Analytic Approach for ICT Embedded in Technical Education

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ABSTRACT

The importance of Information and Communication Technology in driving the overall development of the global space is undeniable. Developed economies have been able to accelerate their growth and progress in this century through their advanced usage of technology. The integration of Information and Communication Technology tools has greatly enhanced research and educational development in these countries. However, Nigeria's Technical Education programme seems to be facing challenges in this aspect. Despite the nation's quest for technological advancement, it is evident that there is a need for improvement in this field to fully utilize the potential of Information and Communication Technology. The meta-analysis conducted on the journal articles regarding Information and Communication Technology adoption in technical education between 2012 and 2024 reveals that Nigeria and Africa are facing significant challenges in adopting this technology. The study, which was conducted using Google Scholar as the database, included 26 publications after applying the specified inclusion and exclusion criteria. The findings of the study suggest that most researchers tend to focus on review studies without providing any specific recommendations for improving the adoption of Information and Communication Technology tool in Technical Education. This highlights the need for further research and efforts to fully integrate this technology into technical education in Nigeria and Africa.

Keywords: ICT, Technical Education, Meta-analysis, Adoption, Employment.

BACKGROUND

The relevance of Information Communication Technology adoption in the programme of technical education has broadly been canvassed (Ramadan & Chen, 2018; Saripudin, Juanda, Abdullah, & Ana, 2020; Yaakob et al., 2020)(Hassan et al., 2021). It seems no particular study has focused on the ICT model for the sustenance of technical education especially, in Nigeria. The majority are either reviews or perceptions about its relevance to Vocational and Technical Education. Similarly, it seems most studies conducted on Information Telecommunication Technology are very broad and lack the specificity of the aspects that require adoption in a specific educational programme.

Consequently, this paper examines some of the methodological challenges faced in ICT adoption into Technical Education with a focus on its acceptance, and implementation strategies. A meta-analysis of the methods used in the published journal articles in the field of technical education was conducted to bring out the strengths, country of origin, and region of publication.

The Search String consisted of a peer-reviewed journal article published between 2012 and 2024. This gave an insight into the existing methods used in conducting research in ICT in Technical Education and the frequency by nations and regions to establish the need for the study on the **ICT Competence Model for Sustainable Development of Technical Education in Higher Institutions in Nigeria.** The consistency in the search and collection of sources for the review was achieved using the Google Scholar citation index services. The database allows for explicit search strings for selecting relevant publications from across large collections of subject areas as shown in the framework.

Keywords on the subject were carefully composed into search strings as shown in Table 1.

Table 1. Search strings

Main search: ICT
Sub search 1: ICT + Technical Education
Sub search 2: ICT + Vocational Education
Sub search 3 ICT + Technical and Vocational Education

METHODOLOGY

The purpose of this study is to assess the level of ICT tool adoption in technical education by countries and the methodology employed for the overall objective of conducting a general study in that captures the subject. This initial study involves a meta-analysis of the publications on relevant articles on ICT in Technical Education was conducted and analysed to bring out their strengths, weaknesses, methods, country of publication, and region. The process is shown in Figure 1.

Figure 1: ICT Competence Model in Technical Education Search Framework.
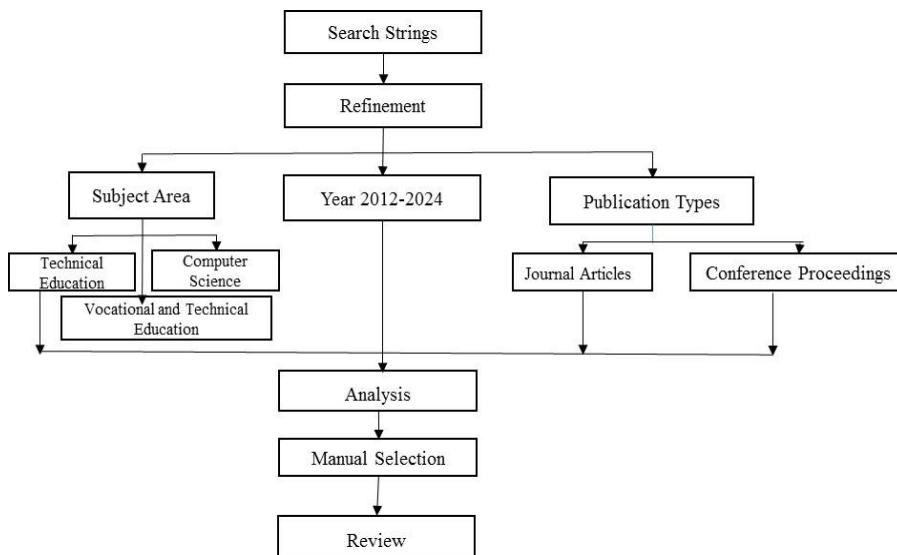
Source: Author.

A total of Nine Hundred and Fifty-one (951) articles were retrieved from the database based on the search conducted. The Google Scholar citation analytical tool was used for the analysis of the results of the search to reflect the publication by author, methodology, country of publication, and region of the world.

