IRESPUB Journal of Education & Literature

Volume: 2 | Issue: 2 | JUL - AUG 2022 | Available Online: www.irespub.com

Constructivist learning strategy: a pedagogical approach for improving students' academic achievement in basic science in secondary schools

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ABSTRACT

The purpose of this research is to explore the impact that constructivist learning strategies have on students' academic achievement in basic science while they are enrolled in secondary school in Rivers State. The research was conducted on students from 11 different junior secondary schools. The research was carried out using a one-group pretest-posttest quasi experimental design, and there was a total of ninety students from two classes in the junior secondary schools that took part in the investigation. The simple random sample, was used to select 200 students studying basic sciences from each of the 2 junior secondary schools. The mean and standard deviation were utilised in the analysis of the data that was gathered. They were utilised in order to provide answers to all of the research questions, whilst a t-test was utilised in order to analyse the hypotheses at 0.5levels of significance. According to the findings of the study, the academic achievement of students majoring in basic sciences is significantly impacted by the use of constructivist learning strategies. As a result, it is advised that the technique be used for instructing fundamental scientific concepts.

KEYWORDS

Constructivist; strategy; academic achievement; students' basic science.

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INTRODUCTION

Studying Basic science in secondary school is a stepping stone to more advanced research and technology. It's crucial for children's scientific literacy and the country's overall development (Joseph (1). This is because basic science education serves as a foundation for all subsequent levels of science education and hence requires specific attention. Basic science education, according to Shulman (2), strives to assist students in acquiring skills and information that will enable them to become successful and productive members of the society. Basic science is important because of its goals, which include instilling permanent literacy in a variety of subjects, the ability to communicate effectively while learning basic science, laying a solid foundation for scientific and reflective thinking, and using science education to achieve these goals. Studies have shown that students have performed badly in basic science, despite its importance to citizens and society. The cause of this lackluster performance has yet to be found. Some scholars believe the problem is linked to the students' poor study habits, their family background, and their parents' educational and economic status. School difficulties, the curriculum, and teachers' factors have all been connected to students' poor performance. The teacher's teaching strategies or methods for imparting information, skills, and the lesson, as well as their suitability for achieving the subject's objectives at this level of instruction, have not been thoroughly studied to understand their role in the observed trend. Despite the fact that numerous experts have attempted to establish the best teaching methods and their relationships to students' academic achievement in the sciences generally and basic science specifically.

THE MEANING OF THE STRATEGY

Constructivists consider that learners produce new information by integrating fresh encounters with past knowledge or experience. As a result, the constructivist paradigm incorporates instructional practices that enable learners to actively participate in the teaching and learning process. According to Duit (3), constructivism is a theory founded on the inmate' natural desire to make sense of the world. Effective teaching needs flexibility, creativity, and accountability in order to offer an instructional environment that is matched to the learners' individual requirements. Beyond the empirical evidence that widespread uniformity in teaching fails many students, as Tomlinson (4) puts it, there is rationale in both theory and research to promote a shift toward education that is attentive to students' variance reflected in at least three areas: the readiness of the student. The constructivist theory has raised the interest of specialists in the disciplines of scientific and social science education in terms of building a curriculum that enables students to learn via activities and the production of meaning and knowledge. Constructivism is a learning theory that claims that individuals learn best when they actively create their knowledge (Kulshreshtha, (5). In this strategy, learners are seen as the makers of meaning and knowledge, not the other way around. A constructivist teacher and classroom differ from traditional teachers and classrooms in several ways: the teacher is actively involved, the environment is democratic, the activities are interactive and student-centered, and the teacher facilitates a learning process in which students are encouraged to be responsible and autonomous (Gray, (6).

