D printing technologies	2.288	0.458	10
DT-1	Online learning management systems like Moodle, Canvas, and Blackboard	2.182	0.436	11

A. Levels of Integration

Based on the RII scores and as shown in Fig.1., the technologies were categorized into three levels of integration thus:

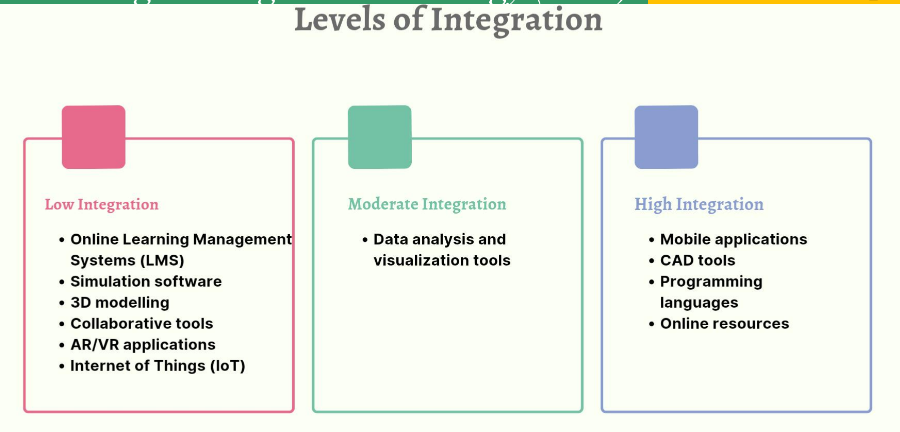

Fig. 1. Levels of integration of digital technologies in engineering education

Low Integration (RII < 0.532): This category includes technologies like Online Learning Management Systems (LMS) (DT-1), Simulation Software (DT-2), 3D Modeling (DT-3), Collaborative Tools (DT-4), AR or VR applications (DT-7), and Internet of things (DT-8). While these technologies offer significant benefits, their relatively low RII suggests a need for exploring reasons behind their limited use.

Moderate Integration (0.532 < RII < 0.628): Data Analysis and Visualization Tools (DT-9) fall into this category, indicating a somewhat inconsistent adoption pattern. Further investigation is needed to understand the factors influencing the use of these tools in some courses but not others.

High Integration (RII > 0.628): Technologies in this category, like Mobile Applications (DT-5), Programming Languages (DT-6), CAD Tools (DT-10), and Online Resources (DT-11), are widely used within the engineering program. This highlights the faculty's openness to incorporating digital tools that enhance specific aspects of engineering education.

The findings reveal a varied landscape of digital technology integration within the engineering program at Nigerian institutions. The results show a stratified integration pattern where some technologies are strongly adopted while others are not presenting the opportunities and challenges associated with integrating digital technologies in engineering education. The high integration of mobile applications, CAD tools, programming languages, and online resources demonstrates the faculty's willingness to leverage these technologies for communication, design, problem-solving, and accessing supplementary learning materials, aligning with global trends in digital education.

However, the low integration of online learning management systems, simulation software, 3D modelling, collaborative tools, AR/VR, and IoT indicate the existence of barriers limiting their full integration. Previous studies have shown inadequate infrastructure, resistance to change, and inadequate training as critical blockers to the digital transformation in higher education [34]. The low RII scores shown by the use of simulation software and AR/VR applications point to lack of access to advanced digital technologies, which can be instrumental in experiential learning and practical demonstrations [35]. Also, the low utilization of learning management systems could be due to a lack of institutional regulations towards digital course management or a general preference for conventional lecture delivery methods [36]. Furthermore, the moderate application of data analysis and visualization tools indicate inconsistent use cases across various courses and institutions. Further research might explore if this is due to variations in course content or a lack of awareness of available tools among some faculty members.

To promote a more comprehensive and effective integration of digital technologies, several strategic recommendations are proposed. First, implementing targeted faculty training through workshops and professional development programs can empower educators with the technical skills and confidence to incorporate digital tools into their teaching methodologies. Second, resource allocation toward upgrading technology infrastructure, including specialized software, hardware, and reliable internet access—can address existing limitations and incentivize broader adoption of digital solutions. Third, providing curriculum development support, such as instructional design guidance or peer collaboration frameworks, will assist faculty in seamlessly integrating these technologies into existing courses or creating new ones centered on specific tools [37]. By prioritizing these strategies, engineering programs can bridge the gap between theoretical potential and practical implementation, fostering a dynamic, technology-driven learning environment. This approach ensures graduates are equipped with the critical digital competencies required to excel in an increasingly digitized engineering landscape.

IV. CONCLUSION

This study highlights the varying levels of digital technology integration in the engineering education program at the University of Nigeria Nsukka. The high integration of mobile applications, CAD tools, programming languages, and online resources reflects a proactive approach by the faculty to enhance communication, design, and problem-solving skills among students. However, the low integration of essential technologies like LMS, simulation software, and 3D modeling indicates areas requiring significant improvement. Addressing these gaps can involve targeted faculty training to boost confidence and competency in using digital tools, better resource allocation to ensure access to necessary technology infrastructure, and curriculum development support to seamlessly incorporate these technologies into teaching methodologies. By implementing these strategies, the engineering program can achieve a more balanced and comprehensive integration of digital technologies, equipping students with the skills required to thrive in a digitally driven engineering landscape. This effort not only enhances educational outcomes but also prepares graduates to meet the evolving demands of the engineering profession.