Inclusion and Exclusion

To reduce and and ensure that only the relevant review papers are available for the study, publications that met the following criteria were selected; (i) papers published between 2018 and 2024, (ii) papers on technical education, vocational and technical education, (iii) documents that are either journal articles or textbooks, (iv) papers that discusses ICT in Technical Education. Excluded from the list are articles in the press, publications not written in English, and those articles that have been published before the year 2018. The manual selection was critically done to filter those articles that did not align with the scope of the study based on their relevance to the topic, contents, and abstract. 26 publications were finally selected for the full-scale study. During the study, a meta-analysis table was formulated to capture the data on the principal author, year of publication, county, region, name of the journal, the title of publication, and the method used for analysis. The Meta-Analysis conducted on ICT embedded in Technical Education is shown in Table 2.

Table 2: Meta-Analysis for ICT Embedded in Technical Education.

S/No	Author/ Year	Journal	Paper Title	Strength	Methodology	Country	Region
1	(Jamil et al., 2023)	Journal of Technical Education and Training Vol. 15 No. 2 (2023) 1-10	Digital Pedagogy Policy in Technical and Vocational Education and Training (TVET) in Malaysia: Fuzzy Delphi Approach	The study agrees with the importance of technology in enhancing pedagogy in vocational and technical education.	Fuzzy Delphi Technique (FDT)	Malaysia	Asia
2	(Dumbiri & Nwadiani, 2020)	Asian Journal of Vocational Education and Humanities Vol 1 No 2	Challenges Facing Application of E-learning Facilities in Vocational and Technical Education Program in South Nigeria Universities	They observed the importance of e-learning in advancing the course of instructional delivery in TVET. It noted that there was an acute shortage of facilities in the instructional delivery of e-learning in TVET in Nigeria. Electronic learning, or simply put E-learning may be described as a technological mediation and Digital empowered learning that utilizes hardware (e.g. PCs, tablets, printers, digital cameras, digital videos, scanners, overhead projector), software (e.g. operating system, cloud technologies, applications, writing, Editing, Ms. Office), and CD textbooks that fall in the category of courseware, e-contents, USB drives, and CDROM, whether from a distance or face-to-face learning to empower teacher-to-student interaction.	Review	Malaysia	Asia.
3	(Som, 2021)	International Journal of Research, 7(1)	ICT In Education: Opportunities and Challenges	It is basically on the review of digital learning with an emphasis on the government policy on the "operation digital board" of the Government of India. This was a step forward against Operation Black Board.	Review	India	Asia
4.	(Rajarapollu et al., 2022)	Journal of Engineering Education Transformations, Volume No 35	ICT - A Tool to Enhance Teaching and Learning Activities in Technical Education	Digital technologies for both online and offline training are essential in this IR4.0 age to make sure that students are adequately equipped for the workforce. Students may access resources like Matlab and digital image monitoring on systems like Moodle, Canvas, Google Classroom Room, or Collpoll.	Review	India	Asia
5.	(Lazarević & Lukić, 2016)	Journal of Education and Practice 4(7)	The Impact of Information and Communication Technology (ICT) on Vocational and Technical Students' Learning	The focus was on the integration of ICT tools into TVET. The author emphasizes the importance of technology to the growth and teaching of TVET.	Review	Nigeria	Africa
6.	(Wahab et al., 2019)	Jurnal Kejuruteraan dan Sains Kesihatan Journal of Engineering and Health	Information And Communication Technologies In Technical (ICTS) And Vocational Education And Training (TVET) For Integration Toward Knowledge	Given the nature and complexity of the TVET sector in economics, industry, and human resource development, ICT is a widely acknowledged technology that must be completely incorporated into all areas of education,	Review	Malaysia	Asia.

		Sciences Jilid 5 2021	Management	particularly TVET including private or public sector.			
7.	(JASMINE, 2014)	INSC International Publishers	Disruptive Technology, Industry 4.0, Advances in Management, Information Technology, and Social Science	A comprehensive reading on the importance of ICT and its relevance	Review	USA	America
8.	(Camilus Bassey & Michael Ushie, 2013)	International Journal of Vocational and Technical Education	The role of ICT in skilled manpower development through vocational-technical education among higher institutions in Cross River State, Nigeria	ICT significantly contributed to the growth of skilled labor, particularly in the areas of involving vocational-technical students, producing skilled ICT professionals, and establishing ICT human infrastructures. Increased vocational technical instruction, quicker capacity building, and more computer literacy at Nigerian higher education institutions in Cross River State, among other things.	Quantitative study	Nigeria	Africa
9.	(Babalola et al., 2020)	International Journal of Scientific Research and Engineering Development– Volume3 Issue 1	Challenges of Effective Utilization of Information and Communication Technology (ICT) in Teaching and Learning of Vocational and Technical Education	The paper discusses the challenges of ICT to TVET; lack of competence, poor access to resources inadequate training and re-training in ICT, poor. Technical support from the government, erratic power supply, finances, and security. The paper concluded that An enabling environment, finances, and technical support should be provided for a smooth transition to ICT.	Quantitative study	Nigeria	Africa
10.	(Sylvester et al., 2019)	African Journal of Education and Practice, 4(1)	An Assessment of The Potential of ICT in Improving The Quality of Teaching and Learning of Kenya's Technical Education	The use of ICT in technical education is beneficial, as is the availability of reasonably priced infrastructure, training for teachers to help spread knowledge and skills, and raising awareness of the potential presented by ICT as a teaching tool for the technical The field of education is equally essential. Although ICT as a teaching tool is an asset, it does not. take the role of traditional instruction and practical, hands-on skills.	Quantitative study	Kenya	Africa
11	(Kattimani & Naik, 2012)	*DESIDOC Journal of Library & Information Technology*, Vol. 32, No. 6	E-Learning Technology in the ICT Era: Application to Technical Education	The following web formats are accessible: • Web Formats • Animations in 2D and 3D Interactive coding, voiceovers, video snippets, and an easily downloadable format The following video formats are available: • In-person classes • Tablet writing; • PowerPoint	Review	India	Asia

