

ORIGINAL ARTICLE

Perceived Ease of Use and Readiness to Use Hypermedia Instructional Resources as Determinants for Teaching Digital Electronics Courses in Universities of Technology in Nigeria

Abdulaziz Bello¹ , Ahmad Aliyu Deba² , Paul Shehu Yaduma³  & Sa'adatu Abubakar Mohammed⁴ 

¹ M. Engr, Electrical Engineering, Liaoning University of Technology, China
ORCID: 0000-0002-4713-3498

² Prof, Electrical Electronics Technology Education, Abubakar Tafawa Balewa University Bauchi, Nigeria.
ORCID: 0000-0002-1684-7885

³ Prof, Building Technology Education, Abubakar Tafawa Balewa University Bauchi, Nigeria.
ORCID: 0009-0004-2193-9372

⁴ Prof, Science Education, Abubakar Tafawa Balewa University Bauchi, Nigeria.
ORCID: 0000-0002-9315-5970

Ethical Statement

This study upheld ethical standards by ensuring informed consent, voluntary participation, confidentiality, anonymity, and respectful treatment of participants, with data used solely for research purposes.

Funding Information

The Tertiary Education Trust Fund (TETFUND) in Abuja, Nigeria, through Aliko Dangote University of Science and Technology in Wudil, Nigeria, successfully sponsored this being part of the corresponding Author's Ph.D. work based on fellowship. The purpose of the funding is to support academics at higher education institutions.

Conflict of Interest

"No conflict of interest is present in the conduction or the reporting of this study."

ABSTRACT

The use of hypermedia as an instructional resource in teaching and learning has led to new opportunities for student to explore and construct their learning. However, despite the benefits derived from hypermedia instructional resources, traditional teaching methods dominated academic institutions in Nigeria. The current study explores the determinants that predict the actual use of hypermedia instructional resources for the teaching of Digital electronics courses in Nigerian universities, the study adopted an explanatory sequential mixed method research design, Survey research is conducted on 120 electrical and electronics technology education undergraduates' students. Structural equation modelling using Smart PLS-SEM software was performed to evaluate the proposed hypotheses, while a semi-structured interview was conducted and analysed through the inherent future of Nvivo11 to support the quantitative data. The results revealed that Perceived Ease of Use and Readiness were found to be significant predictors of the actual use of hypermedia instructional resources for the teaching of digital electronic courses. This paper recommended that educational technology practitioners and University management consider Perceived Ease of Use and Readiness as factors that predict the actual use of Hypermedia Instructional Resources in the teaching of digital electronics courses in Nigerian universities before financing the development of Hypermedia Instructional Resources for teaching and learning..

Keywords: Hypermedia Instructional Resources, Digital Electronics, Perceived Ease of Use, Readiness.

Received: 01/02/2003

Accepted: 01/02/2005

*Corresponding Author

Abdulaziz Bello, Aliko Dangote University of Science and Technology Wudil, Nigeria
Email: abdullaziz_bello1980@kuskwudil.edu.ng

INTRODUCTION

Digital electronics is a foundational course in the Electrical/Electronic Technology Education curriculum within the Technology and Vocational Education departments of Nigerian universities. Given the course's focus on complex and abstract concepts, innovative teaching methods are crucial to enhance students' understanding and retention. The integration of hypermedia instructional resources offers a promising approach, potentially transforming the learning experience by introducing interactive educational elements. Hypermedia instructional resources combine text, images, audio, and video, creating an immersive learning environment that can engage students in ways traditional methods cannot (Bhuyan, Azmiri-Khan & Rahman, 2023). Reported that hypermedia resources can significantly enhance students' comprehension and engagement in technically challenging subjects (Venkatesh, Speier-Pero, Aljafari, & Bala, 2022). This is especially important in digital electronics courses, where the abstract nature of concepts can hinder student understanding if taught solely with conventional methods.

