

Research Abstract

Effects of Cognitive Sequencing and Project-Based Learning on Academic Achievement of Students in Okra Production in Secondary Schools in Anambra State, Nigeria

Introduction/Relevant Literature

Teaching and learning require a conscious effort from teachers and students. According to Adams, Smith and Johnson (2020), the ability of students to learn depend on several factors such as learning environment, level of teacher's competency of subject matter, parental factors and basically the applied methods used. Teaching methods are informed by educational objectives and desired learning outcomes. Okeke (2017), noted that teaching method is the specific techniques, tools, or instructional practices employed to enhance learning outcomes.

Teaching methods used in this study are cognitive sequencing and Project-based. Cognitive sequencing refers to the strategic organization and presentation of educational materials to facilitate effective learning by aligning with students' cognitive abilities and complexity of subject matter. In the view of Ausubel (2021), cognitive sequencing is the organization and presentation of learning materials in a hierarchical manner, putting essential concepts first and then building upon them. In this study, cognitive sequencing as teaching method was compared with project-based learning. Project-based learning (PBL) is a teaching method in which students' gains knowledge and skills by working for an extended period of time to investigate and respond to an authentic, engaging and complex question, problem, or challenge. Guo and Yang (2020), noted that project-based learning is a teaching method that engages students in sustained, collaborative investigation of complex questions or challenges, guided by open-ended inquiry, and often culminating in authentic products or performances. Dodge (2019), noted that project-based learning encourages students to engage in inquiry, critical thinking, and problem-solving leading to deeper understanding of content and concepts.

Academic achievement refers to the overall educational success and performance of an individual, representing the level of mastery and accomplishment in academic pursuits, including learning outcomes, grade point average, and academic awards and can be scored. According to Jones and Brown (2019), academic achievement encompasses the attainment of specific learning outcomes and educational standards, reflecting students' ability to apply and integrate knowledge and engage in critical thinking and problem-solving. The cultivation of okra offers numerous benefits, including its relatively low input requirements, high yield potential, adaptability to diverse growing conditions and high economic return. This could be the strong comparative advantage okra has over other vegetable crops. It is based on this strong assertion that the researchers adopted okra production as a content in secondary school syllabus to ascertain student's academic achievement when taught using cognitive sequencing and project based learning.

The ability of an individual to comprehend certain subject like agricultural science in secondary school could sometimes be influenced by gender. According to Nguyen (2021), gender is a social and psychological difference between man and woman as opposed to biological differences which are referred to as sex. Powell and Tang (2019), further stated that gender has been identified as a contributing factor to disparities in academic achievement in agricultural science, with studies showing differential experiences and outcomes for individuals based on their gender identity. Agricultural science is one of the elective subjects that students in

the state often chose because of its practical oriented and entrepreneurial nature (Okoro, 2018). However, the current status of agricultural science in secondary schools in Anambra state, Nigeria, faces several challenges, including outdated curricula, poor teaching methods, and limited resources for practical agricultural training, a shortage of qualified teachers and low performance of students in external exams like WAEC. To address these issues, there is need to explore different innovative teaching methods like cognitive sequencing and project based learning in order to determine its effect on students' achievement in okra production.

Theoretical/Conceptual Framework

Theoretical framework of the study reviewed was based on two theories which include Jean Piaget (1896-1980) constructivist theory of learning and comparative advantage theory by David Ricardo (1817). Constructivist theory states that learning is an active process in which learners construct new ideas or concepts based upon their current/past knowledge. The theory have close relationship with this study in that application of cognitive sequencing is designed in such a way that learners are active participant in their learning process and that learners learning process is dependent on their prior knowledge in the area and how they fit new knowledge into their already existing mental schema. Theory of Comparative Advantage states that the ability of any given economic actor to produce goods and services at a lower opportunity cost than other economic actors is greater economic value. Since this work intend to determine the use of two teaching methods in teaching okra production to students in order to improve their achievement, it will assist the researcher to compare these two teaching methods to ascertain which one will assert more outcome on student's academic achievement in agricultural science specifically, in okra production. The study conceptualized the following concept: Teaching and learning of agricultural science in secondary school in Nigeria, cognitive sequencing and project-based learning as teaching method in agricultural science, students' academic achievement, and concept of gender and okra production in Nigeria.