				presentations; • Chalk-and-talk • Interactive codes			
12.	(Shamim & Raihan, 2016)	International Journal of Vocational and Technical Education	Effectiveness of Using ICTs to Promote Teaching and learning in technical education: Case of Bangladesh	The research revealed that Integration of ICTs in the teaching and learning process will make teaching and learning very easy, Interesting, and time-saving than that of traditional way of teaching-learning.	Quantitative	Bangladesh	Asia
13.	(Rashevska & Kiianovska, 2023)	http://irbis-nbuv.gov.ua/ ASUA/006354 4	Improving blended learning in higher technical education institutions with mobile and cloud-based ICTs	Cloud-based information and communication technologies (ICTs) are very important in instructional delivery.	Document analysis	Ukraine	Europe
14	Rana Hammad Hassan, Malik Tahir Hassan, Sheraz Naseer, Zafran Khan, And Moongu Jeon (2012)	IEEE Access	ICT Enabled TVET Education: A Systematic Literature Review	The findings of this systematic literature review reveal that the integration of ICT technologies and their application across various components and functional areas of the TVET training cycle is notably low, especially in areas such as monitoring and evaluation, career guidance and job placement, trainee assessment, and teacher training. The TVET Technology index indicates that there is a significant need for greater emphasis on the adoption of IoT, Robotics, Data Science, Artificial Intelligence, cloud computing, and other similar technologies within all TVET training programs. Technologies associated with industrial revolutions 4.0 and 5.0, such as AI, robotics, cloud computing, big data, and IoT, should be incorporated throughout the entire TVET training cycle. 3. Latest ICT technology areas like Machine Learning, Simulation, Augmented Reality, Virtual Reality, Interactive Whiteboards, Video Conferencing3. The latest ICT technology domains such as Machine Learning, Simulation, Augmented Reality, Virtual Reality, Interactive Whiteboards, Video Conferencing, 3D Modeling, DevOps, Social Media, and Recommender Systems should be integrated into all TVET training programs. 4. There is a need for more industry-specific research within TVET to facilitate technology integration, ensuring the development of a skilled workforce that aligns with current market trends and requirements. 5. The ICT integration for	Systematic review	South Korea	Asia

				monitoring and evaluation, assessment, career guidance, and curriculum in TVET is essential.\ 6. At present, TVET training primarily relies on a conventional classroom setting. In today's world, virtual education and open learning are being implemented across various platforms such as COURSERA, Udemy, EdX, MIT OpenCourseWare, Microsoft Education, Oracle Education, and Intel Education. There is a need to embrace comparable approaches in TVET education to increase training, encourage information exchange, and build the capability of the skilled workforce. Since online and virtual training technologies are widely used in all educational sectors, particularly in the wake of the COVID-19 epidemic, it is imperative that these approaches be integrated and evaluated in TVET education as well.			
15	(Bello et al., 2013)	World Applied Sciences Journal 23 (2)	ICT Skills for Technical and Vocational Education Graduates' Employability	The paper highlights the challenges ahead of TVET with emphasis on textbooks conference papers journal articles and conference proceedings. Given how quickly ICT is evolving in the workplace and how sophisticated it is, as well as how it is used in all facets of economic activity, any human resource preparation program, such as TVE, needs to realign its curriculum. As a result, this challenges TVE programmes to have the ICT skills required for employment in the current dynamic workplace. It recommends the procedures for strengthening the TVET curriculum. ICT in TVET requires knowledge of the ICT revolution, globalization and sustainability, emergency knowledge of society, and quick obsolescence of knowledge.	Review	Malaysia	Asia
16	(Yaakob et al., 2020)	Universal Journal of Educational Research 8(6)	Backward and Forward Reviews on Technical and Vocational Education and Training (TVET) in Malaysia: The Evolution and ICT-Driven Future Prospect	It assesses the past and future of TVET in Malaysia and proposes the adoption of ICT to catch up with the global trend.	Review	Malaysia	Asia
17.	(Ramadan & Chen, 2018)	*International Journal of Social Sciences, 4(2)*	Teachers' Perceptions Of ICT Integration In TVET Classes: A Case Study In Khartoum State Sudan	It stresses the importance of ICT in facilitating effective teaching and learning systems. The use of whiteboards and projectors were emphasized in the study.	Qualitative	Sudan	Africa

| 18. | (Zafar, 2019) | International Journal of Engineering Research & Technology, 7(4) | Role of Information Communication Technology (ICT) in Education and its Relative Impact | ICT has made learning possible and better for everyone, everywhere, and from all backgrounds.