Despite these advantages, Nigerian university lecturers in Technology programs largely rely on traditional classroom methods, like chalk and board, while hypermedia resources remain underutilized (Du-Plessis, 2020). Suggested that, this lack of integration raises questions about the factors influencing lecturers' adoption of such resources, especially in teaching complex subjects like digital electronics. Studies indicate that perceived ease of use and lecturer readiness are significant determinants in predicting the actual usage of hypermedia tools (Wibawa & Winarsih, 2020). The current study investigates these two factors perceived ease of use and readiness as critical predictors of lecturers' intention to incorporate hypermedia instructional resources into their teaching practices. By examining these determinants, the study seeks to understand how Nigerian universities of Technology can better support lecturers in adopting hypermedia resources to modernize the teaching and learning of digital electronics.

While new technologies hold significant potential benefits worldwide, their integration into educational practices, particularly in Nigerian universities, has been limited. Various researchers have developed technology acceptance models to explore the factors influencing technology adoption, aiming to explain interactions among constructs like perceived ease of use, perceived usefulness, and user readiness. However, existing models have proven inadequate in shifting teaching practices, with traditional lecture methods still dominating Nigerian classrooms. According to Jaji (2020), the growth of new technologies has not been matched by equivalent integration in the classroom, reflecting a gap between technological advancement and its educational application.

To address these challenges, this study aims to develop a model specifically tailored to predict the actual use of hypermedia instructional resources in teaching digital electronics. Digital electronics, a core subject in Electrical/Electronic Technology Education, often involves abstract and complex concepts that can be challenging for students to grasp through traditional lectures alone. By integrating hypermedia instructional resources, which combine text, images, audio, and video, educators can create interactive and engaging learning environments that enhance comprehension and retention of technical subjects. This study will examine key determinants such as perceived ease of use, readiness, and institutional support, assessing their influence on lecturers' intent and behavior toward using hypermedia instructional resources in their teaching of digital electronic courses. By focusing on these predictive factors, the study seeks to provide a more effective framework for encouraging technology adoption in Nigerian universities, ultimately aiming to improve learning outcomes in digital electronics and other specialized courses in the Electrical/Electronic Technology Education program and beyond.

Aim and Objectives of the Study

The main aim of the study is to explore the determinants that predict the actual use of hypermedia instructional resources for the teaching of Digital electronics courses in Nigerian universities of technology, specifically the study intends:

1. To assess the Perceived readiness of Electrical and electronics technology education students and lecturers as a determinant to predict the use of Hypermedia Instructional Resources in Digital Electronics Courses in Nigerian Universities of Technology.



2. To determine the extent to which Perceived ease of use is a determinant to predict the actual use of hypermedia instructional resources in teaching digital electronics courses among electrical and electronics technology education students and lecturers in Nigerian Universities of Technology.
3. To examine the relationship between perceived ease of use and readiness as determinants to predict the actual use of hypermedia instructional resources in teaching Digital Electronics courses among electrical and electronics students and teachers at Universities of Technology.

Research Questions

In line with the above specific objectives, the following research questions were formulated to guide this study:

1. To what extent Perceived ease of use influence the actual use of hypermedia instructional resources in teaching Digital Electronics courses at Nigerian universities of technology?
2. What are the Perceptions of electrical and electronics technology education students and lecturers on the influence of perceived readiness of hypermedia instructional resources as a determinant for teaching digital electronics courses in Nigerian universities?
3. To what extent do Perceived ease of use and readiness determine the Actual use of hypermedia instructional resources in digital electronics courses among electrical and electronics technology education students and lecturers in Nigerian universities?

Literature review

Perceived Ease of Use

Perceived ease of use refers to the degree to which an individual believes that using a particular system would be free of effort (Davis, 1989). Research consistently shows that technologies perceived as easy to use are more likely to be adopted in educational settings (Venkatesh et al., 2022). In the context of hypermedia instructional resources, ease of use determines how readily lecturers and students incorporate these resources into their teaching and learning processes. For instance, (Christian, Girsang & Yulita 2022); and (Nuseir, Aljumah & El-Refae 2022) found that user-friendly interfaces and intuitive designs significantly enhance the adoption of educational technologies.