As opposed to teaching information to students, Ben (7) advocate for students to learn for themselves. They also said that instead of relying on teachers to impart knowledge, students should actively seek it out for themselves. This belief has been held by a wide range of educators in the fields of science teaching and learning, including teachers, technologists, educational psychologists, and curriculum designers. When it comes to the constructivist worldview, learners are encouraged to create their own unique learning outcomes. In order to generate new knowledge, it may be necessary to work with others to solve real-world problems. (Jonassen, (8). This has resulted in secondary schools laying the groundwork for future learning and aiding students in their preparation for higher education. At the secondary school level, science knowledge production is especially significant, and the constructivist teaching technique is encouraged. According to Lee and Fraser (9), science students have a more favourable perception of their classroom environment than students from other disciplines. According to Miheso (10), girls' achievement scores are greater than boys' when the icon model is utilised instead of the traditional teaching technique. In social scientific areas, several researchers have used the constructivist technique (Jong, (11); Nayak, (12); Cakici & Yvuz, (13); Enok and Joel, (14)). Several studies have further highlighted that students taught using a constructivist approach scored higher than those taught using a traditional method. Richardson (15), Agrawal and Chawla (16), and Qarareh (17). Kim (18) has discovered that constructivist teaching strategy is more efficient than conventional teaching, which is also unsuccessful, but has some influence on motivation, anxiety towards learning and self-monitoring., Hijazi (19), and Qarareh (17) have shown that there was no gender difference in the mean achievement score for the constructivist group compared to the traditional technique. Findings from Kim (18) study show the technique had no impact on the students' ability to speak and write English, but had a statistically significant impact on their ability to read and write. There was no significant difference in student performance between male and female students who were taught using this strategy. According to Folasade and Akinyemi (19) constructivist learning strategy is more successful than the traditional method. To his great surprise, Saran (20) discovered that, in the social science subject, for instance, Geography, low-achieving students who learned through a constructivist approach outperformed those who used more traditional methods. Nayak (12) encourages the use of constructivism in the classroom so that students may build their own knowledge and comprehend the idea at its most fundamental level, in the end, their achievement will be enhanced. Many study findings, on the other hand, support it. The researcher wants to know how much of a difference the constructivist approach makes in terms of student achievement when compared to the conventional way. As a result, it is useful to investigate the impact of the constructivist method on physical science students' achievement.

An examination of all of the aforementioned research indicates that the constructivist method has been widely adopted in the teaching of science. In basic science and several social science courses, the majority of researchers discovered that the constructivist approach to instruction is superior to the traditional style of instruction. It has been demonstrated that the constructivist method is quite beneficial for low-achieving students. According to Enoch and Joel (12) constructivists, learners should utilise new encounters in light of prior knowledge or experience.

As a result, the constructivist model includes instructional strategies that encourage learners' active participation throughout the teaching and learning process. Constructivism, according to Duit (3), is a theory based on the innate desire to make sense of the world. Moreover, the learner actively develops their knowledge by integrating new information and experience with their existing knowledge. In support of this, Ngwoke (21) asserts that the message is more effective when students actively participate in the instruction of rules and procedures, which stimulates their creativity and directs their thinking. It appears that the current method of teaching basic science in secondary schools is tedious and uninspiring. This is especially true when one considers the continued popularity of whiteboards and verbal communication. Despite the desire for a new method in the form of a constructivist perspective, the majority of teachers continue to employ the conventional approach. The topic is whether constructivist teaching methods have a significant impact on the success of secondary school students. Furthermore, given that interest in a topic correlates positively with success in that subject, can a constructivist teaching approach result in a significant shift in secondary school students' interest in basic science?

In her study, Festinger (22) noted that constructivist models allow students to find the meaning of basic science ideas, which allows for improved cognitive accomplishment. According to Glaserfeld (23), when an activity-based method is utilized to teach science in secondary schools, students learn better and get better grades, and the technique increases mastery and retention of topics learned. In this context, the research project aims to investigate the impact of constructivist learning methodologies on secondary school students' academic progress in basic science. Because it incorporates the active engagement of the student, many educators, basic science teachers, technologists, educational psychologists, and curriculum designers think that constructivism is a crucial factor for effective teaching and learning in the sciences. According to the constructivist viewpoint, learners create their own particular knowledge and meaning out of a given learning experience. Solving actual challenges, which generally include collaboration with others, might enhance knowledge creation. (Jonassen, (8). As a result of the preceding argument, Kulshrestha (5) asserted that learners would not be able to answer any given problem unless they had the necessary prior knowledge and abilities. As a result, appropriate adoption of constructivist methodologies in the classroom would improve students' scientific academic achievement. While some studies suggest that true constructivist pedagogies are still uncommon in classrooms, several studies support the potential usefulness of constructivist methods. For example, Abbott and Jeffery (24), for example, discovered a strong link between constructivist strategy and good student achievement. Constructivist approaches, according to Mayer (25), have great potential, but authentic implementation is required to realize that potential.