▪ According to the study, implementing complementary organizational innovations has significantly improved student performance, accomplishments, and learning. They now possess new abilities, competences, a cooperative mindset, team-building techniques, and project management know-how.

▪ According to the report, ICT has promoted professional learning by transforming traditional education into a knowledge economy. encouraging teachers and giving them the tools they need to help the underprivileged. By adeptly utilizing cutting-edge technology, educators have become more imaginative, cooperative problem solvers as well as adept and socially conscious professionals.

▪ According to the study, ICT-based learning environments have improved students' collective abilities and skills and increased the level of activity, collaboration, creativity, integrativeness, cooperation, and evaluation among students, learners, and educators.

It has become more appropriate, relevant, and authentic and effective in the realization and implementation of the pedagogy of constructivism that generated greater responsibility for learning for students.
▪ The study found that educators, policymakers, Administrators and teachers are using ICT tools and resources and collaborating with other educational participants researchers, families, cultural and professional institutions and other stakeholders and eliminating inefficiencies, digital divide, inequality, and stretching beyond the walls of traditional classrooms and promoting everywhere and all the time learning and making effective assessments by analyzing individual abilities, needs, interests, and overall strength and weakness of a students | Review | India | Asia |
| 19. | (Onah et al., 2020) | International Journal of Engineering Research and Technology, | Evaluation of the Impact of Computer-Assisted Instruction on Mathematics and Physics Students' Achievement: Implication for | Computer-Assisted Instruction (CAI) significantly improved mathematics and Physics students' achievement. This finding has implications for | | Nigeria | Africa |

		ISSN 0974-3154, Volume 13, Number 7 (2020),	Industrial Technical Education	Industrial Technical Education for the fact that improved achievement of students in mathematics and physics subjects at Secondary education level will enable them to have an interest in industrial technical education at higher education	Quasi-Experimental		
20.	(Mrs. Shalini & Dr. Deepti Dimri, 2022)	International Journal of Innovative Studies in Sociology and Humanities, 4(6)	The Role and Impact of ICT in Improving the Quality of Education: An Overview	Information and Communication Technology (ICT) offers significant resources for enhancing the quality of education around the world and broadening access to educational opportunities. It explores the advantages of ICT in education as a whole.	Review	India	Asia
21	(Hashim et al., 2019)	Journal of Technical Education And Training Vol. 11 No. 1 (2019)	Knowledge Construction Process in Open Learning System among Technical and Vocational Education and Training (TVET) Practitioners	Results revealed that an open learning system has helped TVET Practitioners to perform the tasks in online group discussions. The interaction that exists in online group discussions has triggered active participation among TVET practitioners and in turn, this enabled the tasks to be completed within the given time frame.	Quantitative	Malaysia	Asia
22.	(Chovanová et al., 2023)	Acta Polytechnica Hungarica Vol. 20, No. 7, 2023	Operations Research in Online Environment Using ICT in Higher Technical Education	Analysis of virtual reality technology, Blended learning, Project-based Learning, Cloud computing teaching, Flipped Classroom. This aligned with ….	Comparative study	Slovak Republic	Europe
23	(Seyed et al., 2022)	*International Journal of Advanced Computer Science and Applications, Vol. 13, No. 7, 2022*	Techno-pedagogical Solution to Support the Improvement of the Quality of Education in Technical and Vocational Training in Mauritania	The paper advocates the mixed pedagogical model by proposing a techno-pedagogical solution to improve the quality of teaching and learning processes. The proposed solution combines the use of technologies such as Modular Object-Oriented Dynamic Learning Environment (Moodle) and Web Real-Time Communication (WebRTC) to provide pedagogical services in a Context with a limited Internet connection. In addition, we set up a signaling system to maintain direct communication between the pairs, Application Programming Interface (API) of Multipoint Control Unit (MCU) to ensure simultaneous collaboration in a Peer-to-peer context used implementations of security protocols such as Datagram Transport Layer Security (DTLS) and Secure Real-time Transport Protocol (SRTP) to secure data transport.	Experimental	Mauritania	Africa
24	(Lytvyn et al., 2020)	Education and Information Technologies	Informatization of technical vocational schools: Theoretical foundations and	The experiment demonstrated that implementing the developed methods for the informational training of skilled workers, as	Experimental	Ukraine	Europe

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			practical approaches	well as utilizing pedagogical software tools in technical vocational schools and training vocational school teachers in the use of ICT, enhances the professional competence of graduates.			
25	Nwauzi Kirian, Kelechi O. Chiorlu, Divine 2021)	Saudi Journal of Engineering and Technology	Constraints to Effective Utilization of Information, Communication and Technology (ICT) in Technical Colleges in Rivers State, Nigeria	ICT skills are important for the effective implementation of technical education. Teachers and students should be competently trained in ICT usage.	Quantitative study	Nigeria	Africa
26	(Rajarapollu et al., 2022)	*Journal of Engineering Education Transformations, Volume No 35, January 2022*	ICT - A Tool to Enhance Teaching and Learning Activities in Technical Education	Various courses like digital signal processing, Digital image processing and digital electronics have been analyzed on various scales.		India	Asia

FINDINGS AND DISCUSSIONS

The main aim of the study is to establish the need for ICT adoption in the teaching and learning of Technical Education in Nigeria. Consequently, the study objective is to identify the ICT adoption gaps in Nigeria, especially concerning the teaching of Technical Education compared to other climes. Therefore, the systematic review was constructed into pictorial drawings/charts as the representation of the study relying on the Excel tool. Emphases were placed on methods, Origin of publication, and the Region of publication to draw the inferences. The results of these constructs are shown in Figures 2 to 5.

