

Unveiling Teacher Competence: A Mixed-Method Exploration of Technology Integration in Upper-Basic Education in Nigeria

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ABSTRACT Technology integration is one of the means of facilitating contemporary teaching and learning processes. This study investigated teachers' perceived competencies in technology integration through their years of teaching experience and gender in Awka Metropolis. The study adopted a sequential-explanatory design approach (MMR), with a sample size of 84 basic education teachers in public secondary schools. A questionnaire with a reliability coefficient value of 0.94 and a semi-structured interview were used as instruments for data collection in the study. Data were analyzed using descriptive analysis to answer the research question and t-test analysis to test the null hypotheses. The findings showed that teachers' perceived competence in technology integration in the classroom was highly positive. More so, the perceived competence of teachers with longer years of teaching was significant, while gender was insignificant. Factors such as technophobia (fear of technology), lack of finance, and poor digital literacy influence technology integration in the classroom. Amongst others, we recommended that stakeholders set up a model for the seamless integration of technology in upper-basic education in Nigeria.

Keywords: Basic science, Teachers' perceived competence, Technology integration, Upper basic education

1. INTRODUCTION

Technology integration (TI) is essential for modern teaching and learning processes, especially in light of the recent COVID-19 pandemic, which further exposed the need for technological advancement, especially in education. This emerging technological environment offers opportunities for teachers and students to improve their experiences through the use of some technological tools such as mobile devices, educational apps, virtual reality (Wakil et al., 2024), computers, projectors (Erickson, 2023), and other technological mediums of instructions. The potential of TI in the classroom is unlimited as it prepares students for future demands (Aiyedun, 2024), improves students' learning engagement (Chukwudum et al., 2024), and trains individuals to be productive in society (Igwe et al., 2022).

Based on the aforementioned potentials, teachers' and students' attendance to TI in the classroom is expected to be done with serious intentions. However, studies (Diallo, 2023; Gil-Flores et al., 2016) have indicated that many teachers lack the necessary skills for effective TI in the classroom, and this lack of technological skill has created a gap in practice in the classroom. Factors such as school leadership, self-efficacy, and teachers' openness to change significantly impact teacher use of technology (Aslan &

Zhu, 2016; Gil-Flores et al., 2016; Menabo et al., 2021). Ultimately, teacher competence and perceptions of technology play a crucial role in facilitating effective TI in the classroom. Despite numerous studies on TI generally, gaps persist in understanding how teachers perceive their competence in TI and how some factors, such as gender and teachers' number of years, influence these perceptions. Thus, this paper focuses on teachers' perceived competence in TI in basic education in Nigeria.

In Nigeria, technology has a recognized impact in addressing educational and national issues, leading to a strong advocacy from the federal government for TI at all levels of education (Etim, 2024; Wakil et al., 2024). However, despite this advocacy, studies reveal that over 90% of public schools lack computer access (Ameen et al., 2019; Onyia & Onyia, 2011). Consequently, traditional teaching methods have dominated the pedagogical practice, thus inhibiting learners' active participation (Oguezie et al., 2022; Nwuba et al., 2024). Lack of computer access, especially in the 21st educational practice, underlines a considerable deficiency in the Nigerian school

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system. Consequently, TI has attracted limited research attention in Nigeria (Etim, 2024), highlighting a critical gap in the literature concerning teachers' perceptions of TI. To fill this gap, a focus on teachers' perceived competence in TI in upper-basic education in Nigeria was necessary.

Basic education in Nigeria aims to equip students with fundamental scientific principles through Basic Science (Agbidye, 2015). As a subject, Basic Science develops essential scientific skills in the students and promotes interest in science at large. Supporting this premise, Udo and Jackson (2023) asserted that as a foundational science subject, it can drive transformative innovation by preparing students for the future in science and technology. Effective teaching of Basic Science is therefore crucial for the holistic development of learners, as it cultivates a scientific mindset, fosters curiosity and inquiry, builds a strong foundation for advanced science studies, and equips students with practical scientific knowledge applicable in everyday life (Christian-Ike et al., 2024). To achieve these benefits of Basic Science, one can categorically posit that understanding how teachers perceive their competence in TI in the 21st-century classroom is crucial in addressing the digital divide between teachers and students, which could be influenced by factors such as age, gender, and years of teaching (Eugene, 2006; Watson & Rockinson-Szapkiw, 2021; Akram et al. 2022; Kuzembayeva et al., 2023).