Science is one of the required disciplines in schools all across the world. Due to a lack of interest and desire, the majority of students in schools disregard science, resulting in low academic achievement in science. In general, the majority of science teachers in schools use conventional teaching approaches. Teachers as exclusive information providers to passive students appears to be an outmoded teaching technique. At the secondary level, scientific topics should be presented through real-life examples. Aside from basic experiments and hands-on experiences, an essential pedagogic technique at this time is to include students (in groups) in meaningful inquiries, especially on topics they feel to be relevant and important. As a result, the best technique for curriculum transitions is to instill a scientific mindset. Science instills the importance of creativity and logical reasoning. Some abilities, such as updating, practicing, critiquing, and evaluating information, are becoming increasingly vital due to the constraints of traditional instruction. As a result, constructivist theory is crucial in the field of education today.

Secondary school serves as a foundation for future education and helps students prepare for higher education. Science knowledge creation is particularly important at the secondary level, and the constructivist method of teaching is welcome. According to Lee and Fraser (9), science students evaluate their classroom environment in a more positive manner than students from other streams. Miheso (10) discovered that when the constructivist strategy is used instead of the standard teaching technique, gender parity is achieved. There was no gender difference in the mean achievement scores for the constructivist group compared to the conventional technique. Other scholars have employed the constructivist method in social science disciplines.

Students taught using a constructivist approach scored higher than those taught using a traditional method. According to Lin (26), (27), Agrawal & Chawla (16), Obiekwe (28), Kim (18), they discovered that constructivist education is more

successful than traditional teaching in terms of motivation, anxiety about learning, and self-monitoring, but it is ineffective in terms of self-concept and learning strategy. Steffe & Gale (29) found that in the social science (Geography) topic, low-achieving students who learned using a constructivist approach scored much higher than their peers who learned through traditional techniques. Nayak (12) emphasizes the use of the constructivist method in the classroom so that students can construct their own knowledge and grasp the concept at its most fundamental level. In the end, their accomplishments will be enhanced. Many study findings, on the other hand, support it. The researcher wants to know how much of a difference the constructivist approach makes in terms of student academic achievement when compared to the conventional way. As a result, it is useful to investigate the impact of the constructivist method on basic science students' achievement. The implementation of the constructivist method during the teaching of science has been widely adopted. In basic science and several social science courses, the majority of researchers discovered that the constructivist approach to teaching is superior to the traditional style of teaching, but it has no bearing in English subjects. The constructivist method has been proven to be quite beneficial for low-achieving students. According to Glaserfeld (23), when an activity-based method is utilized to teach science in secondary schools, students learn better and get better grades, and the technique increases mastery and retention of topics learned. In this context, the study aims to investigate the impact of the constructivist learning method on secondary school students' academic achievement in basic science.

RESEARCH QUESTIONS

1. Is there any significant in the mean achievement scores of students taught with constructivist learning strategy and those taught with the traditional method?
2. Is there any significant in the mean achievement scores of students taught by male and female teachers using constructivist learning strategy?
3. Is there any difference in the mean scores of students taught with constructivist learning strategy in urban and rural schools?

HYPOTHESES

Ho_1: There is no significance difference in the mean achievement scores of students taught with constructivist learning strategy and there with traditional method.

Ho_2: There is no significance difference in the mean achievement score of students taught by makes and female using constructivist learning strategy.

Ho_3: There is no significance difference in the mean achievement score of students in urban and rural schools taught with constructivist learning strategy.

METHODOLOGY

This study used a one-group pretest-posttest quasi-experimental non-randomized design. In this design, the subjects were pretested, after that the treatment was given to the experimental group (treated with the constructivist strategy of teaching), and after six weeks, the students were post-tested. The independent variable is the constructivist strategy, while the dependent variable is academic achievement. The study covers 2 public junior secondary schools, with a population of 349 J.S.S. II students were used for the study. Two secondary schools were selected through simple random sampling techniques. Two intact classes were selected from each school for the study. One secondary school served as the experimental group while the second school was used for control in the urban and rural schools so selected. The instrument for data collection was a teacher-made test well validated titled "Basic Science Achievement Test (BSAT). The reliability of the instrument was obtained through the test-re-test method and the r =.07. The data collected was subjected to analysis. The mean and standard deviation were used to answer all the research questions while ANCOVA was used for testing the hypotheses at a 0.05 level of significance.

