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ASSESSING BIOLOGY TEACHERS' PEDAGOGICAL CONTENT KNOWLEDGE AND ITS INFLUENCE ON STUDENTS' LEARNING DIFFICULTIES IN SECONDARY SCHOOLS IN ILORIN METROPOLIS, NIGERIA

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Abstract

This study explored the Pedagogical Content Knowledge (PCK) of biology teachers concerning students' learning difficulties in secondary schools in Ilorin metropolis, Kwara State, Nigeria. Employing a descriptive survey research design, the study targeted all biology students and teachers in secondary schools within Kwara State. A sample of 120 biology teachers and 180 senior secondary school II (SSII) biology students was selected using random and purposive sampling methods. Guided by three research objectives, the study addressed two research questions descriptively and tested one null hypothesis. Data was collected using two researcher-developed questionnaires: the Pedagogical Content Knowledge of Biology Teachers (PCKBT) and the Teacher's Knowledge of Understanding Student's Learning Difficulties (TUSLD).

Descriptive statistics, including frequency and percentages, were used to answer the research questions, while an inferential t-test was used to test the hypothesis. Findings revealed that the PCK of biology teachers is low. Additionally, male students with learning difficulties scored higher (M = 18.94, SD = 3.45) than female students (M = 16.49, SD = 3.48). The study found a significant gender influence on the learning difficulties experienced by biology students (F= .003, p=.000 < 0.05), leading to the rejection of the null hypothesis. These insights can help develop interventions to enhance biology teachers' PCK and could improve biology education for all students.

Keywords: *Gender; Ilorin metropolis, Learning difficulties, Pedagogical content knowledge*

INTRODUCTION

Globally, teachers that are needed for the actualization of the sustainable developmental needs of society are teachers that make teaching and learning interesting, understandable, meaningful and certified competent, rather than those with ordinary paper qualifications. Such teachers should be able to transform subject content and pedagogy into meaningful learning outcomes. Teachers with good knowledge base on pedagogy are teachers that can meet the demand of 21st century teaching and learning. They are teachers with skills that can be able to cater for the generation 'Z' students. The knowledge that integrates and transforms the teachers' pedagogical competence is what makes such teachers stand out (Moreira et al., 2023).

When we examine the current and future landscape of education, it becomes evident that the expertise of teachers in their respective subjects holds immense significance. The pedagogical content knowledge (PCK) possessed by teachers plays a pivotal role in shaping effective teaching methods and ensuring the successful implementation of curricula. By allowing the fusion of content with pedagogy, PCK holds the potential to greatly impact students' academic achievements over the long term. To excel in their roles, teachers must possess a comprehensive understanding of relevant information, concepts, principles, and methodologies. This depth of comprehension serves as a compass for informed pedagogical deliberation and decision-making (Ahmed & Shogbesan, 2023). Teachers are important to the success of any educational system and the success of any nation in general. Indisputably, the teacher is the most important educational resource in school. The world is not static but dynamic. Therefore, systems in a dynamic world are changing every day. Consequently, there has been a growing focus on discussions surrounding teachers' pedagogical knowledge by various stakeholders within the education sector in recent years. It is a well-known fact that any nation whose government strives to achieve greatness should provide students with highly qualified teachers who are vast in

pedagogical knowledge, and ethically sound. Evidence available from experience suggests that teachers' intellectual abilities significantly affect students' learning experiences. Hence, educators are now focus on the knowledge of the subject matter because research suggest that teachers in Nigerian secondary schools lack essential pedagogical knowledge for teaching (Odumosu. et al, 2018).

Pedagogy refers to the teaching skills teachers use to impart the specialized knowledge or content of their subject area(s). Effective teachers display a wide range of skills and abilities that lead to creating a learning environment where all students feel comfortable and are sure that they can succeed both academically and personally. This complex combination of skills and abilities is integrated in the professional teaching standards that also include essential knowledge, dispositions, and commitments that allow educators to practice at a high level. In an attempt to find solutions to problems confronting teaching and learning in Nigeria, teacher pedagogy needs to be critically considered. Enhancing student achievements involves enhancing the caliber of the teaching staff, as noted by Bakare (2018).