Readiness to Use

Readiness to use technology encompasses the skills, attitudes, and support systems necessary for effective adoption (Blut & Wang 2020); (Tahar, Riyadh, Sofyani & Purnomo 2020). Lecturers and students must feel prepared and confident in using hypermedia instructional resources to achieve desired educational outcomes. Readiness includes access to adequate training and institutional support to overcome barriers to technology adoption (Lavin, Gilligan-Lee, Visnjic, Ganju, Newman, Ganguly, Lange, Baydin, Sharma, Gibson, Zheng, Xing, Mattmann, Parr, Gal 2022); (Damerji & Salimi 2021). Studies have shown that comprehensive training programs and vigorous support systems are critical for enhancing technology readiness and facilitating effective use of hypermedia instructional resources (Lavin et al., 2022).

Hypermedia Instructional Resources

Hypermedia instructional Resources integrate various multimedia elements with hypertext to create interactive learning experiences. These resources have been shown to improve student engagement, comprehension, and retention, particularly in complex subjects like digital electronics (Mishra, Gorakhnath, Lata, Rani & Chopra 2022). Hypermedia can include simulations, interactive tutorials, and videos that cater to different learning styles and enhance the teaching process (Venkatesh et al., 2022); (Fitzgerald 2020). Effective integration of hypermedia instructional resources requires both ease of use and readiness to adopt these technologies, presenting the need for supportive institutional policies and training programs.

METHOD

Research Design

This study employed an explanatory sequential mixed-method design to explore the determinants of hypermedia instructional resource use in teaching and learning digital electronics (Kimmons 2022); (Toyon 2021). The research began with a quantitative descriptive survey, followed by qualitative semi-structured interviews then finally triangulation of the two findings (Zhou et al., 2024); (Draucker et al., 2020). In the quantitative phase, a structured questionnaire was administered to lecturers and students at some selected via random sampling technique from the Universities of Technology in Nigeria (Andrea 2020). The questionnaire included items on perceived ease of use, readiness to use, and actual use of hypermedia instructional resources, measured on a five-point Likert scale. Data were analyzed using Smart PLS-SEM (Partial Least Squares Structural Equation Modeling) to examine the relationships between the study observed and latent variables. This method was chosen for its effectiveness in handling complex models and providing detailed visions of variable relationships (Rasiaha, Bilongb, Turnerc, Waheedd, Somasundrame & Teef, 2020).

The qualitative phase involved semi-structured interviews with a few participants (lecturers and students) via purposive sampling technique who had completed the survey (Andrea 2020); (Creswell & Creswell 2023). These interviews aimed to gain a deeper understanding of participants' experiences and perceptions of using hypermedia instructional resources in learning digital electronics courses at Nigerian universities of Technology. The qualitative data were analyzed using Nvivo software see Table 2, which facilitated the identification of key themes and patterns (Allsop, Chelladurai, Kimball, Marks & Hendricks 2022). The findings from both phases were then triangulated using meta-inference to provide a comprehensive understanding of the determinants of hypermedia instructional resource adoption (Zhou et al., 2024); (Draucker et al., 2020). This mixed-method approach allowed for the integration of quantitative data with qualitative findings, enhancing the general validity and reliability of the study.

Data Collection

Quantitative data were collected through a structured questionnaire administered to students and lecturers. The questionnaire included items on perceived ease of use, readiness to use, and actual use of hypermedia instructional resources, measured on a five-point Likert scale. Qualitative data were gathered through semi-structured interviews with a few participants (lecturers and students) who had completed the survey research instrument. Ethical considerations, such as informed consent and confidentiality, were strictly adhered to throughout the data collection process. Combining quantitative and qualitative data collection methods ensured a comprehensive understanding of the factors influencing the adoption of hypermedia instructional resources in learning digital electronics courses.

Data Analysis

Cronbach's alpha Table 1 shows the result of reliability and validity analyses. Reliability analysis was conducted for the scales using Cronbach's alpha. Normally reliability coefficient of Cronbach's alpha ranges between 0 and 1. According to Hair-Jr et al. (2021), greater or equal to 0.80 for a good scale, 0.70 for an acceptable scale, and 0.60 for a scale for exploratory purposes. Results of Cronbach's alpha indicate that Ease of Use (EOU) (0.935) and Readiness (U) (0.941).