In their respective studies, Aslan and Zhu (2016), Gil-Flores et al. (2016), and Erickson (2023) found no significant gender differences in TI, maintaining that male and female teachers perceive TI equally. On the contrary, Udo and Jackson (2023) and Hong and Koh (2017) argued that male teachers showed more excellent TI perception than females. Teacher years of teaching could influence their beliefs, attitudes, skills, and pedagogical practices, including TI. Teachers with more years of teaching tend to be more favorable toward ICT integration (Pir et al., 2024) because they are better equipped to navigate technical challenges and utilize digital tools effectively. In their studies, Bracey and Stephen (2015) and Erickson (2023) reported significant differences between teacher years of teaching and TI. They maintained that teachers with longer years of teaching experience perceived their competence in TI as higher than newer teachers. However, Bussey et al. (2000) and Gil-Flores et al. (2016) found no significant relationship.

This study addresses a critical gap in the existing literature on TI in the classroom. Previous studies have examined teachers' perceived competence in TI in different contexts and higher levels of education (Aslan & Zhu, 2016; Alelaimat et al., 2021; Abiodun et al., 2023; Etim, 2024), but none, based on the available literature, have been carried out in upper basic education as well as in the study location, Awka Metropolis. More so, the present study employs a mixed-methods approach to explore teachers' perceived competence in TI. This relationship was further

explained through the mechanisms of teachers' gender and years of teaching. By addressing these issues, effective instructional designs for teachers could be achieved, improve students' overall learning experience and academic performance, and ultimately contribute to the limited literature on TI in Nigeria.

1.1 Theoretical Framework

The Technology Acceptance Model (TAM) examines how users perceive and adopt technology, highlighting that perceived usability and usefulness significantly influence user acceptance behaviors. This model particularly pertains to teachers and students as end users in educational settings and, therefore, proposes that users' attitudes toward technology are shaped by their perceptions. TAM is valuable in understanding why the use of technologies is sustained or otherwise. TAM provides valuable insights to explain how teachers perceive and utilize technology in educational settings. Teachers' perceptions directly impact the extent of technology use (Gil-Flores et al., 2016). Therefore, for technology to be used effectively, it must be perceived as useful. Amidst several definitions of perception, it was conceptualized as the level of self-ability attached to technology usage in the classrooms.

1.2 Research Questions

The following research question guided the study:

- What are the perceived competencies of teachers in TI in the classroom?

1.3 Hypothesis

The following null hypotheses were tested at a 0.05 level of significance:

- There is no significant difference in male and female teachers' perceived competence in TI in the classroom.
- There is no significant difference in teachers' years of experience and perceived competence in TI in the classroom.

2. METHOD

The study adopted a mixed methods research (MMR) design. The study consisted of a sample size of 84 Basic Science teachers in the 19 public schools in Awka Metropolis, selected using a simple random sampling technique (balloting with replacement). Questionnaires and semi-structured interviews were used to collect data. The questionnaire adapted from Almekhafi and Amedqadi (2018) was re-validated by three experts and yielded a reliability coefficient 0.94 using Cronbach Alpha. Section A of the questionnaire elicited participants' demographic information (Table 1), such as gender and years of teaching, while section B contained the questionnaire statements (Factors influencing 1). The 15-item questionnaire used a modified four-point scale extending from 4 as 'strongly agree' to 1 as 'strongly disagree.' The questionnaire was distributed to Basic Science teachers at the four sampled

Table 1 Participants' demographics

Participants	Gender	Qualifications	T/Experience
Teacher 1 (T1)	Female	BSC/ED	6-10 YEARS
Teacher 2 (T2)	Female	BSC/ED	1-5 YEARS
Teacher 3 (T3)	Male	MSc/ed	6-10 YEARS
Teacher 4 (T4)	Male	MSc/Ed	1-5 YEARS
Teacher 5 (T5)	Female	BSc/Ed	1-5 YEARS

schools, and the response rate was 85%. The semi-structured interview was conducted with 5 out of the 84 teachers sampled teachers.

