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Teaching and learning in 21st century: skill development and students' learning outcome in biology in Oyo State

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Abstract
The learners' low academic achievement in recent times in Biology needs developing skills in relation to content which may improve teaching/learning of Biology. Therefore, a direct instruction and collaborative learning were used. A pretest -posttest-approach was used in a quasi-experimental design. One educational zone was randomly selected out of four in Ibadan. Purposive sampling was used in selecting four schools and from each school, an arm of SS2 science intact class was used totalling 135 learners. Three instruments were used namely: Achievement Biology Test (ABT) (r = .78), direct instruction guide (DIG) and collaborative learning guide (CLG). Two hypotheses were evaluated at p = 0.05. Data analysis used were descriptive and inferential statistics. The result revealed that there was a significant effect of collaborative learning on pre -test and posttest of learners' academic achievement with high mean score ($\bar{x}$ = 18.13) as well as a considerable impact [$F_{(2, 135)}$ =2505.21, p=.00] while in direct instruction there was no significant effect of direct instruction on pretest and posttest with low mean score ($\bar{x}$ = 9.52) and treatment on learners' gender [$F_{(2, 135)}$ = 12.82, p=.22] of learners' academic achievement. It is recommended that collaborative learning should be encouraged in teaching Biology.

Keywords: 21st Century Skill, Teaching, Learning, Skill, Direct Instruction and Collaborative Learning

Introduction
Biology, being one of the important science subjects to science learners intending to do programmes such as medicine, nursing, physiotherapy, anatomy, physiology, animal production and health among others, here is need for such learners to develop skills in relation to the content which may bring about improvement in learning. Acquiring new comprehension, expertise, actions, attitudes, values, and preferences in the process of learning and there is the possibility of learners having better performance and future learning and results in change as a result of experience. In 20th century education, learning involves passive learning, memorization, learner working in isolation, teaching is teacher - centred, learning is controlled, learning is time - based among others while in recent times there is advocate for 21st century education in which "Employers, educators, school reformers, and others feel that a wide range of information, abilities, work habits, and character qualities are essential for success in the modern workplace". The 21st century skills are skills needed to meet the demands of the 21st century world, which is rapidly embracing digital transformation, actively seeking qualified human resources, moving forward collaboratively, and creatively. The teaching methodology of the twenty-first century combines material with skills. Without skills, learning becomes passive for pupils, who are forced to remember data. The learning paradigm of the twenty-first century provides a chance to coordinate content margins.

Providing pupils with the necessary abilities to thrive in the modern world and fostering their confidence to put those skills into practice are the two main goals of a 21st century education. The seven survival skills that Wagner T. (2010) emphasized are critical thinking and problem solving; collaboration and leadership; agility and adaptability; initiative and entrepreneurialism; effective oral and written communication; accessing and analyzing information; and curiosity and imagination. These skills are necessary for students to be prepared for 21st century life work and citizenship. Teachers are expected to select the best teaching strategy for the lessons they will be teaching in the current educational system. By

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encouraging active student participation in the classroom, this strategy sought to improve academic performance (Yucel & Kanyilmax, 2018). According to Lemke (2010), one of the primary responsibilities of educators is to get pupils ready for a global, participatory society that relies heavily on technology for living, learning, and working.

The three main skill sets, or 3LS, that make up 21st century skills are learning skills, life skills, and literacy skills. This statement is based on the historical evolution of 21st century skills.

Learning skills were the main emphasis of this investigation. The ability to learn is a prerequisite for picking up new information. The learning skill comprise 4C'S which include critical thinking, creativity and innovation, collaboration and communication. The aspect of learning skill focused in this study is collaboration learning. Using groups to improve learning through cooperation is known as collaborative learning. Learning activities, problem-solving, task completion, and concept acquisition in groups of two or more people.
Rather than relying solely on rote memorizing of data, this method actively involves students in the processing and synthesis of knowledge. Students engage with one another on projects that require them to grasp concepts that are being taught to them. Through articulating their thoughts, listening to opposing viewpoints, defending their positions, and reframing ideas, learners will develop a deeper collective understanding than they could alone. Both the organization as a whole and the learners as individuals can gain from collaborative learning.

The organizational benefits include; Development of leadership and self-management abilities – People are given the chance to acquire advanced abilities when they are required to collaborate with others in order to accomplish a shared objective;it improves knowledge acquisition and retention - This process of collaborative learning allows participants to achieve higher levels of thought and the information is retained much longer than when learned in a non-collaborative setting; It improves relationships across teams and departments - Collaborative learning across teams forces individuals to develop new connections and find ways to work together.