Pedagogical content knowledge (PCK) denotes the amalgamation of subject matter proficiency (Content Knowledge, CK) with teaching skills (Pedagogical Knowledge, PK) to organize instruction in a manner that addresses the diverse interests and abilities of learners. The ability to organize, plan, and present content in such a manner that it mostly understand by student in a given context (Ahmed & Shogbesan, 2023). Shulman Lee introduced the concept of pedagogical content knowledge (PCK) in the 1980s, highlighting a previously overlooked aspect of educational research. Since its introduction, PCK has garnered significant attention from educational researchers, redirecting the focus of research towards previously neglected paradigms. This shift has bolstered the teaching profession, as noted by Carlson (2019). The PCK is divided into two, the content knowledge (CK) and pedagogical knowledge (PK).

Pedagogical knowledge (PK) simply refers to the knowledge or method of how teachers teach in theory and practice. It is formed by an educator's teaching beliefs and concerns the interplay between culture and the different ways the student used to learn. This broad definition of pedagogy covers various aspects of teaching, and there are many moving parts to pedagogy that include teaching styles, feedback, and assessment. The term pedagogy boils down to the study of different teaching methods that are centered on dissemination and acquisition of knowledge through teaching and learning of the content of a curriculum. Pedagogy or what is commonly

referred to as teachers' technical skills is what distinguishes professional teachers from nonprofessionals. In today's educational practice, pedagogical skills appear to be a rare and scarce commodity even among professionally trained teachers. Pedagogical skills consist of knowledge of classroom, assessment, methods of motivating students, personal knowledge about particular students and their families, and socio-interactional skills (Clark & Walsh, 2018). From this, we can infer that not everyone in the classroom today possesses the needed pedagogical skills to influence students' learning and by extension, their academic performance. Because when the pedagogical skill is lost, content may be distorted (Bakare, 2018).

Content Knowledge encompasses the essential concepts, principles, relationships, processes, and applications that students are expected to understand within a particular subject area. This knowledge extends to understanding proofs, evidence, and methodologies used to acquire and develop this understanding. It typically refers to the information, concepts, theories, and principles taught and learned in academic courses, distinct from the skills like reading, writing, or researching, which are also part of the educational curriculum. Common content knowledge is defined by its shared use in common across adult pursuits other than just teaching. For example, engineers and mathematics teachers both use knowledge of how to solve algebraic problems in conducting their day-to-day work (Kayalar & Kayalar, 2017).

According to Shulman (1986) emphasised on teachers' knowledge and pedagogy being treated as mutually exclusive instance, affirmed that practical exclusion was product of teacher education programmes in which a focus on either subject matter or pedagogy dominated. To address the dichotomy, He considered the relationship between the two by introducing a notion called pedagogical content knowledge. According to Yulinda and Ilma (2018), pedagogical content knowledge encompasses various effective methods of representing topics, including analogies, illustrations, examples, explanations, and demonstrations. It involves presenting and formulating subjects in a way that is understandable to others, which entails recognizing what aspects of a topic may be easy or difficult for learners based on their age and background, including their existing conceptions and misconceptions. Pedagogical content knowledge encompasses a combination of key elements such as subject matter expertise, understanding of student needs and potential misunderstandings, familiarity with the curriculum, grasp of general teaching methods, and creativity. Furthermore, it involves knowing what, when, why, and how of teaching, drawing from a reservoir of knowledge derived from effective teaching practices and

personal teaching experiences, aiming to nurture individuals capable of making meaningful and positive contributions toward addressing challenges facing humanity on Earth (Adela, 2009). It is therefore essential for both the teacher and students to interact with others outside their domain. This leads to the collaboration of students across the globe. With online platforms and video conferencing tools, students can do joint projects, discussions, and cultural exchanges with peers of a diverse background (Verzella, 2018).

