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Transforming engineering education through entrepreneurship and safety for sustainability: The University of Nigeria's Case Study

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Abstract

This study investigates the integration of digital technologies within engineering education at the University of Nigeria, Nsukka (UNN), focusing on their role in fostering entrepreneurship, enhancing safety practices, and promoting sustainability. Employing a quantitative research approach, data was collected through electronically administered questionnaires via Google Forms from 302 engineering lecturers and students. The questionnaire utilized a fixed, short, and precise multiple-choice format, with respondents rating variables on a 5-point Likert scale to assess their perceptions regarding the significance of digital technologies in these domains. Descriptive statistics, including frequency, percentage, and ranking, were employed to analyze the collected data, providing insights into the perceived requirements, benefits, lack of digital training as the worst of the challenges, and adequate digital training was identified as the most needed solutions to the challenges associated with the adoption of digital technologies in UNN's engineering education for entrepreneurship and safety towards sustainability. The findings of this study offer valuable empirical evidence on the current state and potential of digital technology integration in shaping a more entrepreneurial, safety-conscious, and sustainable engineering education landscape at the University of Nigeria, Nsukka.

Keywords: Engineering Education; Entrepreneurship; Safety; Sustainability; University of Nigeria

1. Introduction

Our world is evolving, and so should engineering education. Just recently, our conversations have shifted from Industry 4.0 to Industry 5.0. Broo et al. (2022) refer to this rapid evolution as the convergence of everything and digital technologies, which requires a complete change in how we teach engineering education to meet the needs of the next thirty years. Raeng (2016) notes that Engineering education has long been recognized as a key driver of economic growth, innovation, and social development. However, as the world becomes increasingly digitized and interconnected, engineering graduates need to be equipped with not only technical skills but also the ability to apply these skills in a rapidly changing environment (Broo et al. 2022). In particular, the integration of digital technology in engineering education has the potential to foster entrepreneurship and safety for sustainable development in the engineering profession (Onyia et al. 2025).

The University of Nigeria Nsukka is a federal university in Enugu State, Nigeria. Well known as UNN, it was founded in 1955 by Dr. Nnamdi Azikiwe, the Governor General of Nigeria from 1960 to 1963 and first President of Nigeria from 1963 to 1966, but was formally inaugurated in 1960. UNN operates 102 academic departments across 15 faculties and offers 82 undergraduate programs and 211 postgraduate programs for a student population of over 36,000. It does so across four campuses: Nsukka; Enugu campus (UNEC); University of Nigeria Teaching Hospital (UNTH), in Ituku-Ozalla; and the University of Nigeria Aba Campus (UNAC). Guskov et al. (2018) rated the university as a leader in international collaboration and impactful projects. According to Okafor et al. (2023), the University of Nigeria is one of the leading universities in Nigeria, with a strong reputation for engineering education. However, there is a growing need to enhance

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the quality of engineering education to meet the demands of a changing world (Broo et al. 2022). This paper aims to investigate the benefits and challenges of integrating digital technologies for entrepreneurship and safety in engineering education.

2. Literature review

2.1. Overview of Engineering Education in Nigeria

As a result of the importance and technicality of engineering education, the study of any engineering degree in Nigeria is structured for five years, with the first year spent studying general sciences (Adekitan and Salau, 2019).

To become a fully qualified engineer, a graduate of any Engineering degree must practice for a minimum of four years, among other requirements, before becoming a registered engineer with the Council for the Regulation of Engineering in Nigeria (COREN, 2018). Oloyede et al. (2017) recounted that the standard of engineering education in Nigeria is of major concern, especially to the industries, as it seems the standard is falling in recent times as against the early independence years. Thus, creates a disconnect between the skills required by the industry and what is obtainable by the graduates (Zeidan and Bishnoi, 2020). This leads to the call for improvement of the existing classical course delivery methods toward meeting the labour market needs.