Figure 2: Continental Publication Rate.
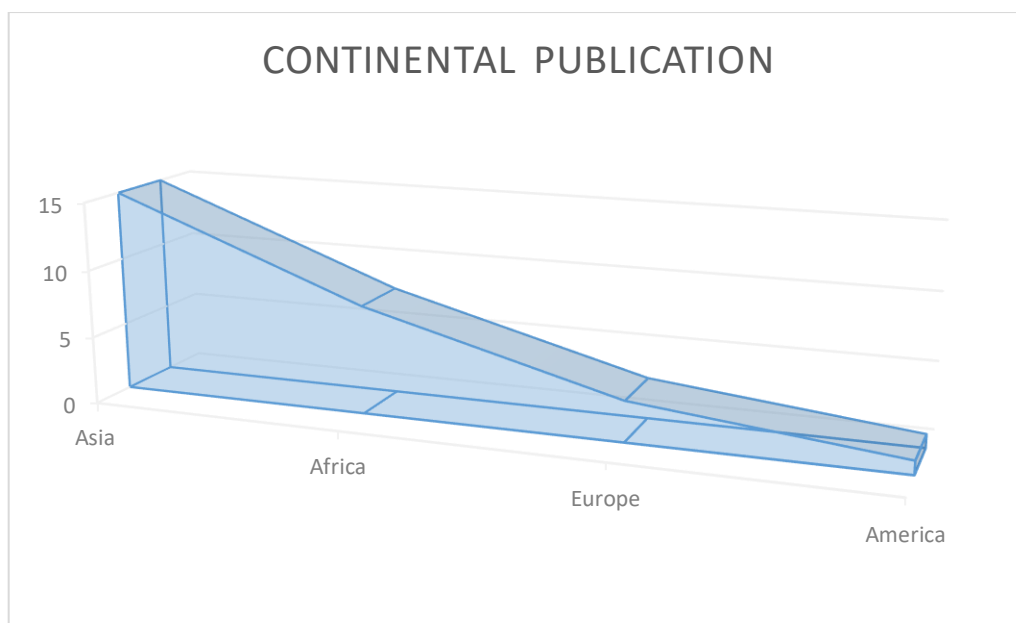
Findings show that most publications on the use of ICT in teaching and learning Technical Education are prevalent in the Asian continent with a percentage of 55 percent to her closest rival of the African continent shares 30 percent as shown in Figure 2 and Figure 3. No wonder Asia is regarded as the technological hub of the world. Africa needed to do more by strengthening its technological base to be able to match what is going on around the world. The adoption of ICT skills in Nigeria would no doubt promote the employability skills of

the students.(Olojuolawe & Adeoluwa, 2022; Olojuolawe et al., 2019; World Economic Forum, 2016). The ICT skills are important to ensure that the students are adequate for the industry. It is of note that today's jobs are driven by technology and no continent should claim ignorance of this.
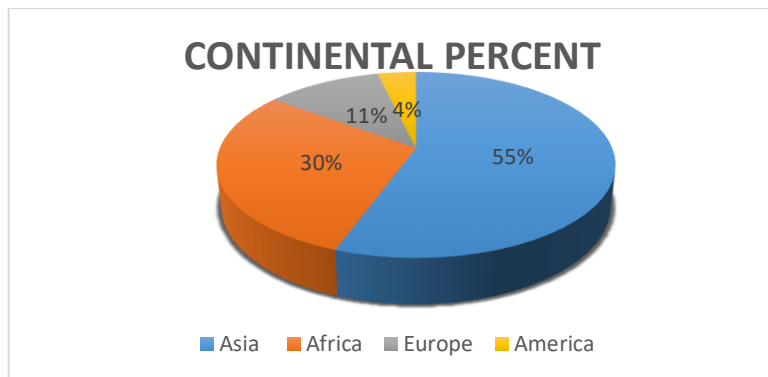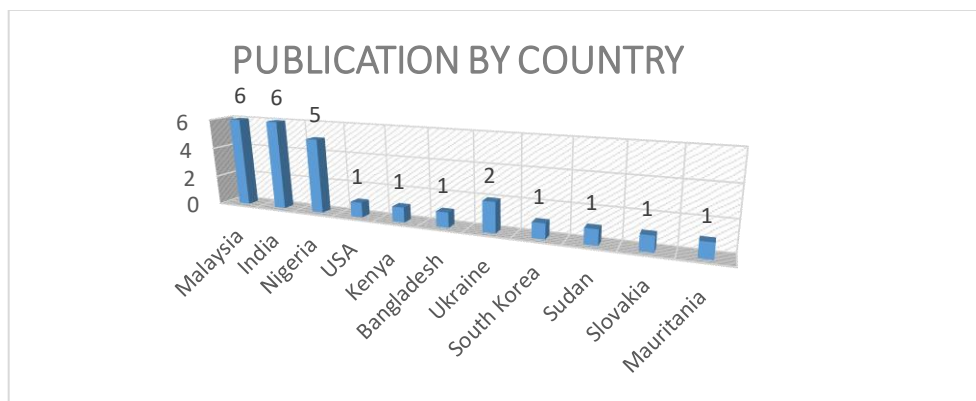
Figure 3: Percent Continental Publication.