At its core, the focus of pedagogical content knowledge revolves around the processes of teaching and learning. Numerous researchers have explored different models of PCK such as Schiering et al. (2023), Fernandez-Rio and Iglesias (2024), and Park and Oliver (2008). In their work, Park and Oliver (2008) built upon Magnesson's model, developing a hexagonal framework that encompasses several key components of PCK. These components comprise orientation to teaching science, knowledge of the science curriculum, awareness of students' grasp of science concepts, teacher confidence in teaching, familiarity with instructional methods for science education, and comprehension of assessing science learning. In terms of PCK related to students' understanding of science, there are factors such as misconceptions, learning obstacles, motivation and engagement, and individualized needs. To enhance their grasp of biology, biology teachers should possess sufficient understanding of students' learning challenges. This aspect is recognized as a component of the Knowledge of Students' Understanding in the Pedagogical Content Knowledge model outlined by Park and Oliver (2008). One of the possible factors that can contribute to learning difficulties is learning style. If teachers are not acquainted with appropriate PCK, it may affect students learning styles and lead to learning difficulties.

The term "learning difficulties" originated in the early 1960s and has strong connections to educational policies (Fletcher, 2019). Since its inception, definitions of learning difficulties have primarily been descriptive and have avoided providing causal models. It is commonly believed that these difficulties arise within the context of overall low cognitive abilities, often indicated by a low Intelligent Quotient (IQ) score, or they may manifest as specific challenges with unexpectedly low performance in particular areas despite normal overall intelligence. According to the International Statistical Classification of Diseases and Related Health Problems (ICD-10) (World Health Organization, 2010), specific forms of learning difficulties are termed learning disorders, which can include issues with basic reading, spelling, and arithmetic. The term "learning difficulties" serves as an overarching term encompassing academic challenges

stemming from various sources, including general learning deficits and issues with achieving satisfactory academic performance, particularly in comprehending science subjects, notably biology.

Biology is a branch of science which studies life. It deals with scientific techniques, attitudes and skills such as: observations, communicating, predicting and others. Therefore, biology education is the act of teaching and learning to inculcate or transfer these attitudes, techniques and skills to the students (Mamman, et. al, 2018). This process requires quality biology teachers to lead the crusade. A qualified biology teacher is assumed to have a mastery of employing relevant teaching methodology to suit his lesson delivery in other to enhance understanding of subject matter by all students. Using the appropriate teaching strategy will give rise to quality teacher productivity in all spheres of teaching life. The Teacher's primary role is to facilitate students' learning as well as the overall comprehension of the materials.

Biology is one of the science subjects offered at the Senior Secondary School level and higher institutions in Nigeria. It is generally defined as the study of life. The significance of Biology in the Nigerian Secondary School curriculum cannot be overemphasized as equipping students with sound background in theories and practical knowledge of Biology would contribute greatly to their ability to manage natural resources in their immediate environment and the larger society. Concepts learnt in Biology as indicated in the curriculum are environmental concepts such as the natural environment, natural resources, pollution, solid waste disposal, degradation, population, famine, health issues, energy conservation, global warming, deforestation, and Desertification and ozone depletion among others. All these concepts are learned by the students when they can overcome their learning difficulties through appropriate learning styles.

According to the National Policy on Education, Federal Republic of Nigeria (FRN, 2014), learning of biology will provide the students with suitable laboratory and field skills in biology, meaningful and relevant knowledge in biology, scientific knowledge that is applicable, in health, agriculture, personal and community daily life matters and development of functional scientific attitudes. To make objectives of teaching and learning of biology achievable, emphasize should be placed on field studies, guided discovery, laboratory techniques and skills along with Conceptual thinking in the curriculum. In pursuance of the stated objectives, the (2009 up till date) edition of the biology curriculum (FRN, 2014) has organization of; life, work, environment and continuity of life as its themes.