2.2. Integrating Digital Technologies for Entrepreneurship in Engineering Education

The concept of modern society is driven by innovative ventures of businesses for economic growth anchored by entrepreneurship. Entrepreneurship plays an increasingly important role in knowledge-based economic development. Hence the global calls by governments for the introduction of entrepreneurial courses across universities around the world (Silva et al. 2015). Hence, technical skills are no longer sufficient for engineers, entrepreneurial culture is needed to enable them to contribute in the context of market and business pressures so as to have social and personal gratification (Nelson and Byers 2010). After a review of 78 publications on entrepreneurship in engineering education, Da Silva et al. (2015) define entrepreneurship as individual accomplishment for social and economic sufficiency, which benefits a community. This aligns with the responsibilities of sustainable engineering as highlighted by Allenby and Rajan (2012). Interestingly, Lopez-Cruz (2022) has attempted to address the modern confusion associated with the definitions of engineering by presenting engineering as an application of science, field of study, profession, and above all, as human activities and a process of creation, design, development, maintenance, and application of things for society. But not just any "thing" in the universe, but those that do not exist in the natural state, hence made by human-mind conception and human-labour action. It can then be argued that the engineering process is entrepreneurial. Hence, engineering education is deficient without an entrepreneurial mindset.

As Jones and English (2004) note, entrepreneurship education teaches engineering students in all disciplines the knowledge, tools, and attitudes that are required to identify opportunities and bring them to life. Students who take part in entrepreneurship programs as undergraduates gain insights not available from traditional engineering education, such as understanding and designing for end users (empathy), working in and managing interdisciplinary teams, communicating effectively, thinking critically, understanding business basics, and solving open-ended problems. These entrepreneurial skills are just as relevant for success in establishing enterprises as they are in start-ups; students with entrepreneurial training who join established firms are better prepared to become effective team members and managers and can better support their employers as innovators (Larionova et al. 2023).

2.3. Integrating Digital Technologies for Safety in Engineering Education

The definition of engineering by Lopez-Cruz (2022) as human driven processes that deal with creative design, construction or manufacturing, development, deployment, maintenance, improvement, operation, and control of engineered systems that aim to transform in a "conscious manner" an existent situation/environment into the desired one is interesting. This implies that engineering should be practiced in "a safety conscious manner" towards the society, environment, and economy**.** Attention is needed for the safety-conscious manner of both human processes and should be facilitated by digitalization. Meyer et al. (2019) emphasized that process safety education should undergo a paradigm change to include the complex subject of digitalization. Fabiano (2017) indicated that special attention is on new challenges and related safety and security elements as plant complexity and economic pressures are increasing, and technological innovations and societal changes are emerging. In this last regard, education is an impediment affecting process safety performance, recalling the importance of a joint effort among academia, industry, and authorities.

The main goal of education in the field of safety - or any other field - is to equip the student with skills to work safely in industrial companies or government institutions. That is, to provide theoretical knowledge and practical skills which the student will be able to use as an employee. During their education, academic students must develop adequate integrated competencies in terms of knowledge, skills, and attitudes that can be applied in an industrial context of possible employment

2.4. Sustainability Principles in Engineering Education

The design choices for engineers are being influenced by economic, social, and environmental concerns, as such are traditionally sustainable in principles. In its 1987 report titled *Our Common Future*, the U.N. World Commission on Environment and Development, commonly called the Brundtland Commission, addressed these concerns in its definition of sustainable development, as follows:

“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland, 1987)

However, fully incorporating sustainable principles in engineering education remains a challenge to the academic community (Davidson et al., 2010). Additionally, because of the ambiguity in defining the term sustainable engineering, there is little consensus in the education community as to how it should be taught (Allenby et al., 2009). Furthermore, there is now a clear consensus as to what educational outcomes define professional competency in sustainable engineering. The key principles that define competency in sustainable engineering will help in establishing the future direction for students and practicing professionals. These principles are anchored as conscious manners toward economic, environmental, and social safety (Lopez-Cruz, 2022).

2.5. Challenges to Integrating Digital Technologies for Entrepreneurship and Safety in Engineering Education.

- Budget Limitations: By far, the greatest factor limiting the efforts of teachers and administrators to provide entrepreneurial and safety training to students using technology is budget cuts and limitations. Walsh (2023) said that Budget limitations are especially challenging to overcome because great education tech tools don’t come cheap.
- Lack of Professional Training: Entrepreneurship in today's economy cannot exist without technology, as highlighted by Da Silva et al. (2022). To meet the challenges of this shift in traditional engineering education, professional training is needed to get the desired effects out of the instructors.
- Poor Network Infrastructure: There is a connection between entrepreneurship and the internet of things. Thus, Mahto et al. (2018) established that this link can pose a challenge when not effectively maintained.
- Resistance to Change: Many teachers have demonstrated a culture of resistance to change and unwillingness to adopt education technology, especially with entrepreneurial and safety as highlighted by Rigler Jr. (2015). This includes adjustment to policy and system changes.