The sample size for the qualitative study was selected using simple random sampling techniques. Although the sample size in a qualitative study could be contextual and differ based on the research paradigm (Boddy, 2016), Wutich et al. (2024) recommended a minimum sample size of four participants. To extend the quantitative results, the interview aimed to collect detailed data about basic science teachers' experiences in TI classrooms. The teachers were

explicitly asked to 'express their views toward the use of technology in the classroom' and highlight 'factors influencing the usage of technology in the classroom.' The duration of the interview was an average of 25 minutes. The interview was coded, transcribed, and analyzed thematically. This type of analysis classifies participants' expressions based on their similarities and differences (Levin & Wadmany, 2006). The participants varied across gender, academic qualifications, and years of teaching experience.

The quantitative data was retrieved and analyzed with SPSS v27, which yielded the study's results. Descriptive analysis was used to answer the research questions, while a T-test was used to test the null hypotheses.

3. RESULTS AND DISCUSSION

3.1 Descriptive statistics of teachers' perceived competencies in TI

Table 2 measures the responses of the teacher's perceived competence in TI. Results indicated that teachers value their competencies highly in several aspects of TI, with a weighted average of 3.13 ± 0.55 . Specifically, the

Table 2 Mean and standard deviation of teachers' perceived competencies in TI in the classroom

s/n	Item	SA	A	D	SD	$\bar{X} \pm SD$	Remark
1	I am proficient in using common input and output devices to make informed technological system choices.	71.4%	28.6%	0%	0%	$3.71 \pm .46$	Agree
2	I can use technology to locate, evaluate, and collect information from a variety of sources	71.4%	28.6%	0%	0%	$3.28 \pm .46$	Agree
3	I can use technology tools and information resources to increase productivity, promote creativity, and facilitate academic learning	28.6%	71.4%	0%	0%	$3.28 \pm .46$	Agree
4	I can collaborate in constructing technology-enhanced models, preparing publications, and producing other creative works using data and report results.	4%	71.4%	9.5%	0%	$3.09 \pm .53$	Disagree
5	I can use content-specific tools (e.g., software, simulation, environmental probes, Web tools) to support learning and research in the classroom	9.5%	57.1%	33.3%	0%	$2.76 \pm .62$	Disagree
6	I know how to use technology tools to process data and report results	14.3%	71.4%	14.3%	0%	$3.00 \pm .54$	Disagree
7	I have a strong understanding of the nature and operation of technology systems	38.1%	57.1%	4.8%	0%	$3.33 \pm .57$	Agree
8	Understand the legal, ethical, cultural, and societal issues related to technology	33.3%	61.9%	4.8%	0%	$3.28 \pm .56$	Agree
9	I can choose learning and technology resources that are adequate for science lessons.	38.1	61.9%	0%	0%	$3.38 \pm .49$	Agree
10	Competence in troubleshooting common computer problems	19.0%	42.9%	38.1%	0%	$2.80 \pm .74$	Disagree
11	I can discuss health and ethical issues related to technology.	42.9%	52.4%	4.8%	0%	$3.38 \pm .58$	Agree
12	Technology tools and resources can be used to manage and communicate information (e.g., finances, schedules, addresses, student assessments, correspondence).	28.6%	66.7%	4.8%	0%	$3.23 \pm .53$	Agree
13	I can discuss diversity issues related to electronic media	23.8%	71.4%	4.8%	0%	$3.19 \pm .51$	Agree
14	My opinion is that most students have so many other needs that technology use is a low-priority	0%	33.3%	38.1%	28.6%	$2.04 \pm .80$	Disagree
15	I can use a variety of media and formats, including telecommunications, to collaborate, publish, and interact with peers, experts, students, and other audiences	28.6%	66.7%	4.8	0%	$3.23 \pm .53$	Agree

Note: N = 84; SA = Strongly Agree; A = Agree; D = Disagree; SD Strongly Disagree. Decision (Weighted Average) = $46.98/15 = 3.13$

teachers perceived themselves as most competent in using common input and output devices to make informed decisions (3.71). Other areas include competence in the use of technology to locate and collect information (3.28), the use of technology to increase learning productivity (3.28), a strong understanding of the nature and operation of technology (3.33), understanding legal and societal issues related to technology (3.28), ability to choose the appropriate technology for each lesson (3.38), ability to discuss health and ethical (3.23), issues related to technology (3.38), ability to use technology to manage information and communication (3.23), ability to discuss diverse issues about technology (3.19) and ability to use a variety of media to interact with a mean of 3.23. From the table, it can be inferred that teachers have a good perception of their competence in TI in the classroom.