Learning difficulties encompass various challenges that students may face in their educational journey. Specifically, these difficulties include a range of diverse disorders that affect learning, speaking, writing, reading, processing information, performing mathematical calculations, maintaining attention, and coordinating movements (Lama, 2019). A significant number of students with learning difficulties struggle primarily with reading and comprehending written text. Reading itself is a complex cognitive task involving the interpretation and analysis of letters, sounds, and the meaning of words in written language. Leonie et al. (2024) notes that due to fundamental assumptions about knowledge and existence, students often find it challenging to grasp how the structure of the cell membrane facilitates its dual roles of separating and connecting environments to sustain life processes.

Kyriakopoulos (2024) provide numerous examples of learning difficulties, including significant issues with reading, writing, spelling, arithmetic, and spatial orientation, such as differentiating left from right, up from down, and front from back. It also points out perceptual and language weaknesses, manual clumsiness, and problems with associations, like linking speech sounds to their written symbols in reading and writing. Individuals with learning difficulties often have trouble processing certain types of information. In the United States, the term "specific learning disability" is legally defined as a condition impacting one or more basic psychological processes involved in understanding or using spoken or written language. This can lead to difficulties with listening, thinking, speaking, reading, writing, spelling, or doing math. It is crucial to distinguish that "learning difficulty" does not refer to problems caused mainly by visual, auditory, or motor impairments, intellectual disabilities, emotional disturbances, or environmental, cultural, or economic factors (Johann et al. 2024).

According to a report by the National Association of Special Education Teachers, classroom teachers are usually the first to notice signs of learning difficulties and may refer any student, regardless of gender, for special education evaluation. Moreover, teachers play a role in collecting assessment data and coordinating specialized services. While students can be identified as having learning disabilities at any age, they are most often observed during elementary school. Alongside these primary indicators of learning disabilities, teachers should also be attentive to various other signs, as noted by Karunanayake et al. (2020).

While gender may influence how learning difficulties are expressed and their prevalence, it's crucial to recognize that these difficulties are highly personalized and influenced by a

combination of various factors, such as genetics, environment, and the level of educational support provided. Research has shown that certain learning difficulties, such as dyslexia and Attention Deficit Hyperactivity Disorder (ADHD), can occur in both boys and girls, but they may manifest differently. Boys are often diagnosed with these conditions more frequently than girls, potentially due to differences in how symptoms are expressed or societal biases in diagnosis (Attoe & Climie, 2023).

The present study assesses biology teachers' pedagogical content knowledge and its influence on students' learning difficulties in secondary schools in Ilorin metropolis, Nigeria. Specifically, the study sought to:

i. examine the level of pedagogical content knowledge among biology teachers in high schools located in Ilorin Metropolis, Kwara State;
ii. identify the types of difficulties do senior school biology students in Ilorin Metropolis, Kwara State face in their learning; and
iii. examine the influence of gender on the learning difficulties encountered by biology students in Ilorin metropolis, Kwara State, Nigeria.

Research Questions

The following research questions were answered to guide this study:

1. What is the level of pedagogical content knowledge among biology teachers in high schools located in Ilorin Metropolis, Kwara State?
2. What types of difficulties do senior school biology students in Ilorin Metropolis, Kwara State face in their learning?

Research Hypotheses

The following hypothesis was tested in this study:

Ho: There is no significance influence of gender on the learning difficulties encountered by biology students in Ilorin metropolis, Kwara State, Nigeria.

METHODS

This study employed a descriptive survey research design. Data were collected using self-designed questionnaires titled "Pedagogical Content Knowledge of Biology Teachers (PCKBT)" and "Teachers' Knowledge of Students' Learning Difficulties (TUSLD)." These questionnaires were distributed to both biology teachers and senior secondary school biology students. Each questionnaire was divided into two sections: one for demographic data and another for the

survey. The PCKBT survey included 20 items where respondents indicated their level of agreement on a scale from strongly agree (SA) to strongly disagree (SD). The TUSLD survey consisted of 10 items addressing students' learning difficulties. Both instruments underwent content and face validation by experts. The split-half reliability technique was employed to conduct a pilot test in senior schools located in remote areas of Moro Local Government Area, Kwara State, which were not included in the main study. The pilot test involved 30 biology students and 20 biology teachers. The reliability of the instruments was assessed using the Cronbach Alpha method, yielding reliability coefficients of 0.85 for students and 0.79 for teachers. These instruments were then administered to the biology teachers and students targeted in the study. The data collected were analyzed using percentages and t-tests, with a significance level set at 0.05.