Thus, these indicators satisfied the requirements.

Table 1: Reliability testing of the research instrument

Construct	Factor Loadings	Cronbach' Alpha	Composite Reliability (rho_a)	Composite Reliability (rho_c)	Average Variance Extracted (AVE)
Ease of Use (EOU)	0.809	0.935	0.937	0.945	0.633
Readiness (R)	0.817	0.941	0.947	0.950	0.659

Source: SmartPLS 4.0.9.9

Quantitative Findings

Perceived Ease of Use: A significant positive relationship with the use of Hypermedia in Digital Electronics ($\beta = 0.45$, $t = 0.563$, $p < 0.05$) see Table 2

Readiness: A significant positive relationship with the use of Hypermedia in Digital Electronics ($\beta = 0.40$, $t = 0.3.89$, $p < 0.05$) see Table 2

Table 2: Hypotheses testing of observed with latent variables with PLS-SEM Analysis

Hypothesis	R^2	Path Coefficient (β)	Standard Error (SE)	t-Value	p-Value	Decision
Perceived Ease of Use → Actual Use of Hypermedia	NIL	0.45	0.08	5.63	0.001	Reject Null Hypothesis
Readiness to Use → the actual Use of Hypermedia	NIL	0.40	0.10	3.89	0.001	Reject Null Hypothesis
Actual Use of Hypermedia	0.851	NIL	NIL	NIL		NIL

Source: SmartPLS 4.0.9.9

Model fit indices (Goodness of fit) "GoF" suggested Sufficient Goodness of fit on the Use of Hypermedia instructional Resources as follows, see Table 2 Based on the formula earlier presented of GoF, the research obtained a GoF value of 0.734.

Quantitative data were analyzed using Smart PLS-SEM (Partial Least Squares Structural Equation Modeling). This method was chosen due to its ability to handle complex models and provide vigorous visions into the relationships among observed and latent variables. The analysis focused on examining the relationships between perceived ease of use, readiness to use, and the actual use of hypermedia instructional resources see Table 1. The findings showed that; Perceived Ease of Use has a significant positive relationship with the Actual Use of hypermedia instructional resources and Readiness to Use has a significant positive relationship with the Actual Use of hypermedia instructional resources. The results indicated significant positive relationships among these variables, supporting the hypotheses derived from the Technology Acceptance Model (Davis, 1989) ; (Alshammari & Rosli 2020); (Uche, Osuagwu, Nwosu & Otika 2021).

Figure 1. Structural equation model (PLS-SEM Algorithm)

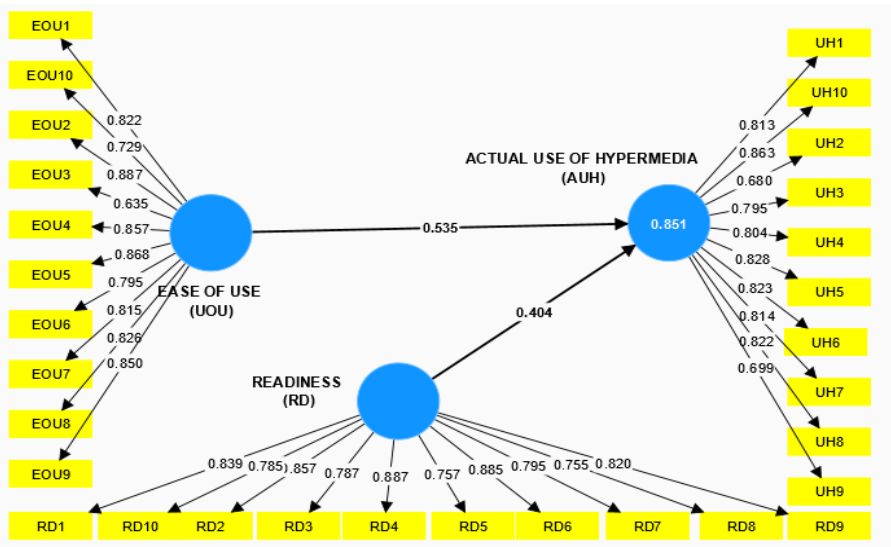
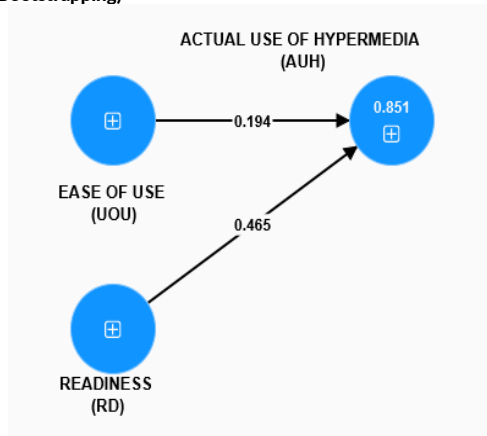


