

# TECHNOLOGY-ENHANCED TEACHING STRATEGIES: BIOLOGY TEACHERS' AWARENESS AND UTILIZATION OF WISELY MANAGED CLASSROOM, INQUIRY BASED LEARNING, MOBILE INTEGRATION AND JIGSAW TECHNIQUES IN MINNA, NIGER STATE

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**ABSTRACT:** The one-size fits all teaching strategies is becoming a relic of the past, replaced by Technology-enhanced teaching strategies that tailor learning to individual student. Therefore, this study investigates the technology-enhanced teaching strategies through biology teachers' awareness and utilization of wisely managed classroom, inquiry-based learning, mobile integration, and jigsaw techniques in public and private secondary schools in Minna, Niger State. Using a cross-sectional survey of 61 teachers, a structured questionnaire was designed and used as instrument for data collection. The instrument was validated by experts in the fields of Science Education, Gombe State University, Nigeria and the reliability coefficient of 0.78 was found. Data was collected in-person and analyzed using frequency counts, percentages, mean, standard deviation and independent sample t-test. The findings reveal that while teachers are moderately aware of and utilize innovative strategies such as inquiry-based learning, multimedia instruction, and wisely managed classroom technology, their implementation remains limited. Male and private-school teachers showed slightly higher awareness and utilization compared to female and public-school counterparts. Though, most differences were statistically not significance. The study concludes that despite moderate awareness and utilization, the full application of inquiry-based learning, multimedia instruction, and wisely managed classroom technology is hindered by insufficient training, resources, and institutional support. The study recommends regular workshops and administrative encouragement to foster innovation in teaching Biology.

**KEYWORDS:** Education Technology, Inquiry Based Learning, Mobile Integration, JIGSAW Techniques

## I. INTRODUCTION

Biology is a fundamental science subject that guide students to understand life processes, environmental issues, and health-related concepts. Teaching Biology is essential for encouraging creativity and addressing social issues about living things, non-living things and their environments. The goal of teaching Biology at secondary schools' level, build and reinforce students' understanding of biological concepts through technology-enhanced teaching strategies. In this century, classroom demands technology-enhanced teaching strategies that cater to diverse learning needs and prepare students for a dynamic world. Technology-enhanced teaching strategies takes a proactive approach by incorporating new strategies and methods into classroom practices to improve the learning experience. The responsibility of teachers is to master innovative instructional strategies and to effectively utilize them in the teaching and learning process. Teachers who lack awareness of these instructional strategies are unable to apply them accurately or effectively (Udeani & Okafor, 2012).

Awareness is fundamental to effective utilization and productivity of any teaching strategy. Understanding the principles and content of such strategies enables individuals to adopt the right strategy, leading to improved productivity and performance (Olumorin, 2014). Teachers' awareness of technology-enhanced

teaching strategies plays a crucial role in their decision to utilize the strategy. Utilization of innovation in education involves adopting and applying new, creative ideas within the educational sector (Okpala *et al.*, 2022). This is essential for fostering a dynamic system that continually evolves by introducing new procedures, pursuing new goals, creating diverse outputs, and achieving greater differentiation over time. Employing technology-enhanced teaching strategies in teaching Biology often involves introducing novel ideas and methods, coupled with updated approaches to evaluating learning outcomes, ensuring a more effective and engaging educational process. Studies have documented different findings about male and female biology teachers on their awareness and utilization of technology-enhanced teaching strategies. A study found that male biology teachers have a higher awareness than their female counterparts (Olagunju *et al.*, 2017). However, Jones and Dindia (2014) found no significant difference between male and female teachers in their level of awareness and utilization of technology-enhanced teaching strategies. It is on this basis that this study investigates male and female biology teachers' awareness and utilization of technology-enhanced teaching strategies such as wisely managed classroom, inquiry-based learning, mobile integration, and jigsaw techniques in public and private secondary schools in Minna, Niger State.