RESULTS

Table 1:

Demographic Distribution of Respondents

Variables	Frequency	Percentage (%)
Gender (students)		
Male	96.0	54.5
Female	80.0	45.5
Total	**176**	**100.0**
Gender (teachers)		
Male	62.0	54.8
Female	51.0	45.2
Total	**113.0**	**100.0**

Table 1 presents the gender distribution of both biology students and teachers who participated in the study. Among the 166 student respondents, 91 (54.8%) were male and 75 (45.2%) were female. For the 113 teacher respondents, 62 (54.8%) were male and 51 (45.2%) were female. This indicates that the majority of the respondents, both students and teachers, were male.

Research Question One:

What is the level of pedagogical content knowledge among biology teachers in high schools located in Ilorin Metropolis, Kwara State?

Table 2.

Biology teachers' pedagogical content knowledge in senior schools in Ilorin Metropolis, Kwara State

S/N	ITEMS	SA (%)	A (%)	D (%)	SD (%)
1	I have a strong command of pedagogical strategies to effectively teach biology concepts.	44 (38.9)	66(58.4)	3 (2.7)	0
2	My teaching methods incorporate a deep understanding of both subject matter and instructional techniques.	58(51.3)	50(44.2)	5(4.1)	0
3	I am skilled at adapting my teaching approach to suit the diverse learning needs of my students.	42(37.3)	69(61.1)	2(1.8)	0
4	I frequently integrate innovative teaching methods to enhance my students' understanding of biology.	43(38.1)	68(60.2)	2(1.8)	0
5	I am confident that my pedagogical content knowledge positively impacts my students' learning outcomes.	49(43.4)	60(53.1)	4(3.5)	0
6	I consistently gather feedback from students to improve my teaching methods in biology.	42(37.2)	65(57.5)	5(4.4)	1(0.9)
7	I encourage active participation and discussions among my biology students during classes.	50(54.9)	62(54.9)	1(0.9)	0
8	I provide supplementary resources such as readings and online materials to support biology learning.	44(38.9)	62(54.9)	7(6.2)	0
9	I collaborate with colleagues to exchange teaching strategies and stay updated on the latest developments in biology education.	48(42.5)	62(54.9)	3(2.7)	0
10	I use technology effectively in my teaching, incorporating relevant educational tools and online resources to enhance the learning experience for my students.	42(37.2)	66(58.4)	5(4.4)	0
11	I receive formal training in pedagogy and instructional strategies related to my subject.	42(37.2)	64(56.6)	7(6.2)	0
12	I stay updated with the latest development in my subject area and teaching methods.	38(33.6)	70(61.9)	5(4.4)	1(0.9)
13	I have confident in my ability to effectively convey complex subject matter to students.	41(36.3)	64(56.6)	8(7.1)	1(0.9)
14	I use a specific instructional strategy or teaching techniques to make difficult concepts more understandable for my students.	36(31.9)	70(61,9)	6(5.3)	0
15	I differentiate my teaching methods to accommodate students with varying levels of prior knowledge or abilities in my subject area.	40(35.4)	68(60.2)	5(4.4)	0
16	I integrate real world applications or examples into my teaching to make the content more reliable to students.	45(39.8)	68(60.2)	7(6.2)	0
17	I assess my students' understanding of the subject matter, to adjust my teaching.	41(36.3)	64(56.6)	8(7.1)	0
18	I foster critical thinking and problem-solving skills among my	36(31.9)	70(61,9)	6(5.3)	0

	students within my subject area.				
19	I address cultural diversity and inclusivity in my teaching to ensure all students fell valued.	40(35.4)	68(60.2)	5(4.4)	0
20	I adapt pedagogical approach to overcome challenging situation while teaching a specific topic.	45(39.8)	60(53.1)	7(6.2)	0