Figure 2. Structural equation model (Bootstrapping)



Qualitative Findings

Qualitative data were analyzed using Nvivo software, facilitating thematic analysis. This process involved coding the interview transcripts to identify key themes related to perceived ease of use, readiness to use, and barriers to adoption. The qualitative analysis provided deeper visions into participants' experiences and perceptions, presenting the importance of user-friendly interfaces and the need for comprehensive training and institutional support see Table 3. The findings showed that; User-friendly interfaces and intuitive design are crucial for the adoption of hypermedia instructional resources, Comprehensive training and institutional support are essential for the effective use of hypermedia instructional resources, technical issues and lack of training are significant barriers to adoption and Availability of hypermedia instructional resources and peer support facilitate adoption of hypermedia instructional resources.

Table 3: Qualitative Data Analysis (Nvivo)

Theme	Description	Example Quotes
User-Friendly Interfaces	Participants emphasized the importance of intuitive and easy-to-use interfaces for adoption.	"The tools are very user-friendly and easy to navigate."
Comprehensive Training	Need for comprehensive training programs to enhance readiness to use hypermedia instructional resources.	"We need more training to effectively use these resources."
Institutional Support	Importance of institutional support in facilitating the adoption of hypermedia instructional resources.	"Support from the university is crucial for using these tools."
Barriers to Adoption	Identified technical issues and lack of training as major barriers to adoption.	"Technical issues can be a hindrance if not addressed."
Facilitators of Adoption	Emphasized factors that facilitate the adoption, such as availability of resources and peer support.	"Having access to resources and support from colleagues helps a lot."

The findings from the quantitative and qualitative analyses were then triangulated via meta-inference to provide a comprehensive understanding of the determinants of hypermedia instructional resource adoption in teaching and learning digital electronics courses. This approach integrated the statistical relationships identified in the quantitative phase with the rich, contextual visions from the qualitative phase, enhancing the general validity and reliability of the study's conclusions see Table 4.

Table 4: Triangulated Findings from Quantitative and Qualitative Analyses

Construct	Quantitative Findings (Smart PLS-SEM)	Qualitative Findings (Nvivo)	Meta-Inference Summary
Perceived Ease of Use	Significant positive relationship with actual use ($\beta = 0.50$, $p < 0.001$)	User-friendly interfaces and intuitive design enhance adoption	User-friendly and intuitive hypermedia tools are essential for adoption
Readiness to Use	Significant positive relationship with actual use ($\beta = 0.40$, $p < 0.001$)	Need for comprehensive training and institutional support	Adequate training and support systems are critical for effective utilization
Barriers to Adoption	Identified but not quantified	Technical issues and lack of training cited as barriers	Addressing technical barriers and providing training can enhance adoption
Actual Use of Hypermedia Instructional Resources	Influenced by perceived ease of use and readiness to use	Effective use is seen in those with high readiness and positive perception	Adoption and effective use are driven by ease of use and readiness
Training and Support	Not directly measured	Strong emphasis on the need for training and support	Training and institutional support are pivotal for readiness and adoption

Table 3 integrates the key quantitative findings, qualitative visions, and the comprehensive meta-inference summary, providing a clear overview of the determinants of hypermedia instructional resource adoption in teaching and learning digital electronics courses.