2.6. Barriers to Integrating Digital Technologies for Entrepreneurship and Safety in Engineering Education

Shirley and Flores (2018) categorize the barriers as;

- Lack of Visionary Leadership: The head of the institution should take the initiative for integrating entrepreneurship and safety using technology.
- Lack of Professional development: In many schools, teachers feel unprepared to learn and integrate entrepreneurship and safety using digital technologies in their classrooms. When a teacher finds a specific technology to be overwhelming or frightening, he or she is unlikely to incorporate it into the curriculum. When teachers have not had training in specific technologies or do not have the time to discover the features themselves, it can prevent digital technology integration into the curriculum.
- Resistance to change culture: Some teachers refuse to change from the old methods of teaching. Using digital technology in the classroom can be initially demanding. Also, teachers and schools give so many excuses for not using technology, like not having enough computers, not getting enough technical training, then other teachers argue that the process of learning technology and how to integrate it in education take too much time, then their others, who feel that technology might replace them, so instead of losing their jobs and old methodology of teaching, they refuse to use technology in education.
- New Technology Takes Time to Learn: Most of the technological tools schools invest in require training. Teachers are busy already and are understandably wary of adding one more thing to their schedule.
- Lack of funds: To successfully incorporate entrepreneurship and safety into engineering education using digital technologies requires a large amount of money. Money to hire specialists, purchase the newest and most up-to-date computers, and the latest hardware/software to train personnel and keep computers working are limited.

- Lack of Infrastructure: Often, the most common factor is the lack of hardware and software necessary to make true technology integration attainable. Many classrooms suffer from too few computers, slow computers, slow or limited internet connectivity, broken hardware, or incorrect software. A lack of appropriate hardware and software makes technology integration extremely difficult but still doable. EdTech tools are expensive, and resources are scarce.
- Lack of Innovation: Applying entrepreneurship and safety through technological tools requires a certain degree of creativity. Some people learn easily without expert help, while others will take a while to master. The most challenging thing about entrepreneurship, safety, and digital technologies is that you do not stop at learning how it works and how to use it. But you must also find ways of integrating them into your daily operations.
- Lack of time: Teachers do not find enough time to learn, innovate, and recreate, which are essential to entrepreneurship, safety, and the use of digital technologies. To make the required pedagogical shifts and capture their practice into the curriculum. Successfully incorporating beneficial technology for these courses requires a large amount of time for production and preparation.
- Internet Safety: Training students to be aware of the safety issues of the internet world would be necessary. Cyber bullies, paedophiles, scams, and identity theft are major issues when introducing students to the web.

3. Methodology

This study adopted a quantitative research approach to gather data. 302 questionnaires were distributed among Engineering lecturers and students at UNN to collect information regarding the integration of digital technologies in engineering education for entrepreneurship and safety at the University of Nigeria, Nsukka (UNN). The questions in the questionnaire were designed to be fixed, short, precise, and easy to comprehend, with each section having over 9 to 12 multiple-choice questions. Respondents utilized a 5-point LIKERT scale to rate variables, offering a numerical representation of their perspectives. The LIKERT scale had 1 denoting Strongly Disagree, 2 - Disagree, 3 - Neutral, 4 - Agree, 5 - Strongly Agree, thus enabling the researcher to measure their perception about the significance of the issues under consideration. The questionnaire was administered electronically through the use of a Google Forms questionnaire with a target of over 300 respondents.

The information gathered from the survey underwent examination through the application of descriptive statistics, which serves as a fundamental technique in quantitative research. Descriptive statistics enabled the concise presentation and condensation of the gathered data, encompassing a range of metrics like frequency, percentage, and ranking. The frequency and percentage distributions unveiled the prevalence of specific responses, while rankings provided insights into the relative significance of various variables. The use of descriptive statistics, including frequency, percentage, and ranking, facilitated a quantitative exploration of the required technology, its associated benefits, the obstacles encountered, and potential solutions. Subsequent chapters will uncover the empirical findings, offering a deeper understanding of the subtleties and significance of the quantitative analysis conducted in this study.