Purpose of the study

The general purpose of the study is to determine the effects of cognitive sequencing and project-based learning on academic achievement of students in okra production in secondary schools in Anambra State, Nigeria. Specifically, the study determined the: Mean academic achievement scores of students taught okra production using cognitive sequencing, project-based learning and conventional teaching methods in Secondary Schools in Anambra State; differences in the mean achievement scores of male and female students taught okra production using cognitive sequencing, project-based learning and conventional teaching methods in Secondary Schools in Anambra State and interaction effects of teaching methods and gender on student's academic achievement in okra production.

Hypotheses

The following null hypotheses was formulated for the study and tested at 0.05 level of significance: There is no significant difference in the mean academic achievement scores of students taught okra production using cognitive sequencing, project-based learning and conventional teaching methods in Secondary Schools in Anambra State; the mean academic

achievement scores of male and female students taught okra production using cognitive sequencing, project-based learning and conventional teaching methods in Secondary Schools in Anambra State does not differ significantly and there is no significant interaction effect of teaching methods and gender on students' academic achievement in okra production.

Research Questions

The following research questions guided the study:

1. What is the mean academic achievement scores of students taught okra production using cognitive sequencing, project-based learning and conventional teaching methods in Secondary Schools in Anambra State?
2. Is there any difference in the mean academic achievement scores of male and female students taught okra production using cognitive sequencing, project-based learning and conventional teaching methods in Secondary Schools in Anambra State?
3. What is the interaction effect of teaching methods and gender on students' academic achievement in okra production?

Methods/Procedures

The design for the study is quasi-experimental research design. Specifically it is a pretest-posttest non-equivalent control group design. The design was adopted because it is not possible to have complete randomization of subjects. Quasi experimental design is considered suitable for the study because intact classes instead of random individuals from the selected secondary schools in Awka Educational zone were assigned to treatment and control groups for the study. Pretest (OPAT) was administered to all the groups before the commencement of the treatment. The experiment lasted for four weeks after which the research assistants administered the posttest (OPAT) to the students in the six schools. The questions were reshuffled by the researcher after the pretest to avoid pretest sensitization before being used for the posttest. During this period, the researcher supervised the experimental processes to ensure strict adherence to the prepared lesson plans. Extraneous variables like teacher variables, instructional situation variable, Inter-group variable, subject interaction and hawthorns effects were controlled while ANCOVA takes care of the initial group equivalence. Data were collected from the three groups (experimental and control) and used for analysis based on the demands of the research questions and hypothesis.

Findings/Results

Table 1: Pretest and posttest mean academic achievement scores of students taught okra production using cognitive sequencing, project-based learning and conventional teaching methods.

Teaching methods	Pre-test			Post-test		Mean Difference
	N	\bar{X}	SD	\bar{X}	SD	
Cognitive sequencing	92	14.22	4.37	28.36	5.53	14.14
Project-based learning	71	14.38	4.17	31.31	4.53	16.93

Conventional	100	11.97	3.62	13.94	3.61	1.97
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Note: N = Number of Respondents, \bar{X} = Mean, SD = Standard deviation

Table 2: Analysis of covariance (ANCOVA) of the difference in the mean academic achievement scores of students taught okra production using cognitive sequencing, project-based learning and conventional teaching methods in Secondary Schools in Anambra State.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared (η^2_p)	Dec.
Corrected Model	19162.542 ^a	6	3193.757	412.652	.000	.906	
Intercept	3567.194	1	3567.194	460.902	.000	.643	
PretestOPA	3042.790	1	3042.790	393.146	.000	.606	
TeachingMethods	10471.057	2	5235.528	676.460	.000	.841	S
Gender	172.881	1	172.881	22.337	.000	.080	S
TeachingMethods * Gender	130.550	2	65.275	8.434	.000	.062	S
Error	1981.336	256	7.740				
Total	168532.000	263					
Corrected Total	21143.878	262					

Note: df= Degree of Freedom, F= F-ratio, Sig. = Significant/probability value, Dec. = Decision, S = Significant.