Table 2 revealed that many respondents, 110 (97.3%), agreed with the statement: I have a strong command of pedagogical strategies to effectively teach biology concepts, while 3(2.7%) respondents disagreed with the statement. 108 (95.5%) respondents agreed on the statement : My teaching methods incorporate a deep understanding of both subject matter and instructional techniques, while 5(4.4%) of respondents disagreed on the statements, furthermore, 111 (98.4%) of the respondents agreed on the statement: I am skilled at adapting my teaching approach to suit the diverse learning needs of my students, while 2 (1.8%) respondents disagreed on the statement. 111(98.4%) respondents agreed on the statement: I frequently integrate innovative teaching methods to enhance my students' understanding of biology.

While 2 (1.8%) disagreed with the statement.109(96.5%) respondents agreed on the statement: I am confident that my pedagogical content knowledge positively impacts my students' learning outcomes, while 4(3.5%) disagreed. 107(94.7%) respondents agreed on the statement: I consistently gather feedback from students to improve my teaching methods in biology 6(5.3%) disagreed. 112(99.3) of the respondents agreed on the statement: I encourage active participation and discussion among my biology students during classes, while 1 (.9%) respondent disagreed on the statement. 106(93.8%) agreed on the statement: I provide supplementary resources such as readings and online materials to support biology learning ,while 7(6.2%) respondents, disagreed with the statement, 110 (97.4%) of the respondents agreed on the statement:

I collaborated with colleagues to exchange teaching strategies and stay updated on the latest development in biology education, while 3 (2.7%) respondents disagreed on the statement. 108(95.5%) respondents agreed on the statement: I use technology effectively in my teaching incorporating relevant educational tools and online resources to enhance the learning experience for my students, while 5(4.4%) disagreed. 106(93.8) of the respondents agreed on the statement: I receive formal training in pedagogy and instructional strategies related to my subject, while 7 (6.2%) respondents disagreed on the statement. 108(95.5%) agreed on the statement: I stay

updated with the latest development in my subject area and teaching method ,while 5(4.4%) respondents, disagreed with the statement, 105(92.9%) of the respondents agreed on the statement:

I have confidence in my ability to effectively convey complex subject matter to subjects, while 8(7.1%) respondents disagreed on the statement. 106(93.8%) respondents agreed on the statement: I use a specific instructional strategy or teaching techniques to make difficult concepts more understandable for my students, while 7(6.2%) disagreed. 108(95.5) of the respondents agreed on the statement: I differentiate my teaching methods to accommodate student with varying levels of prior knowledge or abilities in my subject area, while 5 (4.4%) respondents disagreed on the statement. 105(92.9%) agreed on the statement: I integrate real world applications or examples into my teaching to make the content more reliable to student, while 8(7.1%) respondents disagreed with the statement, 110(97.3%) of the respondents agreed on the statement: I assessed my students' understanding of the subject matter to adjust my teaching, while 3(2.7%) respondents disagreed on the statement.

104(92%) of the respondents agreed on the statement: I foster critical thinking and problem-solving skills among my students within my subject area, while 9(8%) respondents disagreed on the statement. 103(91.1%) agreed on the statement: I address cultural diversity and inclusivity in my teaching to ensure all students fell valued ,while 10(9.9%) respondents disagreed with the statement, 106(93.8%) of the respondents agreed on the statement: I adapt pedagogical approach to overcome challenging situation while teaching a specific topic, while 7(6.2%) respondents disagreed on the statement. This indicates that many teacher respondents agreed on the adequacy of biology teachers' pedagogical content knowledge in senior schools within the Ilorin metropolis, Kwara State.

Research Question Two:

What types of difficulties do senior school biology students in Ilorin Metropolis, Kwara State face in their learning?

Table 3.