The following are some of the advantages of collaborative learning for individuals: It makes learning a truly active process, requiring students to arrange their ideas, formulate a cogent case to support their position, defend it to their peers, and persuade others of the validity of their position; It encourages learning from different perspectives; individuals who come from different backgrounds tend to learn more; It helps learners to think critically and fast. They must immediately synthesize answers and modify their thoughts on the spot if they discover that their argument is weak, It encourages listening to advice and criticism – Learners will also hear others discuss their views and make reasons in favor of or against those of their peers; It improves public speaking and active listening abilities - Students gain the ability to communicate effectively in front of their peers, to actively listen, to challenge ideas, and to collaborate with others to build a framework of ideas; It fosters better cooperation –When given a clear objective, students are more inclined to have meaningful conversations with one another, which enhances their mutual respect and comprehension of the material.

In this study, direct instruction was also used. A teacher-directed teaching strategy is a direct instruction. This implies that the instructor gives the material while standing in front of the class. The instructor provides the pupils with clear, directed instruction.

Learners' gender is another variable focused on in this study. The spectrum of physical, biological, mental, and behavioral traits that apply to and distinguish between the populations of men and women is known as gender. Agbaje & Alake (2014); Dania (2014) states that gender disparities in academic attainment over a long period of time has produced a sizeable body of scholarship.); Nenty (2010); Awofala, Adeneye & Nenji (2011) identified a substantial difference with boys or girls performing better, others noted that there is no significant gender difference in

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students' academic achievement and retention in various students.

The Zone of Proximal Development, a hypothesis developed by Lev Vygotsky, is the foundation of collaborative learning. In order to complete assignments that they could not have finished on their own, the students depend on one another. According to this theory, there is a third zone, referred to as the zone of proximal development that lies between the zones that represent what a person can and cannot do. This is something that can be learned, but doing so requires assistance. New skills that are still developing can be discovered in this area. People that are able to learn from others will acquire the talents located in their zone of proximal development. According to this hypothesis, peer-to-peer learning encourages students to think more deeply in the classroom. According to the principle of collaborative learning, learning in groups fosters the growth of students' oral communication, higher order thinking, self-control, and leadership abilities. Additionally, students can improve their leadership and organizing abilities.

Therefore, collaborative learning suggests that students remember more material when working in groups, is therefore essential for developing critical thinking skills.

Hypotheses

1) There is no significant main effect of treatment on learners' academic achievement.
2) There is no significant interaction effect of treatment and gender on learners' academic achievement.

Methodology

Quasi Experimental Design was employed in the study.

The schools in Ibadan were clustered along four educational zones, three local government areas were chosen at random from each zone totaling 12 local government areas. In order to choose the participants, a purposeful sampling strategy was adopted in selecting coeducational schools. In each school an arm of SS 2 intact class was used, totaling 135 learners (Male 67 and Female 68).

The instrument used for this comprised;

1. Achievement Biology Test (ABT)
2. Collaborative Learning Guide (CLG).
3. Direct Instruction Guide (DIG)

Thirty multiple-choice questions with four answer choices made up the test (A, B, C and D). The questions were derived from six themes in the SS 1 and SS 2 Biology curriculum, with a total of 60 items pilot examined. The researcher created the instrument using a table of specifications that included cognitive areas such as remembering, understanding, and applying. The reliability coefficient of the Achievement Test on Biology was determined using the Kuder – Richardson 20 (KR – 20) method. With discriminating indices between 0.36 and 0.47, the item difficulty indices ranged from 0.37 to 0.68. From the pools of trial-tested products, thirty items were chosen. The multiple-choice test's final selection of items is displayed in the specification table. The coefficient of reliability was 0.81.Table 1 displays the analysis of the questions.

The multiple-choice test's specification table indicates that forty – percent tested remembering, thirty per cent tested understanding and thirty per cent tested applying. One point was awarded for the correct response, and zero for the incorrect one. The maximum mark obtainable for the multiple – choice was 30 marks.

Table 1: Table of Specification for Achievement Test on Biology

Topics/Objectives	Remembering 30%	Understanding 30%	Applying 40%	Total 100%
Basic Ecological Concepts	1	2	2	5
Functioning Ecosystem	1	2	2	5
Plant and Animal Nutrition	1	2	2	5
The Cell	2	1	2	5
Cell and Its environment	2	1	2	5
Tissues and Supporting System	2	1	2	5
Total	9	9	12	30

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Collaborative Learning Guide (CLG)

The following are the steps to follow in building collaboration in classroom.