## II. LITERATURE REVIEW

Technology-enhanced teaching strategies, including wisely manage classrooms technology, multimedia integrated instruction, inquiry-based learning, and Jigsaw strategy have been shown to enhance students' understanding and retention of biological concepts (Owolabi & Okebukola, 2020). Wisely Managed Classroom Technology involves utilization of technological gadgets in teaching. Schools have now started adopting one-to-one programs, where each student has access to their own device, such as a tablet or computer, for learning purposes (Djami, 2022). Teachers must manage technology wisely by incorporating it into a variety of engaging activities. Tools like Google Docs, YouTube, videos, and other innovative apps and websites can significantly enhance student engagement (Trust & Pektas, 2021). These resources allow teachers to remind students of upcoming assignments, provide visual learning through videos, facilitate group collaboration, organize learning materials, and assess student progress through games and online quizzes. Study found that when teachers use technology, students show greater motivation, focus, and achievement (Heggart & Yoo, 2020). The study suggest that wise technology management is about thoughtful planning, selective use, continuous review, and enhancing not replacing strong teaching practices. This approach is especially effective when combined with multimedia-integrated instruction (Owen, 2016). Multimedia Integrated Instruction is another technology-enhanced teaching strategies that refers to the use of multimedia applications that combine various media elements, such as text, graphics, images, audio, animations, and videos, to enhance the teaching and learning process (Nweke, 2015; Yusuf *et al.*, 2019). This approach involves delivering lesson content through carefully planned instructions that incorporate multimedia resources. Teachers use a mix of text, graphics, simulations, animations, and videos, often projected on a slide or board, to facilitate teaching (Mayer, 2021). Multimedia Integrated Instruction improves learning by presenting information in a variety of formats, including text, audio, video, and graphics. This can improve understanding, engagement, and knowledge retention (Zhang & Yang, 2023). Additionally, Inquiry-based teaching strategy is another strategy where teacher engages students through the uses of technology in problem-solving and experiential learning (Adewale *et al.*, 2020). Also, Inquiry-based teaching strategy prioritizes problems that require critical and creative thinking so students can develop their abilities to ask questions, design investigations, interpret evidence, form explanations and arguments, and communicate findings (Llewellyn, 2016; Ibrahim *et al.*, 2018). Studies have found that many teachers valued this strategy theoretically, most still resorted to traditional methods in practice (Olawale *et al.*, 2019; Nwankwo *et al.*, 2019). However, it was found that administrative encouragement and provision of resources significantly increased the use of inquiry-based strategy (Eze *et al.*, 2022). Jigsaw strategy is a cooperative learning strategy that asks groups of students to become experts on different aspects of a topic and then share what they learn with their classmates. It emphasizes cooperative learning

by providing students an opportunity to actively help each other build comprehension (Aronson & Bridgeman, 2021). There are many benefits to using the jigsaw method in one's classroom. For instances, students who take ownership in their learning understand the contents better. As active learners, students are directly immersed in the information and material, which promotes a deeper understanding of that material. When students are given the opportunity to contribute to a group, they also learn life skills such as communication and working within a timeline Johnson *et al.* (2015). This method also promotes collaboration and discussion, as well as self-motivated learning strategies. Students who work together learn to ask questions to clarify their understanding and provide critical feedback in appropriate manners. Despite the importance of these technology-enhanced teaching strategies, it was revealed that many science teachers do not adopt them in their classroom activities (Ofeimu & Kolawole, 2017). It is in view of this, the present study assesses the awareness and utilization of technology-enhanced teaching strategies including Wisely Managed Classroom Technology (WMCT), Multimedia Integrated Instruction (MII), inquiry-based teaching strategy, Jigsaw among male and female biology teachers in both public and private secondary schools in Minna, Niger State.

### III. METHODOLOGY

A cross-sectional survey research design was adopted in this study. The population of this study comprise of all Biology teachers in public and private senior secondary schools in Minna, Metropolis, Niger State who are directly involved in the teaching Biology at the secondary school level. A multistage sampling techniques was used, the schools were first grouped into strata based on public and private, after which a sample of 61 Biology teachers responded to the instrument using convenient sampling technique. A structured questionnaire titled "Biology Teacher Innovative Teaching Strategies Questionnaire (BTITSQ)" was designed and used as instrument for data collection. The questionnaire was divided into two parts: Part I and Part II. Part I focused on the respondents' demographic data include: gender, qualification, school name and school type. Part II was further divided into two sections. Each section contained items derived based on the research objectives. The two sections used three Likert scale to gather insights from the respondents on their level of Awareness and Utilization of Innovative Teaching Strategies. This approach was ensure that the instrument effectively captured the necessary information needed for the study. The research instrument was validated by experts in the fields of Science Education, Gombe State University, Gombe State, Nigeria. The instrument yielded a reliability coefficient of 0.78 and was considered reliable and fit for the study. The questionnaire was distributed to the Biology teachers in person, data collected was analyzed using descriptive statistics such as frequency counts, percentages, mean, and standard deviation and independent sample t-test. Mean range was used to determine level of awareness and utilization of innovative teaching strategy. Where mean values ranging from 0 to 1.49 was considered as low aware or utilization, 1.50 to 2.49 as moderately aware or utilization, and 2.50 to 3.00 as highly aware or utilization. The study was guided by the following research questions and hypotheses.