4. Results and Discussions

Table 1 Analysis of background information

S/N	Gender	Frequency	Percentage
1	Male	248	82.1%
2	Female	53	17.5%
3	Prefer not say	1	0.3%
	Total	302	100

From Table 1 above, it can be deduced that 68.23% of the respondents were male, 17.5% of the respondents were female, while 0.3% of the respondents preferred not to say. This implies that the Faculty of Engineering, UNN is significantly dominated by men, which reaffirms the scanty engagement of Nigerian women in engineering.

Table 2 Distribution of Respondents According to Age

S/N	Age(years)	Frequency	Percentage
1	16-20	50	16.6
2	21-25	170	53.3
3	26-30	67	22.2
4	31-35	9	3
5	36-40	4	1.3
6	41-45	1	0.3
7	46-50	0	0
8	51-55	1	0.3
9	56 and above	0	
	Total	302	100

From the Table 2 above, 16.6% of the respondents were between 16-20 years, 53.3% were 21-25 years, 22.2% were between 26-30 years, 3% were between 31-35 years, 1.3% were between 36-40 years, then 0.3% were between 51-55years and nobody is at the range of 56 years and above. These data terms prove that the respondents were young academics significantly below the age of 30.

Table 3 Distribution of Respondents According to their Role in the Institution

S/N	Role	Frequency	Percentage
1	Students	289	95.7
2	Lecturer	11	3.6
3	Prefer not say	2	0.7
	Total	302	100

From Table 3, 95.7% respondents were students, while 3.6% were lecturers and 0.7% preferred not to say. These findings validate the significance of this study as the majority of respondents (students) are the beneficiaries of integrating digital technologies for entrepreneurship and safety in engineering education.

Table 4 Distribution of Respondents According to the Engineering department are you officiating

S/N	DEPARTMENT	Frequency	Percentage%
1	Civil Engineering	80	26.5
2	Mechanical Engineering	35	11.6
3	Electrical Engineering	34	11.3
4	Computer Engineering	10	3.3
5	Agric and Bioresource Engineering	25	8.3
6	Metallurgical and Material Engineering	41	13.6
7	Electronics Engineering	40	11.6
8	Biomedical Engineering	15	5
9	Mechatronics Engineering	22	7.3
10	Total	302	100

From the Table 4, 26.5% of the respondents were from civil Engineering, 11.6% of the respondents were from Mechanical Engineering, 11.3% of the respondents were from electrical engineering department, 3.3% of the respondents were from computer engineering department, 8.3% of the respondents were from Agric and Bioresource Engineering department, 13.6% of the respondents were from Metallurgical and Material Engineering department, 11.6% of the respondents were from Electronics Engineering department, 5% of the respondents were from Biomedical Engineering department and 7.3% of the respondents were from Mechatronics Engineering department. From the above information Civil Engineering proves to have the highest respondents.

The Likert five-point scale was employed to explore the respondents' opinions about the questions posed in the study, where "1" represents strongly disagree, "2" represents disagree, "3" represents neutral, "4" represents agree, and "5" represents strongly agree.

Table 5 The Benefit of Integrating Digital Technologies for Entrepreneurship in Engineering Education at the University of Nigeria Nsukka

S/N	DESCRIPTION	1	2	3	4	5	TOTAL	R11	RANK
		SD	D	N	A	SA			
BT-1	Real-World Entrepreneurial Experience	15	41	52	141	56	302	0.773	7
BT-2	Prototyping and Product Development	15	22	104	104	57	302	0.682	9
BT-3	Exposure to entrepreneurial mindset	14	31	27	189	41	302	0.900	2
BT-4	Collaborative and Project-Based Learning	12	17	38	122	113	302	0.736	8
BT-5	enhance technical skills	9	23	29	211	31	302	0.918	1
BT-6	Business Modelling and Planning	14	15	43	165	65	302	0.816	3
BT-7	Access to Entrepreneurial Resources	19	27	61	134	61	302	0.772	6
BT-8	Access to Funding and Investors	34	18	118	95	37	302	0.624	10
BT-9	Access Collaborative Tools	6	19	57	144	76	302	0.774	5
BT-10	Access to entrepreneurial resources	12	20	54	177	39	302	0.810	4