RESULT

Research Question 1. Is there any difference in the mean achievement scores of students taught with the constructivist learning strategy and those taught using the traditional method?

TABLE 1: Summary of descriptive statistics comparing the mean achievement scores of students taught using the constructivist learning strategy versus those taught using the traditional method.

Group	N	Pretest		Posttest		Gain	
		Mean	SD	Mean	SD	Mean	SD
Experimental group	150	12.45	7.98	19.59	11.45	7.14	9.68
Control Group	150	10.53	4.76	15.01	7.57	4.48	7.39

The result from Table 1 shows the summary of descriptive statistics on the difference in the mean achievement scores of students taught with the constructivist learning strategy and those taught using the traditional method. It shows the experimental group had a mean gain score of 7.14, SD = 9.68, whereas their counterparts had a mean score of 4.48, SD = 7.39.

H01: There is no significant difference in the mean achievement scores of students taught with the constructivist learning strategy and those taught using the traditional method.

TABLE 4: ANCOVA summary of the difference in mean achievement scores between students taught using the constructivist learning strategy and those taught using the traditional method.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	8469.251[a]	2	4234.625	59.387	.000
Intercept	5807.629	1	5807.629	81.447	.000
Pretest	6900.597	1	6900.597	96.775	.000
Group	738.906	1	738.906	10.363	.001
Error	21177.749	297	71.306		
Total	119434.000	300			
Corrected Total	29647.000	299			

a. R Squared = .286 (Adjusted R Squared = .281)

The result from Table 4 shows the summary of ANCOVA on the difference in the mean achievement scores of students taught with the constructivist learning strategy and those taught using the traditional method. It demonstrates a significant difference in mean achievement scores between students taught using the constructivist learning strategy and those taught using the traditional method (F = 1, 297 = 10.363, p.05). The null hypothesis was rejected at.05 levels of significance.

Research Question 2: Is there any difference in the mean achievement scores of male and female students taught with the constructivist learning strategy?

TABLE 2: Descriptive statistics on the difference in mean achievement scores between male and female students taught using the constructivist learning strategy.

Gender	N	Pretest		Posttest		Gain	
		Mean	SD	Mean	SD	Mean	SD
Male	68	11.68	7.11	19.62	11.35	7.94	10.54
Female	82	13.09	8.63	19.56	11.61	6.48	8.91

The result from Table 2 shows the summary of descriptive statistics on the difference in the mean achievement scores of male and female students taught with the constructivist learning strategy. It shows that the mean gain score of the male students was 10.54, SD = 0.54, whereas that of their female counterparts was 6.48, SD = 8.91.

H_{02}: There is no significant difference in the mean achievement scores of male and female students taught with the constructivist learning strategy.

Summary of ANCOVA on the difference in the mean achievement scores of male and female students taught with the constructivist learning strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6040.360[b]	2	3020.180	32.872	.000
Intercept	4071.320	1	4071.320	44.312	.000
Pretest	6040.241	1	6040.241	65.742	.000
Gender	51.775	1	51.775	.564	.454
Error	13506.013	147	91.878		
Total	77092.000	150			
Corrected Total	19546.373	149			

a. Group = Experimental group

b. R Squared = .309 (Adjusted R Squared = .300)

The result from Table 5 shows the summary of ANCOVA on the difference in the mean achievement scores of male and female students taught with the constructivist learning strategy. It demonstrates that there is no statistically significant difference in mean achievement scores between male and female students taught with the constructivist learning strategy (F = 1, 147 =.564, p >.05).At.05 levels of significance, the null hypothesis two was retained.

Research question 3. Is there any significant difference in the mean achievement scores of urban and rural students taught with the constructivist learning strategy?

TABLE 3: Descriptive statistics on the difference in mean achievement scores between urban and rural students taught using the constructivist learning strategy.

Location	N	Pretest		Posttest		Gain	
		Mean	SD	Mean	SD	Mean	SD
Rural	100	14.40	8.91	23.17	11.06	8.77	9.85
Urban	50	8.54	3.16	12.42	8.55	3.88	8.53

The result from Table 3 shows the summary of descriptive statistics on the difference in the mean achievement scores of urban and rural students taught with the constructivist learning strategy. It shows that the mean gain score of the urban students was 8.77, SD = 9.85, whereas that of their rural counterparts was 3.88, SD = 8.53.