Types of learning difficulties faced by biology students in senior secondary schools

S/N	ITEMS	SA	A	D	SD
1	I find it difficult to understand complex biological concepts.	43(41.5%)	3(1.7%)	85(48.3%)	15(8.5%)
2	The language used in my biology	67(38.1%)	80(45.5%)	18(10.2%)	11(6.3%)

	textbooks is too difficult to understand.				
3	I struggle with the amount of memorization required in biology.	60(34.1%)	69(39.2%)	31(17.6%)	15(8.5%)
4	There are not enough practical experiments in my biology classes.	82(46.6%)	76(43.2%)	11(6.3%)	6(3.4%)
5	I have difficulty connecting biological theories to real-life situations.	61(34.7%)	81(46.0%)	24(13.6%)	10(5.7%)
6	I do not have access to enough supplementary learning materials.	75(41.5%)	85(48.3%)	14(8.0%)	4(2.3%)
7	The pace of teaching in biology classes is too fast for me to keep up.	89(50.6%)	60(34.1%)	20(11.4%)	7(4.0%)
8	8. I find it challenging to prepare for biology exams.	74(42.0%)	89(50.6%)	13(7.4%)	0
9	I often do not receive enough support from my biology teacher.	85(48.3%)	65(36.9%)	22(12.5%)	4(2.3%)
10	I have trouble understanding biology because of a lack of foundational knowledge.	58(33.0%)	66(37.5%)	23(13.1%)	7(4.0%)

Table 3 summarizes responses from senior school biology students in Ilorin Metropolis, Kwara State, highlighting the difficulties they face in learning biology. A notable portion of students (41.5%) struggle with understanding complex biological concepts, though 48.3% disagree, indicating mixed perceptions. A significant majority (83.6%) find the language in textbooks challenging, suggesting it's a major barrier. Additionally, 73.3% of students struggle with the amount of memorization required, pointing to the challenge of rote learning.

An overwhelming 89.8% of students feel there aren't enough practical experiments, indicating a critical lack of hands-on learning opportunities. Similarly, 80.7% find it hard to connect theories to real-life situations, highlighting a gap in practical application. A large majority (89.8%) also report insufficient supplementary learning materials, impeding their understanding.

Many students (84.7%) find the teaching pace too fast, making it hard to keep up, while 92.6% find exam preparation challenging, indicating significant stress. Furthermore, 85.2% feel they lack adequate support from their teachers, suggesting a need for better teacher-student interactions. Lastly, 70.5% of students struggle due to a lack of foundational knowledge, indicating early education in biology might be inadequate.

Hypothesis (H_0): There is no significance influence of gender on the learning difficulties encountered by biology students in Ilorin metropolis.

Table 4.

Influence of gender on the learning difficulties encountered by biology students

Variable	N	Mean	Df	SD	Std. Error	Variance	t	sig	Remark
Male	96	18.9375	174	3.45440	35256	.003	668	.000	*S
Female	80	16.4875		3.48230	38933		4.664		

Results in Table 4 indicated that the male students with learning difficulties had the higher mean score (M = 18.94, SD = 3.45) than their female counterparts (M = 16.49, SD = 3.48) using a benchmark of 2.00. The result also shows that there is significance influence of gender on the learning difficulties encountered by biology students in Ilorin metropolis, Kwara State, Nigeria by implication, F= .003, p=.000 < 0.05. Therefore, the earlier stated hypothesis is rejected.

DISCUSSION

The study indicates that biology teachers in Ilorin Metropolis exhibit robust pedagogical content knowledge. They demonstrate high confidence in their teaching strategies, adaptability, the incorporation of innovative methods, and a positive impact on student learning outcomes. This aligns with research by Shulman (1986) and Bakare (2018), emphasizing the importance of pedagogical content knowledge in effective teaching. Darling-Hammond et al. (2019) highlight that teachers' ability to adapt their methods to diverse student needs and incorporate real-world applications is crucial for engaging students and enhancing comprehension. The teachers in Ilorin also emphasize collaboration, continuous professional development, and inclusivity, reflecting best practices in teaching. This is in support of Eden et al. (2024) that note that this collaborative approach helps teachers stay updated with the latest developments in biology education, fostering an environment of continuous improvement and adaptability.