Future research with a larger sample size encompassing multiple universities can provide a more comprehensive understanding of technology adoption practices. Also, further research exploring successful implementation models and best practices for integrating specific technologies within engineering curricula can offer valuable insights for other institutions.

REFERENCES

[1].Oloyede, A. A., Ajimotokan, H. A., & Faruk, N. (2018). Embracing the future of engineering education in Nigeria: Teaching and learning challenges. Nigerian Journal of Technology, 36(4), 991. https://doi.org/10.4314/njt.v36i4.1
[2].Igbokwe, N. C., Godwin, H. C., & U-Dominic, C. M. (2019). Engineering Education in Nigeria for Engineering Graduates: Issues and Strategies. Journal of Scientific Research and Reports, 22(2), 1–10. https://doi.org/10.9734/JSRR/2019/29895
[3].Holzmann, P., Hartlieb, E., & Roth, M. (2018). From Engineer to Entrepreneur - Entrepreneurship Education for Engineering Students: The Case of the Entrepreneurial Campus Villach. International Journal of Engineering Pedagogy (iJEP), 8(3), 28–39. https://doi.org/10.3991/ijep.v8i3.7942
[4].10 Business Skills Every Professional Needs | HBS Online. (2019, May 23). Business Insights Blog. https://online.hbs.edu/blog/post/business-skills-every-professional-needs
[5].Gajek, A., Fabiano, B., Laurent, A., & Jensen, N. (2022). Process safety education of future employee 4.0 in Industry 4.0. Journal of Loss Prevention in the Process Industries, 75, 104691. https://doi.org/10.1016/j.jlp.2021.104691
[6].Ottosson, H. (2021). Considering Social Impact when Engineering for Global Development. Theses and Dissertations. https://scholarsarchive.byu.edu/etd/9158
[7].Sustainability | United Nations. (n.d.). Retrieved June 24, 2024, from https://www.un.org/en/academic-impact/sustainability
[8].Seay, J. R. (2015). Education for sustainability: Developing a taxonomy of the key principles for sustainable process and product design. Computers & Chemical Engineering, 81, 147–152. https://doi.org/10.1016/j.compchemeng.2015.03.010
[9].Ciarli, T., Kenney, M., Massini, S., & Piscitello, L. (2021). Digital technologies, innovation, and skills: Emerging trajectories and challenges. Research Policy, 50(7), 104289. https://doi.org/10.1016/j.respol.2021.104289
[10].Advantages of Computer-Aided Design | Drexel CCI. (n.d.). Retrieved June 24, 2024, from https://drexel.edu/cci/stories/advantages-and-disadvantages-of-cad/
[11].Childs, E., Mohammad, F., Stevens, L., Burbelo, H., Awoke, A., Rewkowski, N., & Manocha, D. (2023). An Overview of Enhancing Distance Learning Through Emerging Augmented and Virtual Reality Technologies. IEEE Transactions on Visualization and Computer Graphics, 1–15. https://doi.org/10.1109/TVCG.2023.3264577
[12].Novak, E., Brannon, M., Librea-Carden, M. R., & Haas, A. L. (n.d.). A systematic review of empirical research on learning with 3D printing technology. https://doi.org/10.1111/jcal.12585
[13].Nandi, D. G., & Sharma, D. R. K. (2020). Data Science Fundamentals and Practical Approaches: Understand Why Data Science Is the Next. BPB Publications.
[14].Sathish & Smys, S. (2020). A Survey on Internet of Things (IoT) based Smart Systems. Journal of ISMAC, 2(4), 181–189. https://doi.org/10.36548/jismac.2020.4.001
[15].Fonseca, I., Martins, N. C., & Lopes, F. (2023). A web-based platform and a methodology to teach programming languages in electrical engineering education – evolution and student feedback. 2023 32nd Annual Conference of the European Association for Education in Electrical and Information Engineering (EAEEIE), 1–3. https://doi.org/10.23919/EAEEIE55804.2023.10181316
[16].Tai, M. (n.d.). Understanding Faculty Use of Learning Management Systems in U.S. Higher Education [University