This finding conforms with Bauer and Kenton (2015), Udo and Jackson (2023), and Aslan and Zhu (2016), who found that teachers were highly skilled in technology and had the competencies required for successful TI. The result, however, contradicts that of Diallo (2023) and Mintah et al. (2023), who observed that teachers had a low perception of technology competencies. Teachers' demographic differences, contextual differences, age, and experiences may have affected their responses. These results imply hope for the students to prepare for the digital age and improve in TI in Nigerian classrooms.

The results also showed that teachers are less competent in some areas of technology instruction. These include using content-specific learning tools, processing data using technology, troubleshooting simple computer issues, and reporting findings. This is supported by Ndirika et al. (2014), who found that teachers were only competent in minor computer skills, with the majority only competent in using technology as reference material. Teachers' high perception of competence cannot be generalized as they grapple with complex areas in TI.

3.2 Independence sample t-test of perceived competence of male and female teachers

Table 3 shows there was no significant difference ($t(df) = 82, P = .95$) in the perception scores of Male teachers

(51.00 ± 5.19) and female teachers (48.74 ± 4.98). However, males with a higher mean value (51.00) reported a higher perceived competence in TI in the classroom. The magnitude of the difference in the means (mean difference = 0.14, 95%CI: -3.90 to 4.18) was non-significant. Hence, the null hypothesis (H1) that no significant difference in the perceived competence of male and female teachers in TI in the classroom was sustained.

The result revealed that male and female teachers have the same perception of their competence in TI (no significant difference). This aligns with the findings of Aslan & Zhu (2016), Gil-Flores et al. (2016), and Erickson (2023), who reported that there is no significant difference between gender and perceived TI. This implies that irrespective of gender, the perception of male and female teachers' competence in TI remains the same in upper-basic education in Awka Metropolis. However, the result disagrees with Udo and Jackson (2023) and Hong and Koh (2017), who observed significant differences in gender and teacher perception of competence in TI in favor of male teachers.

More so, the male teachers' mean score was higher than the female, which implies a higher perception of technology competence than the female. This could mean female teachers were less interested and confident in technology than males in Awka upper basic education in Awka Metropolis. This could also mean that male teachers have more technology training or support opportunities, leading to increased comfort and confidence. Hong and Koh (2017) found that female teachers were more anxious than male teachers about TI (hardware). The school culture and dynamics also encourage or discourage technology adoption among male and female teachers differently.

3.3 Perceived competence among teacher based on their years of experience

The findings (Table 4) revealed a significant difference ($t(df) = 82, P = .00$) between teachers with 6-10 years of experience (51.00 ± 2.17) and teachers with 1-5 years of experience (43.88 ± 3.98). Teachers with 6-10 years of experience had a significantly higher mean value ($M = 51.00$) when compared with teachers with 1-5 years of teaching

Table 3 T-test of the significance of male and female teachers' perception of competence in TI

	Gender	Mean	SD	Levene's Test of Equality		T	df.	Sig. (2-tailed)	Mean Diff.	95% Confidence Interval	
				F	sig					LL	UL
Perceived Competence	Male	51.00	5.19	3.28	.086	.074	82	.95	.14	-3.90	4.18
	Female	48.74	4.98								

Table 4 T-test of significance of teachers' years of teaching experience and their perceived competence in TI

	Experience	Mean	SD	Levene's Test of Equality		T	df.	Sig. (2-tailed)	Mean Diff.	95% Confidence Interval	
				F	sig					LL	UL
Perceived Competence	1-5yrs	43.88	3.98	6.88	0.17	-5.05	82	.000	-4.88	-6.92	-2.83
	6-10yrs	51.00	2.17								

experience (43.88). The magnitude of the difference in the means (mean difference = -4.88, 95%CI: -6.92 to -2.83) was significant. Thus, the null hypothesis (H2) that there is no significant difference in the teachers' years of teaching and their perceived competence in TI in the classroom was rejected.