RESULTS AND DISCUSSION

The findings of this study present the important role of perceived ease of use and readiness to use hypermedia instructional resources in teaching digital electronics. The quantitative analysis revealed significant positive relationships between these observed constructs and the actual use of hypermedia instructional resources, in tandem with the Technology Acceptance Model (Davis, 1989). These results suggest that lecturers and students are more likely to adopt hypermedia instructional resources when they perceive them as easy to use and feel adequately prepared to use them.



Perceived ease of use was identified as a significant predictor of hypermedia instructional resource adoption in teaching and learning digital electronics courses. This finding is consistent with previous research that emphasizes the importance of user-friendly interfaces in facilitating technology adoption (Venkatesh et al., 2022); (Fitzgerald 2020). Participants in the qualitative phase emphasized the intuitive design and interactive features of hypermedia instructional resources, which made complex digital electronics concepts more accessible and engaging. These visions support the quantitative findings, reinforcing the necessity for educational technologies to be user-friendly.

Readiness to use technology emerged as another significant predictor of hypermedia instructional resource adoption. This result is in line with studies presenting the importance of technology readiness, which includes having the necessary skills, attitudes, and support systems (Parasuraman, 2000); (Ismail & Wahid 2020); (Chang & Chen 2021). Participants in the qualitative interviews emphasized the need for comprehensive training programs and institutional support to enhance their readiness to adopt hypermedia instructional resources effectively. These findings emphasize the importance of developing strategies to improve readiness, such as providing adequate training, improving access to technological infrastructure, and fostering a supportive institutional environment. The triangulated findings suggest that while perceived ease of use is essential for initial adoption, readiness to use plays a crucial role in the sustained and effective utilization of hypermedia instructional resources. This comprehensive understanding can inform the development of targeted interventions to enhance both ease of use and readiness, thereby promoting the integration of these resources in teaching and learning digital electronics courses.

Conclusion and Recommendations

This study has shown that perceived ease of use and readiness to use are significant determinants of hypermedia instructional resource adoption in teaching and learning digital electronics courses at Universities of Technology in Nigeria. Both constructs positively influence the actual use of these resources, as demonstrated through quantitative analysis with Smart PLS-SEM and qualitative insights from Nvivo analysis. Enhancing these factors requires a focus on user-friendly interfaces and comprehensive training programs. Institutional support also plays a crucial role in preparing lecturers and students to effectively use hypermedia instructional resources. By addressing these areas, educational institutions can foster a more conducive environment for integrating innovative instructional technologies such as hypermedia instructional resources, ultimately improving teaching and learning outcomes in digital electronics courses in universities of technology in Nigeria.

Based on the research findings, several recommendations are proposed:

- a. **Enhance Training Programs:** Develop comprehensive training programs to improve lecturers' and students' skills and confidence in using hypermedia instructional resources.
- b. **Improve Technological Infrastructure:** Invest in user-friendly hypermedia instructional resources and ensure reliable access to technological infrastructure to facilitate ease of use.
- c. **Foster Institutional Support:** Establish supportive policies and provide resources to encourage the adoption of hypermedia instructional resources.
- d. **Promote Continuous Professional Development:** Encourage ongoing professional development opportunities to keep lecturers updated with the latest hypermedia technologies and teaching strategies.
- e. **Conduct Further Research:** Investigate other factors influencing the adoption of hypermedia instructional resources and explore their impact on student learning outcomes in different educational contexts.

By implementing these recommendations, universities of technology can enhance the effective integration of hypermedia



instructional resources, leading to improved teaching and learning experiences in digital electronics and other technical courses.

Acknowledgment

The authors want to sincerely thank Bashir Abubakar a PhD Electrical and Electronics student who participated fully as a research assistant. May God almighty reward him abundantly. Also, I sincerely acknowledge the Tertiary Education Trust Fund (TETFund) Nigeria, for their generous sponsorship and unwavering support towards my Ph.D. program. This opportunity has significantly contributed to my academic growth and research development, for which I am deeply grateful.