of Massachusetts Amherst]. https://doi.org/10.7275/36000001
[17].Castro-Arquinigo, M. F., Janjachi-Nieto, N. S., Peña-Flores, E. J., Alvaro-Enrriquez, J. A., Huamanchahua, D., Escobar-Baquerizo, S., & Valcarcel-Castillo, H. (2023). Collaborative Tools for Project Management: A Technological Review. 2023 IEEE Colombian Caribbean Conference (C3), 1–6. https://doi.org/10.1109/C358072.2023.10436211
[18].Kaushik, P., Rao, A. M., Singh, D. P., Vashisht, S., & Gupta, S. (2021). Cloud Computing and Comparison based on Service and Performance between Amazon AWS, Microsoft Azure, and Google Cloud. 2021 International Conference on Technological Advancements and Innovations (ICTAI), 268–273. https://doi.org/10.1109/ICTAI53825.2021.9673425
[19].Evripidou, S., Georgiou, K., Doitsidis, L., Amanatiadis, A. A., Zinonos, Z., & Chatzichristofis, S. A. (2020). Educational Robotics: Platforms, Competitions and Expected Learning Outcomes. IEEE Access, 8, 219534–219562. https://doi.org/10.1109/ACCESS.2020.3042555
[20].Zhao, Y., Liu, Y., & Wang, R. (2023). A Study on Improving Continuing Education in Scientific Organizations through Information Technology. International Journal for Infonomics, 16(1), 2152–2163. https://doi.org/10.20533/iji.1742.4712.2023.0226
[21].Harborth, D., & Kümpers, K. (2022). Intelligence augmentation: Rethinking the future of work by leveraging human performance and abilities. Virtual Reality, 26(3), 849–870. https://doi.org/10.1007/s10055-021-00590-7
[22].Effiom, B., A., F., Ekwok, M., Ntamu, B., Petters, J., Mbua, A., & Idika, D. (2023). The Educational Imperative of Guidance and Counselling on Information and Communication Technology (ICT), Usage on Students' Academic Performance in University of Nigeria. 10, 5029–5042.
[23].Effiom, B., Amuchi, G., Ojedor, F., Ebuka, G., & Ubi, G. (2023). Impact Of Information and Communication Technology (ICT), Usage on Students' Academic Performance in University of Nigeria Nsukka Enugu State. International Journal of Information Systems and Informatics, 4, 43–53. https://doi.org/10.47747/ijisi.v4i1.1109
[24].Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. Sustainable Operations and Computers, 3, 275–285. https://doi.org/10.1016/j.susoc.2022.05.004
[25].Design & Engineering | Autodesk. (n.d.). Retrieved June 24, 2024, from https://www.autodesk.com/industry/manufacturing/design-and-engineering
[26].Yilmaz, N., & Bae, H. D. (2020, November 7). Integration of Digital Tools for Engineering Design, Analysis and Optimization. 2020 Fall ASEE Mid-Atlantic Section Meeting. https://peer.asee.org/integration-of-digital-tools-for-engineering-design-analysis-and-optimization
[27].Al-Busaidi, S., & Al Seyabi, F. (2021). Project-based Learning as a Tool for Student-Teachers' Professional Development: A Study in an Omani EFL Teacher Education Program. International Journal of Learning, Teaching and Educational Research, 20, 116–136. https://doi.org/10.26803/ijlter.20.4.7
[28].Shin, I.-S., & Go, E. (2022). Understanding the Effectiveness of Online Engineering Education in the Time of COVID-19. 2022 ASEE Annual Conference & Exposition Proceedings, 40627. https://doi.org/10.18260/1-2--40627
[29].Lehtinen, E. (2023). Can simulations help higher education in training professional skills? Learning and Instruction, 86, 101772. https://doi.org/10.1016/j.learninstruc.2023.101772
[30].Díaz-Ramírez, J. (2020). Gamification in engineering education – An empirical assessment on learning and game performance. Heliyon, 6(9), e04972. https://doi.org/10.1016/j.heliyon.2020.e04972
[31].NSPE Advocacy: Hard and Soft Skills | National Society of Professional Engineers. (n.d.). Retrieved June 24, 2024, from https://www.nspe.org/resources/pe-magazine/january-2016/nspe-advocacy-hard-and-soft-skills
[32].Online Collaboration Tool & Coordination Software • Asana. (n.d.). Retrieved June 24, 2024, from https://asana.com/uses/team-collaborationm
[33].A.-L. Cirneanu and C.-E. Moldoveanu, "Use of digital technology in integrated mathematics education," Appl. Syst. Innov., vol. 7, no. 4, p. 66, 2024. Available: https://doi.org/10.3390/asi7040066
[34].A. Singun, "Unveiling the barriers to digital transformation in higher education institutions: a systematic literature review," Discov. Educ., vol. 4, p. 37, 2025. Available: https://doi.org/10.1007/s44217-025-00430-9
[35].K. Okoye, H. Hussein, A. Arrona-Palacios, et al., "Impact of digital technologies upon teaching and learning in higher education in Latin America: an outlook on the reach, barriers, and bottlenecks," Educ. Inf. Technol., vol. 28, pp. 2291–2360, 2023. Available: https://doi.org/10.1007/s10639-022-11214-1
[36].N. Fadip, G. Ukala, and N. Ibezim, "Exploring the use of learning management system for instructional delivery during the COVID-19 pandemic: A case of University of Nigeria, Nsukka," J. Educ. Technol. Syst., vol. 9, pp. 159–167, 2023.
[37].C. C. Thelma, Z. H. Sain, D. L. Mpolomoka, W. M. Akpan, and M. Davy, "Curriculum design for the digital age: Strategies for effective technology integration in higher education," Int. J. Res., vol. 11, no. 7, pp. 85–201, 2024. Available: https://doi.org/10.5281/zenodo.13123899