Figure 4: Country Publication Rate.

Malaysia and India have the highest number of publication among the 13 countries of the world whose journal articles matches the need of the study as revealed in Figure 4. Although it could be said that Nigeria made a very good stride in this regard, it is yet to be seen whether the feat is good enough to justify its technological know-how. A deeper analysis of the 5 publications though, quantitative and experimental failed to identify any ICT tool that is good for teaching Technical Education. Thus, the outcome seems to be broad and theoretical. The global trend today is that employers lay more emphasis on what an employee can achieve with skills such as technological skills, management, analytical and the rest. The basic skills that a technical student must possess to be job-ready were clearly stated in the structural classification of employability skills (Olojuolawe, Bt, Amin, Latif, et al., 2019; Olojuolawe & Amin, 2019).
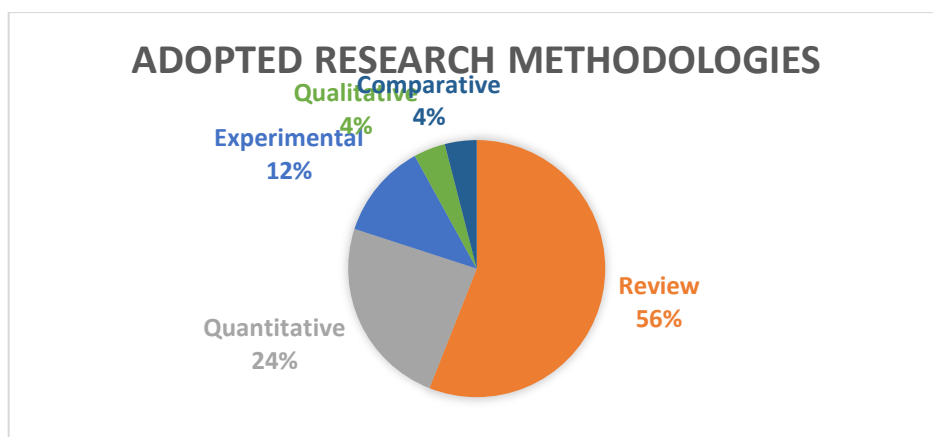
Figure 5: Authors' Research Methods Adoption.

Figure 5 indicates that varying research techniques were used by the researchers in this study. A greater number of the articles were review papers with a 56% adoption. This is more than the average of the total. The question now is, do we have to agree that "review" is better when conducting studies into ICT and Technical Education or that it is much simpler and easier?

These questions beg for answers. However, research has shown that the adoption of a single research method such as qualitative makes a study lack sensitivity to context and limits the ability to capture process and change (Blenker et al., 2014; Creswell, 2013a; Legg-Jack, 2014; Noble & Smith, 2015; Shukla et al., 2014). It is on record that the integration of both qualitative and quantitative research methods would produce a better research outcome in terms of depth, undisputable source of data, and validation of best practices (Creswell, 2006, 2013b; Creswell & Creswell, 2013; Creswell John. w, 2014; Harrison & Reilly, 2011; Ivankova, 2014; Morgan, 2017; Wetzel & Carstensen, 2014).

CONCLUSION AND RECOMMENDATION

The study revealed that much has to be done in identifying the ICT tools essential for teaching and learning Technical Education in Nigeria. Similarly, the majority of the studies were review studies. This has taken out the benefits of mixed methods research that guarantees depth and validation. Therefore, Nigerian and African researchers are enjoined to vary their methods and ensure that a more holistic study is conducted regarding the Information and Communication Technology adoption in Technical Education. This stands to serve the interest of the learners in employment generation, the parents, and the society in crime control and Gross Domestic Product growth (GDP).