1. The teacher assigns pupils to work in groups; based on each student's strengths and weaknesses, the teacher forms the groups.
2. 2. The teacher chooses the group size. Four or five is usually the ideal number because too small a group may not have a diverse or lively enough discussion, and too big a group may discourage participation from some students.
3. 3. The teacher teaches the students how to listen to each other - The teacher spends time talking about and practicing listening techniques, instructing the students on how to maintain eye contact, refrain from interrupting, and reiterate key points.
4. The teacher established the guidelines for language and cooperation - The instructor devotes time to instructing students on how to define terms, how to paraphrase, and how to argue in a productive way.
5. The teacher makes goals and expectations clear – The teacher states clear goals they are expected to meet.
6. The teacher designates each group's members – The teacher delineates roles to students, so that each of them will know the role to play
7. The teacher uses real – world problems – The teacher gives them real – world assignment in order to be able to research and form real opinions
8. The teacher gives each group a different task – The teacher delegates different tasks to each group
9. Evaluate each group on its own merit – Each group's performance in achieving its objectives and each student's role-playing ability is graded by the teacher.

Direct Instruction Guide (DIG)

The instructional guide was prepared by the researcher to show the various steps the teacher followed. The following steps were followed;

Step 1 – The instructor gives a lesson introduction. This is done in an effort to draw pupils in, grab their interest, and draw on past knowledge.

Step 2 – The teacher presents new materials by using clear and guided instruction in other to allow learners absorb the new material

Step 3 – The teacher gradually displays the abilities or idea. This is a visual presentation.

Step 4 – The teacher conducts practice – This is done to provide direction for first practice, correct errors, reteach, and give pupils enough practice to be able to work on their own and questions are asked to verify the learners' understanding

Step 5 – The teacher guides practice by correcting learners' mistakes and give feedback

Step 6 – The teacher leaves the learners to practice independently.

Step 7 - The teacher evaluates the learners.

The study enlisted the help of six qualified Biology teachers. For one week, the researcher instructed the biology teachers on how to implement collaborative learning and direct instruction. In the first week, a pre-test of achievement was given. The treatments lasted for six weeks, thereafter, biology achievement test was administered on the participants as post – test. There were two different treatment groups. These were collaborative learning and direct instruction. In collaborative learning group, N = 68 learners. The treatment in this group involved teaching the learners for 1hr for each contact totaling 10 contacts. In direct instruction group, N = 67 learners. The treatment in this group involved teaching the learners for 1hr for each contacts totaling 10 contacts.

The data was analysed using descriptive statistics (mean and standard deviation) and inferential statistics – Analysis of Covariance (ANCOVA) - treatment: two groups.

Results

Ho_1: There is no significant main effect of treatment on learners' academic achievement.

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Table 2 Descriptive Statistics of Treatment

Treatment	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Collaborative Learning	68	5.96	2.51	18.13	3.68	13.86
Direct Instruction	67	5.67	1.99	9.52	1.88	5.81

In table 2, the result shows that collaborative learning has the mean gain of 13.86 while direct instruction has a mean gain of 5.81. This result indicates that the learners perform better in collaborative learning than direct instruction with the mean gain of 5.81

Table 3 ANCOVA of Learners' Academic Achievement in Biology

Source	Dependent Variable	Type 111 Sum of Squares	df	Mean Square	Sig.
Corrected Model	Pretest	17.19[a]	3	5.73	.34
	Posttest	2516.39[b]	3	838.79	.00
Intercept	Pretest	4557.26	1	4557.26	.00
	Posttest	25795.33	1	25795.33	.00
Treatment	Pretest	2.85	1	2.85	.46
	Posttest	2505.21	1	2505.21	.00
Gender	Pretest	12.73	1	12.73	.12
	Posttest	1.85	1	1.85	.64
Treatment*Gender	Pretest	1.81	1	1.81	.55
	Posttest	12.82	1	12.82	.22
Error	Pretest	667.18	131	5.09	
	Posttest	1125.93	131	8.59	
Total	Pretest	5249.00	135		
	Posttest	29573.00	135		
Corrected Total	Pretest	684.37	134		
	Posttest	3642.33	134		

a. R squared = .02 (Adjusted R squared = .00) = sig at $p < .05$
b. R squared = .69 (Adjusted R squared = .68)

Likewise in table 3, it shows that there is significant main effect of treatment on learners' academic achievement [$F_{(2,135)} = 2505.21$), $p = .00$] therefore, null hypothesis is rejected.