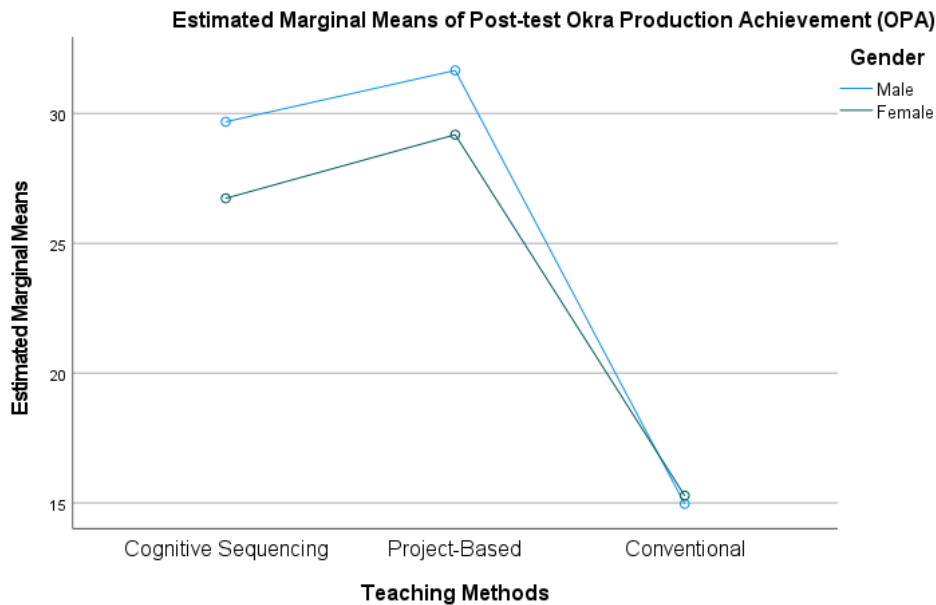
There is a significant difference in the mean academic achievement scores of students taught okra production using cognitive sequencing, project-based learning and conventional teaching methods in Secondary Schools in Anambra State. A Post-hoc test further revealed that Project-based learning is the most effective, followed by cognitive sequencing.

Table 3: Pretest and posttest mean academic achievement scores of male and female students taught okra production using cognitive sequencing, project-based learning and conventional teaching methods in Secondary Schools

Gender	N	Pretest		Posttest		Adjusted Mean Score
		\bar{X}	SD	\bar{X}	SD	
Male	101	13.27	4.44	25.19	10.28	11.92
Female	162	13.49	4.02	22.73	7.96	9.24

Note: N = Number of Respondents, \bar{X} = Mean, SD = Standard deviation

The academic achievement scores of male and female students taught okra production using cognitive sequencing, project-based learning and conventional teaching methods in Secondary Schools in Anambra State differs significantly.



Covariates appearing in the model are evaluated at the following values: Pre-test Okra Production Achievement (OPA) = 13.41

Figure one (1): Profile plot for the interaction effect of teaching methods and gender on students’ academic achievement in okra production.

The profile plot (graph) below (Figure 1) indicates that there is a significant interaction effect of teaching methods and gender on students’ academic achievement. This is evident as the teaching methods lines drawn against the students’ gender in the graph intercept at the point of the conventional teaching method to produce substantial interaction effect on their mean achievement scores. This implies that there is a significant interaction effect of teaching methods and gender on students’ academic achievement when taught okra production.

Recommendations/ Conclusion

Based on the findings of the study, it was concluded that project-based learning was more effective than cognitive sequencing and conventional method in enhancing students’ achievement, gender-based variations was observed in students’ achievement, a significant interaction effect exist between teaching methods and gender. It was therefore recommended that teachers of agricultural science should incorporate project-based learning to enhance students’ achievement when teaching okra production among others. Limitation of the Study lies in the fact that the study concentrated specifically in okra production, which may not fully represent the impact of cognitive sequencing and PBL on the broader agricultural science curriculum. The effectiveness of these methods in teaching other agricultural topics/contents remains an area for further research.

References

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