- (a). What is the level of awareness of technology-enhanced teaching strategies among biology teachers in secondary schools in Minna, Niger State?
- (b). To what extent do biology teachers among secondary schools in Minna, Niger State utilize technology-enhanced teaching strategies in their teaching?
- (c). What is the gender difference among Biology teachers of secondary schools in Minna, Niger state on their awareness of technology-enhanced teaching strategies?
- (d). What is the gender difference among Biology teachers of secondary schools in Minna, Niger state on their utilization of technology-enhanced teaching strategies?
- (e). What is the level of awareness of technology-enhanced teaching strategies between public and private secondary schools Biology teachers in Minna, Niger state?
- (f). What is the level of utilization of technology-enhanced teaching strategies between public and private secondary schools Biology teachers in Minna, Niger state?

### Research Hypothesis

Based on the research questions, the following null hypothesis was tested at 0.05 level of significance:

Ho1: There is no significance differences between male and female Biology teachers’ awareness of technology-enhanced teaching strategies among secondary schools in Minna, Niger state.

Ho2: There is no significance differences between male and female Biology teachers’ utilization of technology-enhanced teaching strategies among secondary schools in Minna, Niger state.

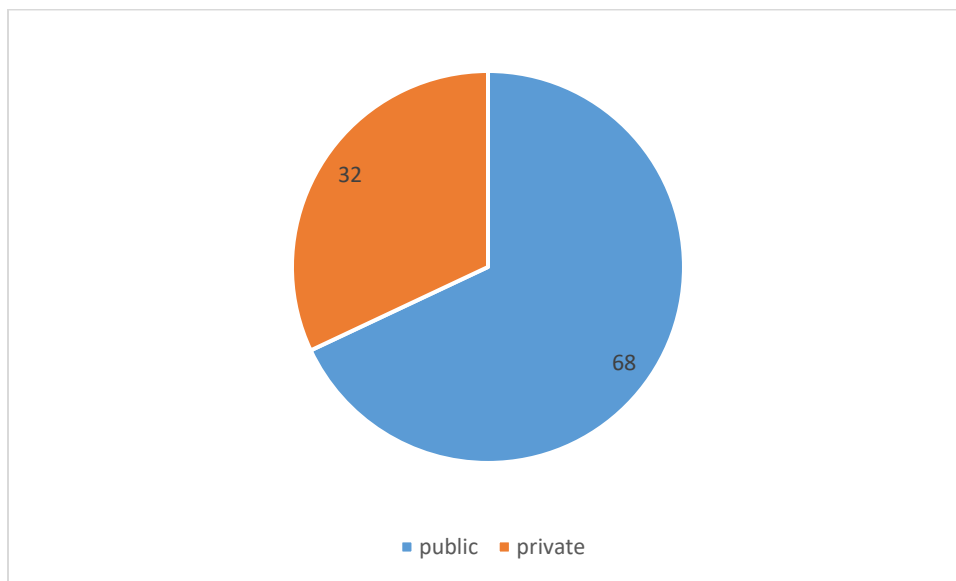
Ho3: There is no significance differences between private and public secondary schools Biology teachers’ awareness of technology-enhanced teaching strategies in Minna, Niger state.

Ho4: There is no significance differences between private and public secondary schools Biology teachers’ utilization of technology-enhanced teaching strategies in Minna, Niger state.