However, the study highlights several critical areas where senior school biology students in Ilorin face challenges. Language barriers in textbooks, a lack of practical experiments, insufficient supplementary materials, and the fast pace of teaching are significant obstacles.

Previous researchers corroborated these: Johann et al. (2024) identify similar barriers to effective science education. Kyriakopoulos (2024) notes learning difficulties, including significant issues with reading, writing, spelling, arithmetic, and spatial orientation, such as differentiating left from right, up from down, and front from back. The lack of hands-on experiments limits students' ability to connect theoretical knowledge with practical applications, which is essential for deep learning in science (Odumosu et al., 2018).

The study also reveals a significant gender difference in the learning difficulties faced by biology students, with male students reporting higher levels of difficulty compared to female students, and this difference is statistically significant. Gender disparities in science education have been widely documented, with various studies suggesting that male students often face different challenges compared to their female counterparts (Cezair, 2018; Odumosu et al., 2018; Attoe & Climie, 2023). Karunanayake et al. (2020) suggest these challenges may stem from differences in learning styles, societal expectations, and classroom dynamics.

The findings underscore the need for targeted interventions to address these challenges and improve the overall learning experience in biology. Aggarwal (2023) recommends developing more accessible language in textbooks, increasing the frequency and quality of practical experiments, providing additional supplementary materials, and adjusting the teaching pace to better suit student needs. Addressing gender-specific challenges by incorporating diverse teaching strategies that cater to different learning styles and fostering an inclusive classroom environment can also help mitigate these difficulties (Lusa et al., 2024). Verzella (2018) suggests collaboration between students from different parts of the world through online platforms and video conferencing tools. This enables students to engage in joint projects, discussions, and cultural exchanges with peers from diverse backgrounds.

CONCLUSION

The study reveals that biology teachers in Ilorin Metropolis possess strong pedagogical content knowledge. They report high confidence in their teaching strategies, adaptability, use of innovative methods, and positive impacts on student learning. They also emphasize collaboration, continuous learning, and inclusivity in their teaching practices. However, the study reveals several key areas where senior school biology students in Ilorin Metropolis face

difficulties in their learning, including language barriers in textbooks, a lack of practical experiments, insufficient supplementary materials, and the fast pace of teaching. These findings underscore the need for targeted interventions to address these challenges and improve the overall learning experience in biology. In addition, the study reveals a significant gender difference in the learning difficulties faced by biology students. Male students report higher levels of difficulty compared to female students, and this difference is statistically significant. Both groups show similar variability in their responses. The results suggest that gender plays a significant role in the learning difficulties encountered by biology students, with males experiencing greater challenges on average.

RECOMMENDATIONS

Based on the best common practices in educational research and the findings, the followings were recommended:

- ✓ Implement ongoing professional development programs focusing on advanced pedagogical strategies, real-world application integration, and innovative teaching methods.
- ✓ Encourage collaborative teaching practices and knowledge exchange among biology teachers through regular workshops, seminars, and peer observation sessions.
- ✓ Develop and utilize textbooks and learning materials with simplified language and clear explanations to make biological concepts more accessible to students.
- ✓ Increase the frequency and quality of practical experiments in biology classes by equipping laboratories with necessary resources and training teachers in effective lab instruction.
- ✓ Provide a variety of supplementary learning materials, such as additional readings, online resources, and interactive tools, to support and enhance student learning.
- ✓ Adjust the pace of teaching to match the learning speed of students, possibly through differentiated instruction and periodic assessments to gauge student understanding.
- ✓ Incorporate diverse teaching strategies that cater to different learning styles and address gender-specific challenges in biology education.
- ✓ Foster an inclusive classroom environment that encourages participation from all students, regardless of gender, and addresses societal expectations and classroom dynamics that may affect learning.
- ✓ Facilitate international collaboration between students through online platforms and video conferencing tools, enabling joint projects, discussions, and cultural exchanges

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