The findings revealed that teachers with 6-10 years of experience had a higher mean perception of technology competence in the classroom. The result aligns with Bracey and Stephen (2015) and Erickson (2023), who observed a significant difference between the teachers' years of teaching and their perceived competence in TI. This implies that as teachers gain experience, they improve their TI in the classroom. In essence, teachers' years of teaching positively impart their technology use. This could also mean that experienced teachers, in terms of years of service, have a deeper understanding of their subject area, allowing them to quickly incorporate technology to improve students' learning experience. Several factors, such as increased self-confidence, initiative, pedagogical maturity, and personal motivation of the experienced teachers, may have influenced this perfect relationship. However, Bussey et al. (2000) and Gil-Flores et al. (2016) disagreed with the result. They maintain that irrespective of the teacher's years of teaching experience, their perception of technology competence is not affected. Thus, the present study disagrees with their reports.

3.4 Qualitative analysis

The interview was analyzed to understand teachers' experiences with TI in the classroom and to discover underlying factors that influence this experience. The result revealed recurring themes concerning the use of technology in the classroom. Two questions were posed to determine teacher experience: (a) the teachers' view on the use of technology in the classroom and (b) factors that influence these perceptions.

Q1: What is your perspective on using technology in the classroom?

Teacher one (T1) with 1-5 years of teaching experience gave her perspective on TI; "good innovation, but not robust enough accommodate different learning styles of the students. [...]". In the same vein, T2 said, "In my experience, technology allows me access to information, unlike the traditional classroom, and it enhances the digital literacy skills of students as well [...]". T4, however, stressed that "Technology is a contemporary practice in the 21st century, but its implementation and real-time practice is still very low [...]" T3 and T5 further emphasized TI and time management "it should be encouraged (T3) because "It saves times and energy. [...]"

The teacher's perspective on the use of technology in the classroom was qualitatively found to be positive. Their general perspectives were that technology is a good and contemporary innovation with the potential for enhancement of students' learning, access to information

unlike the traditional means of instruction, an opportunity for digital literacy acquisition, and that technology saves time and energy. This supports the quantitative findings that teachers in Awka Metropolis generally perceive their competence in TI as an aid to effective classroom instruction.

Despite teachers' general positive perspectives about technology use in the classroom, the researchers observed some salient but pertinent concerns from the teacher's responses. They expressed that some technological tools may not be robust enough to accommodate the different learning styles of the students and that the implementation and real-time practice of technology is still very low. The implication is that teachers are still facing challenges with the effective integration of technology in the classroom despite their general positive perspective. Teachers' low patronage of technology could be attributed to poor awareness, lack of monitoring, and teacher attitude toward technology use. This conforms with Ibara (2014), who states that many teachers still face difficulties delivering technology-compliant lessons in Nigeria.

Q2: Briefly explain things that make you use or not use technology in the classroom (Please answer in detail)

1) Time factor

All five teachers felt that using technology in the classroom requires adequate time for preparation and presentation. For instance, T2, who has been a teacher for four years and has been using technology, said, "Teachers need enough time both to master the skill of technology usage in the class and then enough time for presentation" [...]. T4 added, "Due to the time constraints, I find it difficult to effectively use technology during a forty-minute lesson period."

2) Teacher literacy and proficiency

Three of the five teachers interviewed admitted that technology demands teacher proficiency and skillsets. T3 and T5 added, "the level of digital and technological literacy amongst the teachers is not encouraging [...]" In this regard, T2 added, "Compared to the students, the gap is still wide [...]"

3) Other factors

Other factors influencing teachers' use of technology in the classroom were interpreted as technophobia, finance, availability, and accessibility of the tools (Figure 1). On these issues, T1 reported that "the integration of technology comes with a lot of concerns, so I accept and use technology with fear and reluctance." T4 noted that the "non-availability of technological and digital tools in Nigerian schools makes deployment of technology in the classroom nearly impossible."