## IV. RESULTS AND DISCUSSION

### A. Demographic Presentation

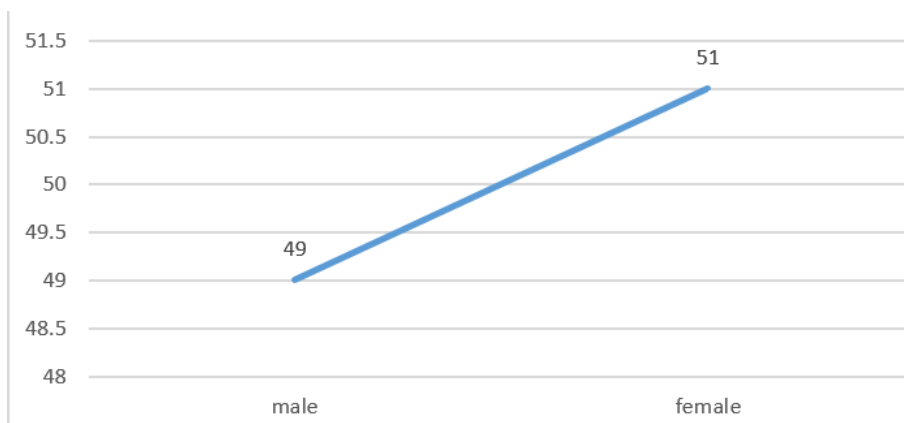
Distribution of sample size by School type and Gender among Biology Teachers Minna Metropolis Niger State. The distribution of demographic data of respondents in terms of School Type is presented in Figure 1:



V.

**Figure 1:** Frequency Demographic Data by School Type

Figure 1 shows the frequency and percentage distribution of the respondents. From the figure 62% of the respondents were from public schools while 38% of the respondents were from private schools. This shows that public school teachers responded more than the private school biology teachers.



**Figure 2:** Frequency and Percentage of Demographic Data by Gender

Figure 2 shows the frequency and percentage distribution of the respondents. From the figure 49% of the respondents were male Biology teachers while 51% of the respondents were female biology teachers. This shows that female biology teacher responded more than the male biology teachers.

**Table 1:** Mean and Standard Deviation of the Awareness of Innovative Teaching Strategies

S/N	ITEMS	Mean	Std. Deviation
1.	I am generally aware of innovative teaching strategies	2.67	.473
2.	I have received training, workshop/seminars on innovative teaching strategies.	2.05	.825
3.	I am familiar with integrating technology into biology teaching.	2.44	.620
4.	I am not aware of innovative teaching strategies.	1.93	.750
5.	I know different innovative strategies that can be used in teaching biology effectively.	2.26	.681
6.	I am aware of using inquiry-based learning (IBL) strategy in teaching biology.	2.30	.527
7.	I know about the use of collaborative and cooperative learning such as jigsaw strategies (JS) in teaching biology.	2.34	.655
8.	I know how to use wisely managed classroom technology (WMCT) strategy in teaching biology.	2.62	.553
9.	I am aware of multimedia integrated instructional (MII) strategy in teaching biology.	2.43	.618
10.	I regularly update myself on any new innovative teaching strategies.	2.41	.642
<b>Grand Mean</b>		<b>2.35</b>	

Table 1 Mean response on the level of awareness of innovative teaching strategies among biology teachers in secondary schools in Minna, metropolis. The table shows the awareness mean value of the respondents ranged between 1.93 and 2.67. Additionally grand mean of 2.35 shows the teachers were moderately aware of innovative teaching strategies.

**Table 2:** Mean and Standard Deviation of the Utilization of ITS

S/N	ITEMS	Mean	Std. Deviation
1.	I use innovative teaching strategy in teaching biology	2.64	1.033
2.	I adapt my teaching strategies to meet the diverse needs of biology learners	2.36	.578
3.	I adopt wisely managed classroom technology (WMCT) strategy when teaching some topics in biology.	2.39	.585
4.	I use inquiry-Based learning strategies (IBI) in my biology classroom	2.51	.595
5.	I use multimedia integrated instructional (MII) strategy such as videos and animations during biology lessons.	2.18	.695
6.	I organize student into groups for collaborative and cooperative learning while teaching biology	2.52	.595
7.	I regularly update my teaching strategies to include innovative methods	2.44	.563
8.	I am not using these innovative teaching strategies due to some challenges	2.11	.798
9.	I perceived innovation teaching strategies such as multimedia integrated instructional strategy (MII), wisely managed classroom technology (WMCT), inquiry-Based learning strategies (IBL), Jigsaw strategy(JS) are easy to use	2.46	.565
10.	These innovative teaching strategies are useful in teaching biology concept	2.64	.517
<b>GRAND MEAN</b>		<b>2.43</b>	

Table 2 Mean response on the utilization of innovative teaching strategies among biology teachers in secondary schools in Minna, metropolis. The table shows the utilization mean value of the respondents ranged between 2.11 and 2.64. Additionally, grand mean of 2.43 shows that the teachers moderately utilizing innovative teaching strategies in Minna, metropolis.