REFERENCES

1. Babalola, K., Abbas, B. Z., & Ado, N. M. (2020). Challenges of Effective Utilization of Information and Communication Technology (ICT) in Teaching and Learning of Vocational and Technical Education. 3(1), 387–395.
2. Bello, H., Shu'aibu, B., Bin Saud, M. S., & Buntat, Y. (2013). ICT skills for technical and vocational education graduates' employability. World Applied Sciences Journal, 23(2), 204–207. https://doi.org/10.5829/idosi.wasj.2013.23.02.588
3. Blenker, P., Elmholdt, S. T., Frederiksen, S. H., Korsgaard, S., & Wagner, K. (2014). Methods in entrepreneurship education research: A review and integrative framework. Educ. + Train., 56(8/9), 697–715. https://doi.org/10.1108/ET-06-2014-0066
4. Camilus Bassey, B., & Michael Ushie, A. (2013). The role of ICT in skilled manpower development through vocational-technical education among higher institutions in Cross River State, Nigeria. International Journal of Vocational and Technical Education, 5(5), 92–99. https://doi.org/10.5897/IJVTE2013.0132
5. Chovanová, H. H., Fidlerová, H., Babčanová, D., & Banáš, D. (2023). Operations Research in Online Environment Using ICT in Higher Technical Education. Acta Polytechnica Hungarica, 20(7), 117–132. https://doi.org/10.12700/APH.20.7.2023.7.7
6. Creswell, J. . (2013a). Research Design Qualitative, Quantitative, and Mixed Methods Approaches (4th ed.). SAGE Publications, Inc.
7. Creswell, J. W. (2006). Choosing a Mixed Methods Design. Designing and Conducting Mixed Methods Research, 58–88.
8. Creswell, J. W. (2013b). Steps in Conducting a Scholarly Mixed Method Study. In DBER Speaker Series.
9. Creswell, J. W., & Creswell, J. (2013). Steps in Conducting a Scholarly Mixed Methods Study.
10. Creswell John. w. (2014). RESEARCH DESIGN Qualitative, Quantitative and Mixed Methods Approaches (Knight Vicki (ed.); 4th ed.). SAGE Publications, Inc.
11. Dumbiri, D. N., & Nwadiani, C. O. (2020). Challenges Facing Application of E-learning Facilities in Vocational and Technical Education Programs in South Nigeria Universities. Asian Journal of Vocational Education and Humanities, 1(2), 1–8. https://doi.org/10.53797/ajvah.v1i2.1.2020
12. Harrison, R. L., & Reilly, T. M. (2011). Mixed methods designs in marketing research. Qualitative

Market Research: An International Journal, 14(1), 7–26. https://doi.org/10.1108/13522751111099300

13. Hashim, S., Rahman, M. H. A., Nincarean, D., Jumaat, N. F., & Utami, P. (2019). Knowledge construction process in open learning system among technical and vocational education and training (TVET) practitioners. Journal of Technical Education and Training, 11(1), 73–80. https://doi.org/10.30880/jtet.2019.11.01.009

14. Hassan, R. H., Hassan, M. T., Naseer, S., Khan, Z., & Jeon, M. (2021). ICT enabled TVET education: a systematic literature review. IEEE Access, 9. https://doi.org/10.1109/ACCESS.2021.3085910

15. Ivankova, N. V. (2014). Implementing Quality Criteria in Designing and Conducting a Sequential QUAN ! QUAL Mixed Methods Study of Student Engagement With Learning Applied Research Methods Online. https://doi.org/10.1177/1558689813487945

16. Jamil, M. R. M., Hashim, A. T. M., Othman, M. S., Ahmad, A. M., Noh, N. M., & Kamal, M. F. M. (2023). Digital Pedagogy Policy in Technical and Vocational Education and Training (TVET) in Malaysia: Fuzzy Delphi Approach. Journal of Technical Education and Training, 15(2), 1–10. https://doi.org/10.30880/jtet.2023.15.02.001

17. Jasmine, K. (2014). In Penambahan Natrium Benzoat Dan Kalium Sorbat (Antiinversi) Dan Kecepatan Pengadukan Sebagai Upaya Penghambatan Reaksi Inversi Pada Nira Tebu.

18. Kattimani, S. F., & Naik, R. R. (2012). E-learning technology in the ICT era: Application to technical education. DESIDOC Journal of Library and Information Technology, 32(6), 459–467. https://doi.org/10.14429/djlit.32.6.2842

19. Kirian, K., & O. Chiorlu, D. (2021). Constraints to Effective Utilization of Information, Communication and Technology (ICT) in Technical Colleges in Rivers State, Nigeria. Saudi Journal of Engineering and Technology, 6(3), 37–44. https://doi.org/10.36348/sjet.2021.v06i03.001

20. Lazarević, S., & Lukić, J. (2016). The Impact of Information and Communication Technology on Human Resources. 369–375. https://doi.org/10.15308/sinteza-2016-369-375

21. Legg-Jack, D. W. (2014). Employability skills of technical college graduates: A case for government technical college (GTC) in Ahoada Rivers State Nigeria by. International NGO Journal, 5(3), 059–064.

22. Lytvyn, A., Lytvyn, V., Rudenko, L., Pelekh, Y., Didenko, O., Muszkieta, R., & Żukow, W. (2020). Informatization of technical vocational schools: Theoretical foundations and practical approaches. Education and Information Technologies, 25(1), 583–609. https://doi.org/10.1007/s10639-019-09966-4

23. Morgan, D. L. (2017). Mixed methods research. The Cambridge Handbook of Sociology, 1, 153–161. https://doi.org/10.1017/9781316418376.015

24. Shalini, & Dr. Deepti Dimri. (2022). The Role and Impact of ICT in Improving the Quality of Education about NEP 2020. International Journal of Advanced Research in Science, Communication and Technology, 4931(June), 125–128. https://doi.org/10.48175/ijarsct-7428