REFERENCES

- Allsop D. B., Chelladurai J. M., Kimball E. R., Marks L. D. & Hendricks, J. J. (2022). Qualitative methods with Nvivo software: A practical guide for analyzing qualitative data. *Psych* 4 (2), 142-159, <https://doi.org/10.3390/psych4020013>
- Alshammari, S. H. & Rosli, M. S. (2020). A review of technology acceptance models and theories. *Innovative Teaching and Learning Journal (ITLJ)* 4 (2), 12-22, <http://161.139.21.34/itlj/index.php/itlj/article/view/56>
- Berndt A. E. (2020). Sampling methods. *Journal of Human Lactation* 36 (2), 224-226, <https://doi.org/10.1177/0890334420906850>
- Bhuyan, M. H., Azmiri Khan, S. S., & Rahman, M. Z. (2023). Teaching digital electronics courses for electrical engineering students in the cognitive domain. *International Journal of Learning and Teaching*, 10(1), 1–12. <https://DOI: 10.11591/ijere.v12i1.22565>
- Blut, M., Wang, C. Technology readiness: a meta-analysis of conceptualizations of the construct and its impact on technology usage. *J. of the Acad. Mark. Sci.* 48, 649–669 (2020). <https://doi.org/10.1007/s11747-019-00680-8>
- Chang, Y. W. & Chen J. (2021). What motivates customers to shop in smart shops? The impacts of smart technology and technology readiness. *Journal of Retailing and Consumer Services* 58, 102325, <https://doi.org/10.1016/j.jretconser.2020.102325>
- Christian M., Girsang L. & Yulita H. (2022). Measuring the ease-of-use aspects of shop usage behavior during the pandemic using the PLS-SEM approach. *Proceedings of the 1st International Conference on Emerging Issues in Humanity Studies and Social Sciences-ICE-HUMS*, 192-197, https://www.researchgate.net/profile/Michael-Christian-5/publication/366093493_Measuring_Ease_of_Use_Aspects_of_Shopee_Usage_Behavior_during_Pandemic_using_PLS-SEM_Approach/links/63916697484e65005bf1b25c/
- Damerji H. & Salimi A. (2021). The mediating effect of use perceptions on technology readiness and adoption of artificial intelligence in accounting. *Accounting Education* 30 (2), 107-130,
- Fitzgerald, G. E. (2020). Hypermedia in teacher education: Development of course support materials. *Multimedia and Megachange*, 47-68, <https://doi.org/10.1080/09639284.2021.1872035>
- Ismail, K. A. & Wahid, N. A. (2020). A review of technology readiness concept to explain consumer's online purchase intention. *International Journal of Industrial Management* 6, 49-57, <https://doi.org/10.15282/ijim.6.0.2020.5629>
- Jaji, M. M. (2020). Effect of Learning Management System in Teaching Telecommunication Concepts on Academic Achievement and Retention Ability of Students in Colleges of Education in Gombe and Yobe States [Doctoral dissertation the Modibbo Adama University of Technology, Yola]. <https://www.seahipublications.org/wp-content/uploads/2024/07/IJISTR-J-3->