**Table 3:** Mean and Standard Deviation on Gender Awareness of ITS

Variable	Gender	Mean	Std. Deviation
AWARE	Male	2.42	.258
	Female	2.27	.309

Table 3 shows the mean and standard deviation on the gender difference among biology teachers' awareness of innovative teaching strategies. From the table, male teachers have mean value of 2.42 while the female teachers have mean value of 2.27. This shows that the male teachers are more aware of innovative teaching strategies than their female counterpart.

**Table 4:** Mean and Standard Deviation on Gender Utilization of ITS

Variable	Gender	Mean	Std. Deviation
UTILISE	Male	2.49	.282
	Female	2.36	.280

Table 4 shows the mean and standard deviation on the gender difference among biology teachers utilization of innovative teaching strategies. From the table, male teachers have mean value of 2.49 while the female teachers have mean value of 2.36. This shows that the male teachers utilized innovative teaching strategies more than their female counterpart.

**Table 5:** Mean and Standard Deviation between Public and Private Secondary School Biology Teachers Awareness of ITS

Variable	School Type	Mean	Std. Deviation
AWARE	Public	2.33	.294
	Private	2.38	.292

Table 5 shows the mean and standard deviation between public and private secondary school biology teachers' awareness of innovative teaching strategies. From the table, public schools' biology has mean value of 2.33. While the private school biology teachers have mean value of 2.38. This shows that the private school biology teachers are more aware of innovative teaching strategies than public school teachers.

**Table 6:** Mean and Standard Deviation between Public and Private Secondary School Biology Teachers Utilization of ITS

Variable	School Type	Mean	Std. Deviation
UTLISE	Public	2.38	.267
	Private	2.50	.306

Table 6 shows the mean and standard deviation between public and private secondary school biology teachers' utilization of innovative teaching strategies. From the table, public schools' biology teachers have mean value of 2.38 while the private school biology teachers have mean value of 2.50. This shows that the private school biology teachers utilized innovative teaching strategies more than their counterpart.

**Table 7:** Independent Samples t-test between Male and Female Biology Teachers Awareness of ITS

Variable	Gender	N	Mean	Std. Deviation	T	Df	p-value
AWARE	Male	30	2.42	0.258	2.005	59	.050
	female	31	2.27	0.309			

Table 7 shows the independent samples t-test conducted to compare male and female Biology teachers' awareness of innovative teaching strategies, although male biology teachers (M =2.42, SD = 0.258) have a slightly higher awareness of ITS than female teachers (M =2.27, SD = 0.309). The result shows that the difference was statistically significant,  $t(59) = 2.005$ ,  $p = 0.050$ . This means that there is significant difference between male and female biology teachers' awareness of innovative teaching strategies in Minna, metropolis. This implies that male teachers are more aware of ITS than their female counterpart.

**Table 8:** Independent Samples t-test between Male and Female Biology Teachers Utilization of ITS

Variable	Gender	N	Mean	Std. Deviation	T	Df	p-value
UTLISE	male	30	2.49	0.282	1.744	59	0.086
	female	31	2.36	0.280			

Table 8 independent samples t-test conducted to compare male and female Biology teachers’ utilization of innovative teaching strategies, male biology teachers (M = 2.49, SD = 0.282) have a slightly higher a of ITS than female teachers (M =2.36, SD = 0.280). The result shows that the difference was not statistically significant,  $t(59) = 1.744, p = 0.086$ . This means that there is not significant difference between male and female biology teachers’ utilization of innovative teaching strategies in Minna, metropolis. This implies that male teachers are more aware of ITS than their female counterpart.

**Table 9:** Independent Sample T-Test Between Private and Public-School Biology Teachers Awareness of ITS

Variable	School Type	N	Mean	Std. Deviation	t	Df	p-value
AWARE	public	38	2.33	0.294	-.671	59	0.505
	private	23	2.38	0.292			

Table 9 independent samples t-test result shows that private biology teachers (M = 2.38, SD = 0.292) public biology teachers (M =2.33, SD = 0.294),  $t(59) = -.671, p = 0.505$ , this means that there is significant difference between public and private biology teachers’ awareness of innovative teaching strategies in Minna, metropolis. This implies that private school biology teachers are more aware of innovative teaching strategies than their public counterpart.