In Table 5, the outcomes of the inquiry regarding the advantages of integrating digital technologies for entrepreneurship in engineering education at UNN are as follows: Firstly, the most significant benefit, with an RII value of 0.918, is the enhancement of technical skills. Secondly, exposure to an entrepreneurial mindset is the second most valuable advantage, with an RII value of 0.900. Lastly, in third place, we have Business Modelling and Planning, with an RII value of 0.816. These rankings collectively suggest that integrating digital technology into entrepreneurship education in engineering will enable students to develop technical skills, cultivate an entrepreneurial mindset, and gain proficiency in modeling, planning, operating, and managing business projects. This aligns with Goli and Babu (2024). This is critical as these benefits drive entrepreneurship and can be facilitated through the integration of digital technologies. The other benefits, ranked from 4th to 10th, with RII values ranging from 0.810 to 0.624, also contribute to the advantages of integrating digital technology into entrepreneurship education for engineering students; however, they are not as prominent as these top three benefits.

The Likert five-point scale was employed to explore the respondents' opinions about the questions posed in the study, where "1" represents strongly disagree, "2" represents disagree, "3" represents neutral, "4" represents agree, and "5" represents strongly agree.

In Table 6 below, concerning the inquiry into the advantages of integrating digital technology into safety-focused engineering education at the University of Nigeria Nsukka, respondents were presented with nine variables. According to the feedback received, Safety documentation and reporting claimed the top position with an RII value of 0.840. This indicates that a majority of the respondents either agreed or strongly agreed that safety documentation and reporting can be facilitated by integrating digital technologies in Engineering education at UNN. Schroth and Hody (2020) discussed the impact of digital technologies on safety documentation and management, the respondents think its impact is most beneficial.

Table 6 The Benefits of Integrating Digital Technology in Engineering Education for Safety at the University of Nigeria Nsukka

S/N	DESCRIPTION	1	2	3	4	5	TOTAL	R11	RANK
		SD	D	N	A	SA			
BS-1	Remote Safety Inspections and Audits	58	52	56	51	85	302	0.788	5
BS-2	Continuous Learning and Updates	9	17	30	183	56	302	0.794	3
BS-3	To ensure Training in Safety Standards and Regulations	16	26	33	185	42	302	0.768	8
BS-4	Risk Analysis and Hazard Identification	11	30	28	204	29	302	0.830	2
BS-5	Hazard Visualization and Analysis	11	19	58	136	78	302	0.790	4
BS-6	For Virtual Simulations	13	49	50	157	35	302	0.770	6
BS-7	Remote Monitoring and Control	26	88	45	77	66	302	0.743	9
BS-8	Data-driven Safety Practices	10	49	50	167	26	302	0.742	10
BS-9	Safety documentation and reporting	76	48	43	57	78	302	0.840	1

In the second spot, Risk Analysis and Hazard Identification held sway with an RII value of 0.830. Respondents expressed agreement or strong agreement regarding the potential of digital technology integration in engineering education to contribute to risk analysis and hazard identification within the university environment and other relevant contexts. On the other hand, Remote Monitoring and Control, as well as Data-driven Safety Practices, were ranked lowest among the various variables, with RII values of 0.743 and 0.742, respectively. In this regard, respondents disagreed or strongly disagreed that these aspects had a paramount impact on engineering education at UNN.

The Likert five-point scale was employed to explore the respondents' opinions about the questions posed in the study, where "1" represents strongly disagree, "2" represents disagree, "3" represents neutral, "4" represents agree, and "5" represents strongly agree.

Table 7, The Benefit of Integrating Digital Technology in Engineering Education for Sustainability at the University of Nigeria Nsukka

S/N	DESCRIPTION	1	2	3	4	5	TOTAL	R11	RANK
		SD	D	N	A	SA			
BS-1	Providing Sustainable Design and Engineering services	13	41	49	110	89	302	0.754	10
BS-2	Ensuring a Renewable Energy Systems	79	18	31	134	40	302	0.832	2
BS-3	Giving adequate Environmental Modelling and Analysis	9	74	56	64	99	302	0.794	9
BS-4	propagating Data-driven Sustainability Decisions	11	14	64	177	32	302	0.814	6
BS-5	Ensuring Waste Management and Recycling	9	34	70	150	39	302	0.795	8
BS-6	Ensuring Energy Management and Efficiency	14	22	61	130	75	302	0.816	5
BS-7	Maintaining Sustainable Infrastructure and Smart Systems	7	21	30	158	86	302	0.833	1
BS-8	Giving Room to Collaboration and Networking	8	18	37	160	79	302	0.826	4
BS-9	Ensuring adequate Environmental Monitoring and Reporting	10	13	70	173	36	302	0.828	3
BS-10	Promoting Online Resources and Open Educational Materials	26	24	40	134	78	302	0.800	7