2023.pdf

- Du-Plessis, E. (2020). Student teachers' perceptions, experiences, and challenges regarding learner-centered teaching. *South African Journal of Education*, 40(1). <https://doi.org/10.15700/saje.v40n1a163>
- Allman, B., Kimmons, R., Rosenberg, J. et al. Trends and Topics in Educational Technology, 2023 Edition. *TechTrends* 67, 583–591 (2023). <https://doi.org/10.1007/s11528-023-00840-2>
- Koliasa, O., Lelet, I., Serebriakova, V., & Yukhymets, S. (2021). The use of hypermedia technologies in higher education institutions during the COVID-19 lockdown. *Arab World English Journal (AWEJ) Special Issue on COVID-19 Challenges* (1)23 68-79. DOI: <https://dx.doi.org/10.24093/awej/covid.5>.
- Lavin A., Gilligan-Lee C. M., Visnjic A., Ganju S., Newman D., Ganguly S., Lange D., Baydin, A. G., Sharma A, Gibson A., Zheng S., Xing E. P., Mattmann C., Parr J., Gal Y. (2022). Technology readiness levels for machine learning systems. *Nature Communications* 13 (1), 6039. <https://doi.org/10.1038/s41467-022-33128-9>
- Mishra M., Gorakhnath I., Lata P., Rani R. & Chopra P. (2022). Integration of technological pedagogical content knowledge (TPACK) in classrooms through a teacher's lens. *International Journal of Health Sciences* 6, 12505-12512, DOI:10.53730/ijhs.v6ns3.9536 Corpus ID: 251044772
- Nuseir M. T., Aljumah A. I. & El-Refae G. A. (2022). Trust in adoption of internet of things: role of perceived ease of use and security. *International Arab Conference on Information Technology (ACIT)*. 2(3), 1-7, doi: 10.1109/ACIT57182.2022.9994207.
- Amka, A. (2020). A structural equation modeling study of the determinants of retirement preparedness. *International Journal of Innovation, Creativity and Change* 11(6), 1-24 https://www.ijicc.net/images/Vol11iss6/11601_Rasiah_2020_E_R.pdf
- Tahar A., Riyadh, H. A., Sofyani H. & Purnomo, W. E. (2020). Perceived ease of use, perceived usefulness, perceived security and intention to use e-filing: The role of technology readiness. *The Journal of Asian Finance, Economics and Business* 7 (9), 537-547, <https://doi.org/10.13106/jafeb.2020.vol7.no9.537>
- Toyon, M. A. S. (2021). Explanatory sequential design of mixed methods research: Phases and challenges. *International Journal of Research in Business and Social Science* (2147- 4478), 10(5), 253–260. <https://doi.org/10.20525/ijrbs.v10i5.1262>
- Uche, D. B., Osuagwu, O. B., Nwosu, S. N. & Otika, U. S. (2021). Integrating trust into technology acceptance model (TAM), the conceptual framework for e-payment platform acceptance. *British Journal of Management and Marketing Studies* 4 (4), 34-56, DOI URL: <https://doi.org/10.52589/BJMMS-TB3XTKPI>
- Venkatesh V.; Speier-Pero C., Aljafari R.; & Bala H. (2022) IT Use and Job Outcomes: A Longitudinal Field Study of Technology Contingencies. *Journal of the Association for Information Systems*, 23(5), 1184-1210. DOI: 10.17705/1jais.00760
- Wibawa, B., & Winarsih, M. (2020). The Development of Hypermedia Based E-Book for Integral Calculus Subject. *International Journal of Online & Biomedical Engineering*, 16(4). DOI: 10.3991/ijoe.v16i04.13393
- Zhou Y., Zhou Y. & Machtmes K. (2024). Mixed methods integration strategies used in education: A systematic review. *Methodological Innovations* 17 (1), 41-49, <https://doi.org/10.1177/20597991231217937>


Author Information

Abdulaziz Bello

 <https://orcid.org/0000-0002-4713-3498>

Aliko Dangote University of Science and Technology,

Ahmad Aliyu Deba

 <https://orcid.org/0000-0002-1684-7885>

Abubakar Tafawa Balewa University, Bauchi




Wudil Nigeria

Contact e-mail: abdullaziz_bello1980@kustwudil.edu.ng

Nigeria

Contact e-mail: daahmad@atbu.edu.ng

Paul Shehu Yaduma


 <https://orcid.org/0009-0004-2193-9372>

Abubakar Tafawa Balewa University, Bauchi

Nigeria

Contact e-mail: psyaduma@atbu.edu.ng

Sa'adatu Abubakar Mohammad

 <https://orcid.org/0000-0002-2092-6527>

Abubakar Tafawa Balewa University, Bauchi

Nigeria

Contact e-mail: smabubakar2@atbu.edu.ng