H03: There is no significant difference in the mean achievement scores of urban and rural students taught with the constructivist learning strategy.

Summary of ANCOVA on the difference in the mean achievement scores of urban and rural students taught with the constructivist learning strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7397.169[b]	2	3698.585	44.751	.000
Intercept	4581.115	1	4581.115	55.429	.000
Pretest	3545.086	1	3545.086	42.894	.000
Location	1408.584	1	1408.584	17.043	.000
Error	12149.204	147	82.648		
Total	77092.000	150			
Corrected Total	19546.373	149			

a. Group = Experimental group

b. R Squared = .378 (Adjusted R Squared = .370)

The result from Table 6 shows the summary of ANCOVA on the difference in the mean achievement scores of urban and rural students taught with the constructivist learning strategy. It demonstrates that the mean achievement scores of urban and rural students taught with the constructivist learning strategy differ significantly (F = 1, 147 = 17.043, p.05). The null hypothesis of three was rejected at.05 levels of significance.

DISCUSSION

The relevance of the constructivist learning strategy in the sciences was verified by the study, and the results are discussed below. The study found that the constructivist learning technique has an effect on student academic achievement, as evidenced by the results. The findings indicated that the mean scores of students taught using the constructivist learning strategy (CLS) were better than the mean achievement scores of students taught using the traditional method. Furthermore, the analysis of the results showed that there was a significant difference in the mean achievement scores of students taught using the CLS and those taught using other traditional methods. The findings of the present study corroborate the findings of Abbot and Jeffery (24), who found that constructivist learning strategies improve the academic achievements of students in the sciences. Students should be able to solve problems on their own, and the way to encourage this is to engage students through the constructivist learning strategy. (Kalshreshtha, (5).

According to the findings, male students fared better than female students in terms of the application and achievement. This was determined by looking at the students based on their gender as well as the method. However, more investigation into the significance difference indicated that there was no significant difference between the acceptance and performance of students in basic science based on their gender. The findings support those of (Driver, (29); Hijazi, (18), Qararch, (17)), who discovered in their separate research that there was no significant difference between the mean achievement scores of male and female students who were exposed to the constructivist learning strategy in science. The result of this study reinforces these findings.

When the CLS was put to the test in both urban and rural schools, as well as the application of the strategy by teachers in both settings, as well as the achievement of the students, the findings showed that the rural school students performed significantly better than their urban school counterparts. However, the findings showed that there was no discernible change in the academic performance of the children who had been exposed to the constructivist learning technique. It has not been discovered what reason or reasons are responsible for the variance between the two places. There are two potential explanations for this: 1. Compared to their urban counterparts, the educators in the rural schools where the research was carried out may have had a greater opportunity to get professional nurture or development, therefore increasing their familiarity with more contemporary teaching practises. 2. It is possible that students in urban schools did not embrace the plan; instead, they opted for the conventional teacher-centered technique; as a consequence, they deprived themselves of the opportunity for adequate application, which led to low performance.

According to the results in table 1, the mean score on the constructivist pre-test was 12.45, while the mean score on the constructivist post-test was 7.98. This suggests that the constructivist post-test had a higher mean score than the pretest, indicating that the difference was consequent to the treatment introduced. In addition to this, it reveals the effect that constructivist learning approaches have on the academic achievement of students. Taylor (30). The posttest achievement of students who were taught using a constructivist learning strategy was 1.59, indicating that these students had higher academic achievement than those students who were taught using the lecture method, indicating that there is a significant difference between the academic achievement of students who were taught using a constructivist learning strategy and those students who were taught using the lecture method. (Glasserfelds, (23).

CONCLUSION

The results of this study show that constructivist learning strategies had effects on students' academic achievement, and the effects were significant. Students taught with this learning strategy found their academic achievement was very high and better than those taught using the lecture method.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made:

1. It was discovered that students who were taught using a constructivist learning strategy outperformed their peers in academic achievement, which was very encouraging; therefore, teachers should strive to incorporate this method into the teaching of other science subjects.
2. A constructivist learning strategy should be adopted by teachers in urban and rural schools for the betterment of students' achievement in the sciences.
3. The constructivist teaching strategy should be emphasized in the teacher education curriculum at all levels to enable a good background in the strategy.

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