From Table 7, concerning the inquiry into the advantages of integrating digital technology into engineering education for sustainability at UNN, we observed the following rankings:

Leading the way with an RII value of 0.833 was the aspect of Maintaining Sustainable Infrastructure and Smart Systems.

In the second position, with an RII value of 0.832, was the focus on Ensuring Renewable Energy Systems.

Securing the third spot, with an RII value of 0.828, was the emphasis on Adequate Environmental Monitoring and Reporting.

The rankings of these three statements signify that the incorporation of digital technology empowers engineering students to design and maintain sustainable structures that can withstand the test of time. Additionally, these digital tools contribute to ensuring that engineering students maintain an organized and well-maintained environment. While the remaining variables, ranked from 4th to 10th, with RII values ranging from 0.826 to 0.754, also hold significance, they do not match the significance of the top three.

The Likert five-point scale was employed to explore the respondents' opinions about the questions posed in the study, where "1" represents strongly disagree, "2" represents disagree, "3" represents neutral, "4" represents agree, and "5" represents strongly agree.

Table 8 Challenges That May Affect the Integrating Digital Technology in Engineering Education for Entrepreneurship, Safety, And Sustainability at The University of Nigeria Nsukka

S/N	DESCRIPTION	1	2	3	4	5	TOTAL	R11	RANK
		SD	D	N	A	SA			
CH-1	Budget Limitations	7	22	22	150	101	302	0.714	13
CH-2	Maintenance and support	9	23	27	59	184	302	0.834	2
CH-3	Poor Infrastructure	46	20	45	82	109	302	0.674	15
CH-4	Resistance to Change	37	11	72	43	139	302	0.738	12
CH-5	No Systems in Place to Utilize Technology in Curriculum	10	39	60	166	27	302	0.790	7
CH-6	Lack of Professional Training	10	13	27	143	199	302	0.854	1
CH-7	Technological obsolescence	8	13	64	53	164	302	0.814	5
CH-8	Faculty training and readiness	11	14	59	55	163	302	0.815	4
CH-9	Curriculum adaptation	6	13	72	139	74	302	0.788	8
CH-10	Administrators Don't See the Need for More Technology	8	17	40	175	63	302	0.822	3
CH-11	Connectivity and reliability	9	5	66	86	138	302	0.771	9
CH-12	Environmental impact	49	19	31	100	103	302	0.700	10
CH-13	Faculty workload and time	30	15	32	180	34	302	0.770	14
CH-14	Maintenance and support	40	24	41	63	136	302	0.750	11
CH-15	Digital literacy	23	26	26	45	163	302	0.808	6

In Table 8, concerning the obstacles that could potentially impede the integration of digital technology into engineering education for entrepreneurship, safety, and sustainability at the University of Nigeria Nsukka, we found the following rankings:

Topping the list was the challenge of Lack of Professional Training, with an RII value of 0.854.

Following closely in second place was the issue of Maintenance and Support, scoring an RII value of 0.834.

Securing the third position was the perception that Administrators Don't see the Need for More Technology, with an RII value of 0.822.

In the fourth spot, we have the challenge of Faculty Training and Readiness, registering an RII value of 0.815.

The rankings of these four aforementioned challenges indicate that survey respondents regarded them as the primary obstacles that require immediate attention and resolution. These findings align with the observations of Hitesh Patel in 2021. The remaining challenges were ranked from 5th to 15th, with RII values ranging from 0.814 to 0.674. While these lower-ranked challenges also contribute to the difficulties associated with integrating digital technology into engineering education, their impact is not as significant as the top four challenges mentioned earlier.

The Likert five-point scale was employed to explore the respondents' opinions about the questions posed in the study, where "1" represents strongly disagree, "2" represents disagree, "3" represents neutral, "4" represents agree, and "5" represents strongly agree.