25. Noble, H., & Smith, J. (2015). Issues of validity and reliability in qualitative research. 18(2), 34–35. https://doi.org/10.1136/eb-2015-102054

26. Olojuolawe, S., & Adeoluwa, O. V. (2022). Equipment and Facilities Gap in Vocational Technical Education of Higher Institution: Implication for Graduates Employability in Nigeria. Sains Humanika, 14(2), 13–21. https://doi.org/10.11113/sh.v14n2.1838

27. Olojuolawe, S. R., Bt, N., & Amin, M. (2018). The Role of ICT in Employability of Electrical Technology Graduates.

28. Onah, E. N., Ugwuanyi, C. S., Okeke, C. I. O., Nworgu, B. G., Agwagah, U. V. N., Ugwuanyi, C. C., Obe, P. I., Nwoye, M. N., & Okeke, A. O. (2020). Evaluation of the Impact of Computer-Assisted Instruction on Mathematics and Physics Students Achievement: Implication for Industrial Technical Education. International Journal of Engineering Research and Technology, 13(7), 1786–1794. https://doi.org/10.37624/ijert/13.7.2020.1786-1794

29. Rajarapollu, P., Bansode, N. V., & Katkar, V. (2022). ICT-A Tool to Enhance Teaching Learning Activity in Technical Education. Journal of Engineering Education Transformations, 35(Special Issue), 14–18. https://doi.org/10.16920/jeet/2022/v35is1/22002

30. Ramadan, A., & Chen, X. (2018). Teachers' Perceptions on ICT Integration in Tvet Classes: a Case Study in Khartoum State-Sudan. PEOPLE: International Journal of Social Sciences, 4(2), 639–654. https://doi.org/10.20319/pijss.2018.42.639654

31. Rashevska, N. V., & Kiianovska, N. M. (2023). Improving Blended Learning in Higher Technical Education Institutions with Mobile and Cloud-Based ICTs. Educational Dimension, 9, 13–31.

https://doi.org/10.31812/ed.608

32. Rufus Olojuolawe, S., & Amin, F. N. B. (2019). Determination of Employability Skills Required by Electrical Technology Students in Colleges of Education in Nigeria. International Journal of Engineering Education, 1(1).

33. Saripudin, S., Juanda, E. A., Abdullah, A. G., & Ana, A. (2020). Integration of ICT Skill Among Vocational School Teachers: A Case in West Java, Indonesia. International Journal of Innovative Technology and Exploring Engineering, 9(5), 251–260. https://doi.org/10.35940/ijitee.b7281.039520

34. Seyed, C., Bilong, J. R. N., Sidi, M. A., & Nanne, M. F. (2022). Techno-Pedagogical Solution to Support the Improvement of the Quality of Education in Technical and Vocational Training in Mauritania. International Journal of Advanced Computer Science and Applications, 13(7), 662–668. https://doi.org/10.14569/IJACSA.2022.0130777

35. Shamim, R. H., & Raihan, A. (2016). Effectiveness of Using ICTs to Promote Teaching and Learning in Technical Education: Case of Bangladesh. International Journal of Vocational and Technical Education, 8(2), 12–19. https://doi.org/10.5897/IJVTE2015.0177

36. Shukla, N., Wilson, E., & Boddy, J. (2014). Combining Thematic and Narrative Analysis of Qualitative Interviews to Understand Children's Spatialities in Andhra Pradesh, India. 30.

37. Som, S. (2021). ICT In Education : Opportunities and Challenges. International Journal of Research, 7(1), 156–163.

38. Sylvester, O. O., Simon, W., & Simiyu, P. J. (2019). An Assessment of the Potential of ICT in Improving the Quality of Teaching and Learning of Kenya's Technical Education An Assessment of the Potential of ICT in Improving the Quality of Teaching and Learning of Kenya's Technical Education. 4(1), 1–28.

39. Wahab, Y., Hazlina, H., & Ali, M. (2019). Information and Communication Technologies in Technical (Icts) and Vocational Education and Training (Tvet) (Effective Integration Toward Knowledge Management in the Changing World of Work). Jurnal Kejuruteraan Dan Sains Kesihatan Journal of Engineering and Health Sciences Jilid, 3, 106–118.

40. Wetzel, E., & Carstensen, C. H. (2014). Reversed Thresholds in Partial Credit Models: A Reason for Collapsing Categories? Assessment, 21(6), 765–774. https://doi.org/10.1177/1073191114530775

41. World Economic Forum. (2016). The Future of Jobs Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution. Growth Strategies, January, 2–3. https://doi.org/10.1177/1946756712473437

42. Yaakob, M. F. M., Awang, H., Ismail, M. Z., Zain, F. M., Kasim, M., & Adnan, A. A. Z. (2020). Backward and Forward Reviews on Technical and Vocational Education and Training (TVET) in Malaysia: The Evolution and ICT-Driven Future Prospect. Universal Journal of Educational Research, 8(6), 2197–2203. https://doi.org/10.13189/ujer.2020.080601

43. Zafar, S. M. T. (2019). Role of Information Communication Technology (ICT) in Education and its Relative Impact. International Journal of Engineering Research & Technology (IJERT), 7(4), 1–10. www.ijert.org.