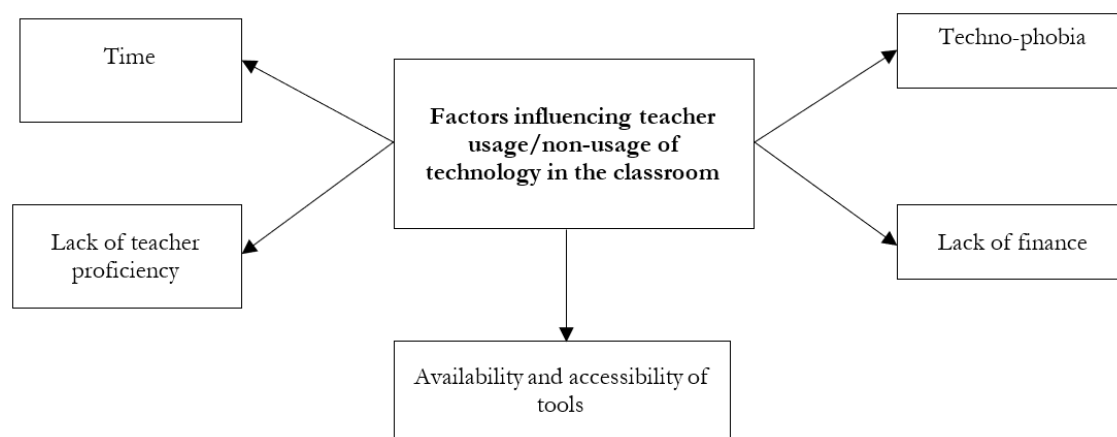


Figure 1 Factors influencing TI among teachers

The teachers' interview offered insight into teachers' TI experiences in the Awka Metropolis classroom. Whereas the teachers perceived that technology saves time and energy, they noted that TI requires adequate time for both preparation and presentation. Thus, time is an essential factor to consider when planning technology-based lessons. This aligns with Hall et al. (2011), who observed that innovations in the classroom require time and support for proper adoption and implementation to any substantial degree by the teachers. In essence, teachers should be supported time-wise (enough time) to plan and implement instructions with technology. On the other hand, teacher literacy and proficiency in TI were another factor.

Poor teacher literacy and proficiency in TI could be attributed to their lack of openness to change or innovation. Teachers who are open to change appear to adopt technologies quickly (Baylor & Ritchie, 2002). Openness is important because the teacher understands that technology helps students learn content and improve their higher-level thinking skills. However, a lack of openness to change may have predicted teachers' technophobia (Fear of technology) as a factor influencing TI.

4. CONCLUSION

This study examined teachers' perceived competence in TI in the classroom. The findings of this study show that teachers have a generally positive perception of their competence in TI, although they grapple with some complex areas. The relationship between male and female teachers regarding their perceived competence in TI was insignificant. However, a significant difference was observed between teachers' years of teaching experience and TI in favor of those with longer years of experience in teaching. This implies that male and female teachers perceive their competence in TI equally, irrespective of gender. Equal perception of technology by male and female teachers is a good sign that could lead to equal technological contribution, meeting global education

standards. However, teachers' perceived competence in TI was observed to increase with an increase in teachers' years of teaching. Thus, the connection between TI and the number of years in teaching was found to be a perfect relationship about TI; the older, the better.

Teachers should be exposed to consistent technology awareness through seminars and workshops to master complex areas in TI, thus bridging the digital divide. Stakeholders should also set up a model for the seamless integration of technology in upper-basic education to guide the teacher in achieving effective instruction. Teachers should adopt technology not as supplementary tools but as the central part of each lesson.

This study contributed to the Technology Acceptance Model by revealing that the perceived competence of teachers could predict their behavioral intention to use technology in the classroom. Also, the gender and years of teaching experience of teachers could moderate the use of technology in the classroom. Future studies should examine teacher TI in the light of the self-confidence, initiative, pedagogical maturity, and personal motivation of teachers other than their perceived competence. Factors contributing to teachers' fear of technology (technophobia) should be explored in future studies.

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