Table 9, Mitigating the Challenges to Integrating Digital Technology in Engineering Education for Entrepreneurship, Safety, And Sustainability at The University of Nigeria Nsukka

S/N	DESCRIPTION	1	2	3	4	5	TOTAL	R11	RANK
		SD	D	N	A	SA			
CH-1	Learning analytics	6	10	18	96	172	302	0.840	6
CH-2	Robust Technological Infrastructure	7	21	42	58	174	302	0.860	5
CH-3	Collaborations with Industry:	6	13	28	76	179	302	0.868	3
CH-4	Financial Resources and Funding	6	7	13	87	188	302	0.890	2
CH-5	Curriculum Alignment	71	10	118	67	36	302	0.346	15
CH-6	Student Engagement and Support	56	8	115	82	41	302	0.394	14
CH-7	Research and Evaluation	37	9	106	95	55	302	0.436	13
CH-8	Partnerships with Educational Technology Providers:	5	11	112	60	114	302	0.768	8
CH-9	Policy and Supportive Leadership	5	14	24	95	164	302	0.832	7
CH-10	Blended learning model	8	5	53	58	179	302	0.861	4
CH-11	Sustainability initiative	5	13	36	105	143	302	0.764	9
CH-12	Grant and funding opportunities	39	12	20	54	177	302	0.504	12
CH-13	Faculty Development and Training	7	9	20	194	72	302	0.918	1
CH-14	Cloud-based solutions	7	49	47	117	82	302	0.648	10
CH-15	Open educational resources	44	18	33	136	71	302	0.580	11

Table 9, in response to the question, what mitigates the challenges of integrating digital technology in engineering education for entrepreneurship, safety, and sustainability in the University of Nigeria Nsukka? Ranked first was Faculty Development and Training with an RII value of 0.918; 266 out of 302 of the respondents agreed or strongly agreed with the statement. Ranked 2nd was Financial Resources and Funding with an RII value of 0.890; 275 out of 302 respondents agreed or strongly agreed with the statement. Ranked 3rd was Collaborations with Industry, with an RII value of 0.868, and 255 out of 302 of the respondents agreed or strongly agreed with the statement. The survey respondents considered these three solutions as critical factors needed to mitigate the challenges of integrating digital technology in engineering education, which works in accordance with Shirley and Flores's (2018) statement. The remaining statements ranked from 4th to 15th, and RII values ranged from 0.861 to 0.346. The survey respondents believed that there are solutions to the challenges of integrating digital technology in engineering education but not to compare to the previously mentioned three statements.

5. Conclusion

This quantitative study has provided a foundational understanding of the perceptions of engineering lecturers and students at the University of Nigeria, Nsukka (UNN), regarding the integration of digital technologies to transform engineering education for entrepreneurship, safety, and ultimately, sustainability. The descriptive statistical analysis of the survey data has illuminated the prevalence of required digital technology, the anticipated benefits, the existing obstacles hindering their adoption with lack of digital training as the worst of the challenges, and adequate digital training was identified as the most needed solutions to the challenges associated with the adoption of digital technologies in UNN's engineering education for entrepreneurship and safety towards sustainability. The frequency and percentage distributions have highlighted the common perspectives, while the rankings have indicated the relative importance of different aspects related to digital technology integration within the engineering curriculum in Nigerian universities.

The empirical findings, detailed in subsequent sections, offer a deeper and more nuanced understanding of the quantitative patterns identified in this study. These findings will be crucial in informing strategic decisions aimed at effectively leveraging digital technologies to cultivate an entrepreneurial mindset among engineering graduates, instill robust safety practices, and embed sustainability principles within their education. Ultimately, this research contributes to the growing body of knowledge on the transformative potential of digital technologies in higher education, specifically within the context of engineering in a developing nation like Nigeria. By understanding the perspectives and experiences of stakeholders at UNN, this study provides valuable insights from the academia for advocate groups, policymakers, educators, and administrators seeking to modernize engineering education and equip engineering students with the skills and knowledge necessary to contribute to a more entrepreneurial, safe, and sustainable future for Nigeria and beyond. Further research could explore the causal relationships between the identified variables and delve into qualitative perspectives to provide a richer understanding of the challenges and opportunities highlighted in this quantitative analysis.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

Statement of ethical approval

The study adhered to all research standard and ethics required of study of this nature, this study was approved by the Faculty of Engineering, University of Nigeria, Nsukka, Nigeria.

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