Ho_2: There is no significant interaction effect of treatment and gender on learners' academic achievement.

Table 3 ANCOVA of Learners' Academic Achievement in Biology

Source	Dependent Variable	Type 111 Sum of Squares	df	Mean Square	Sig.
Corrected Model	Pretest	17.19[a]	3	5.73	.34
	Posttest	2516.39[b]	3	838.79	.00
Intercept	Pretest	4557.26	1	4557.26	.00
	Posttest	25795.33	1	25795.33	.00
Treatment	Pretest	2.85	1	2.85	.45
	Posttest	2505.21	1	2505.21	.00
Gender	Pretest	12.73	1	12.73	.12
	Posttest	1.85	1	1.85	.64
Treatment*Gender	Pretest	1.81	1	1.81	.55
	Posttest	12.82	1	12.82	.22
Error	Pretest	667.18	131	5.09	

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	Posttest	1125.93	131	8.59
Total	Pretest	5249.00	135	
	Posttest	29573.00	135	
Corrected Total	Pretest	684.37	134	
	Posttest	3642.32	134	

a. R squared = .02 (Adjusted R squared = .00) = sig at p < .05
b. R squared = .69 (Adjusted R squared = .68)

Table 3 indicates a summary of result of effect of treatment (collaborative learning and direct instruction) as well as the learners' gender on their academic achievement in biology. It reveals that there is no significant interaction effect of treatment and gender of the learners and their academic achievement [F $(_{2, 135})$ = 12.82, p =.22] after controlling for covariate. The null hypothesis is therefore accepted.

Discussion

In the educational framework, educators bear the responsibility of selecting the most suitable mode of instruction for imparting knowledge. The result indicates that learners taught with collaborative learning outscore the students taught with direct instruction. This result is in tandem with Awang – Hashim, R., Yusof, N., Benlahcene, A., Kaur, A., & Suppiah Shanmugam S.K. (2023), which concluded in the findings that collaborative learning fully mediated the predictions of student – faculty interaction, teaching quality, and relatedness on reflective and integrative learning and higher – order thinking. The collaborative learning method provides learners ample opportunities to improve their critical thinking abilities by offering prospective experiences that allow them to recall and integrate the gained skills and knowledge (Ghavifekr, 2020). Yucel, E.O. & Kanyilmax, B.M. (2018) states that by encouraging active student participation in the classroom, it sought to improve academic performance. Uwizeyimana et al (2018) found that in order to enhance students' academic achievement they need to learn actively through collaborative learning-based instructions. The result of this study also conforms to the findings of Ajayi et al. (2020), Al-Ammary (2013) and Tsai and Guo (2012) that Online Collaborative Learning has a significant influence and positive impact on student achievement and learning outcomes. According to Lemke (2010), a primary responsibility of educators is to equip students for a global, participatory world that relies heavily on technology according for living, learning, and working. It was also revealed in this study that the instructional strategies does not have significant effect on learners' gender. Dania (2014) states that a student's academic success is independent of their gender when it comes to the relationship between treatment and gender. Long-term research on gender variations in academic success has produced a significant body of literature (Agbaje & Alake (2014); Awofala, Adeneye & Nenji (2011); Nenty (2010), etc.). The finding is also in line with Oloyede, Adebowale and Ojo (2012) whose findings revealed that there was no significant interaction between learning strategies and students' gender. Furthermore, this finding is in tandem with Olatoye and Adekoya (2010) who found out that the interaction effect of treatment and students' gender does not have effect on students' academic in agricultural science. This means that treatment does not depend on gender to be effective.

Conclusion

Collaborative learning has a positive impact on learners' academic achievement in biology. By fostering a deeper understanding of concepts, enhancing knowledge retention, improving learners' academic achievement, developing critical thinking skills, and increasing motivation and engagement, collaborative learning prepares students for both academic and real-world challenges in the field of biology. Although not new, the kind of critical thinking that appears to be at the core of teaching "21st century skills," as stated in the introduction, is becoming increasingly significant. The study's results led to the conclusion that therapy has a major and positive impact on students' academic performance. This implies that learners' need to

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develop skill in order to improve academic achievement in order to be able to move along with 21st century goals and objectives. Also, gender does not distinguish academic achievement in skill development.

Recommendation

The following are recommended:

(i) Biology teachers should employ skill development approaches as supplement to the regular conventional method in order to improve learners' learning outcomes.

(ii) The biology curriculum should be revised to make adequate provisions in order to meet up with 21st century goals and objectives.

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