**Table 10:** Independent Sample T-Test between Private and Public Biology Teachers’ Utilization of ITS

Variable	School Type	N	Mean	Std. Deviation	T	Df	p-value
UTLISE	public	38	2.38	.267	-1.589	59	0.117
	private	23	2.50	.306			

Table 10 independent sample t-test of public-school biology teachers (M= 2.38, SD = 0.267) while private school biology teachers (M = 2.50, SD = 0.306). The result shows that the difference was not statistically significant,  $t(59) = -1.589, p = 0.117$ , this means that there is no significant difference between public and private biology teachers’ utilization of innovative teaching strategies in Minna, metropolis.

### Discussion of the Findings

The study found that Biology teachers are moderately aware of wisely managed classroom, mobile integration, inquiry-based learning, and jigsaw techniques in Minna Niger State. This finding is supported by several studies in the literature e.g., Yusuf et al. (2022), Eze et al. (2022), Okonkwo et al. (2021) all in their respective findings showed that biology teachers are moderately aware of technology-enhanced teaching strategies. However, a report of a high level of awareness among biology teachers was found in a

study of Nwagbo (2011). This partially contradicted the finding of this study which could be due to several factors and therefore implies that awareness may vary depending on institutional support and teacher motivation. Suggesting that frequent participation in workshops and in-service training enhances teachers' exposure to innovative practices.

The finding on the biology teacher's utilization of technology-enhanced teaching strategies such as wisely managed classroom, mobile integration, inquiry-based learning, and jigsaw technique shows that they were moderately utilizing innovative teaching strategies. This finding is supported by Olawale et al. (2019), Okonkwo (2021), Nwankwo et al. (2019), Eze et al. (2022). Their findings showed that although many teachers valued these strategies theoretically but most teachers still resorted to traditional methods in practice. Key reasons cited included large class sizes, rigid school timetables, and a lack of institutional support experimentation in teaching. In their studies, it was indicated that the presence of administrative encouragement and provision of resources significantly increased the use of innovative techniques. The finding of gender on the awareness of biology teachers shows that male biology teachers are more aware of technology-enhanced teaching strategies than the female biology teacher. It further relieved that there is significant difference among male and female biology teacher. Supporting this finding is Afzal et al. (2023) who said that gender-based differences exist on the awareness of biology teachers innovative teaching strategies. Contrarily, Mohammed et al. (2024) founded that gender has no different on the awareness of innovative teaching strategies among biology teachers.

The male biology teachers utilized technology-enhanced teaching strategies more than their female counterpart. There is no significant difference between male and female biology teachers' utilization of innovative teaching strategies in Minna, metropolis. This finding is supported by Gbadamosi and Abimbola (2013), Mohamed et al, (2024) whose findings shows that gender has no significant influence on the biology teachers' utilization of technology-enhanced teaching strategies. The private school biology teachers are more aware of technology-enhanced teaching strategies than public school teachers and no significant difference was found. Supporting this finding, Eze et al. (2022), Yahaya et al. (2019), Adewale et al. (2020) whose studies shows private school teachers shows moderate awareness compare to the government institutions. This disparity may reflect the proactive investment of private schools in technology and innovation. On the utilization. The finding shows that Private school teachers utilized innovative teaching strategies more frequently though no difference from public school teachers. These findings supported by Yahaya et al. (2019), Bello et al. (2020) which showed a strong correlation between frequent training workshops and the adoption of innovative methods Schools. Between public and private school teachers' awareness, suggesting that recent government-sponsored workshops and ICT programs have begun bridging the awareness gap in public schools.

## VI. CONCLUSION

Based on the findings of this study, it implies that biology teachers in Minna Metropolis are moderately aware and utilized technology-enhanced teaching strategies. While, private school biology teachers demonstrate high awareness and utilization of technology-enhanced teaching strategies compared to public schools. Hence, biology teachers need to be up skill to bridge the awareness gap, and create a more enable environment for the practical application of technology-enhanced teaching strategies. It was recommended that Niger State Ministry of Educational Board should organize regular training, workshops, and seminars for biology teachers on different types of technology-enhanced teaching strategies to improve the use of technology-enhanced teaching strategies in secondary schools in Minna, Niger State. Also, School administrators should encourage and create supportive environment for female biology teachers to adopt technology-enhanced teaching strategies in improving their teaching.

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