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Efficacy of Scaffolding Instructional Strategy in Enhancing Secondary School Physics Students' Motivation In Malumfashi Local Government, Katsina State, Nigeria

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ABSTRACT

This study investigated the Efficacy of Scaffolding Instructional Strategy on Secondary School Physics Students' Motivation in Malumfashi Local Government, Katsina State, Nigeria. Two research objective, research question were raised and two corresponding research hypotheses were raised and tested at 0.05 levels of significance. The study adopted pre-test post-test quasi-experimental design. The population of the study consisted of one thousand two hundred and forty-two (1,242) SSII Physics students from which a total of one hundred and twenty three (123) SSII Physics students drawn from two intact classes that participated in the study. The schools were randomly assigned to experimental and control group. A 30 items "Physics Students Motivation Questionnaire" (PSMQ) was used for data collection. The PSMQ was validated by specialist in science education and psychology. The reliability PSMQ and the Cronbach' Alpha reliability method was established and the reliability index was found to be 0.88. The collected data was analyzed using SPSS Version 26.0 to answer the research questions using descriptive statistics (mean rank and sum of rank) and testing the null hypotheses using Mann Whitney U-test. The findings of the study revealed that students taught using Scaffolding Instructional Strategy were motivated significantly higher than students taught using Lecture method. On the basis of these findings, the study concluded that Scaffolding Instructional Strategy brings positive motivation in Physics of SSII students. The study therefore, recommended among others that, Scaffolding Instructional Strategy should be adopted in the teaching and learning of Physics at secondary school.

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INTRODUCTION

Science education is the underlying basis for national progress by protecting human communities from ignorance, illiteracy, diseases and poverty (Bunkure, 2019). It is a field of specialization concerning with two basic aims, which are the production of scientifically interactive society and technological manpower. The development of any nation depends on its innovation due to science and technology as a result emphases are laid on science learning. The science related disciplines that will enable learner to have true knowledge of science and be able to use it in solving problem are Physics, Chemistry, Biology and Mathematics.

Physics is a branch of science that deals with the study of matter in relation to energy, it is a school subject that plays an important role in life, it is important because it is the basic science subject for the development of many study fields such as mechanical engineering, electronics, nuclear sciences, and digital information system.

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It plays a major role in the area of health, economic development, energy and environment; the x-rays, radioisotope, nuclear energy, microscope, and synchrotron radiator among other advances in medicine depend on physics. Teaching and learning of physics is attack with problems such as poor instructional techniques and inadequate instructional materials among others which usher to negative outcome on the academic achievement of students (Mekonnen, 2014). These problems make students to find it difficult to understand and relate Physics to the real world. To teach Physics effectively, teachers needs to employ technique including students-oriented methods that will enable students to learn more, retain more and apply what is learned by participating in an important activities and scaffolding instructional strategy may be good in this aspect.

Scaffolding instructional strategy is a teaching strategy that drives its source from Lev Vygotsky socio-cultural theory and the notion of zone of proximal development. Scaffolding is a structure outside building that support workers in construction. In education, it refers to various instructional techniques that help teacher move his students forward to a stronger understanding of what they are learning and to a greater independence in their own learning process and development. Scaffolding is an instructional technique whereby teacher model the desired learning task, then gradually shift responsibility to the students (Bunkure & Saifullahi, 2021; Ahmad, 2016). This teaching strategy is described as the strategy that focuses on raising student's ability one step at a time and removing the support as students' progress. Like scaffold that support construction workers in building, educational scaffold can be added, modified and removed according to the need of the group that an educator is working with. In scaffolding instructional strategy, the learning activities should include the need of different learners. Therefore teacher must identify and determine the following in order to carry out scaffolding strategy: (1) what a student can accomplish independently, (2) what a student can accomplish with guidance (determination of students zone of proximal development). The teacher then should provide the instructions that are just enough to support the learners in the task beyond the reach without teachers support (Olubunmi & Ese, 2018). If the potentials of scaffolding strategies are fully utilized, student's motivation to subjects like Physics and other science subject could improve.

Motivation is an internal drive that spurs one into action (Tus, 2020). It is an important psychological construct that drives a person action. Motivation is a strong desire or passion in a person that encourages the person to try and do something in order to succeed (Sale, 2014). Motivation affects student learning and plays an important role in directing behavior towards a certain goal, increasing the effort and energy towards a goal, increasing the initiative and perseverance of an activity, and improves individual performance. Teaching Physics in a fun and effective manner may increase students' motivation towards the subject. It was believed that, if teachers give suitable feedback to the students on their level, initiate students' interest, makes them understand the importance of the content, and have students share their idea in classroom discussion, then the student's motivation increases. Student effort toward academic achievement is controlled by motivational factors such as interest, competence and autonomy. In addition, studies exploring the motivational outcome should be conducted in the classroom setting where learners participate in the activities as indicated in the situated learning paradigm irrespective of their gender.

In a typical classroom that is co-educational in nature, where male and female interact in the learning process; the existent of male and female is called gender. Gender is any physical and behavioral difference between male and female which are socially, culturally based. Researches on gender and academic achievement like that of Abumchukwu and Okeke (2020) and Ayu, Jufriadi and Sujito (2018), observed that boys achieved better than girls. Okoyefi (2014) reported that female students performed better in physics than male counterpart, while Omwirhim (2015) revealed that gender

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influences students' understanding of science subject in favor of male.

STATEMENT OF THE PROBLEM

The impact of globalization and the evolving economy has influenced the school system to reconsider ways of effective teaching and learning because the current conventional instructional practices in the classroom were designed in the 20th century, which was a period of the industrial-based economy and was not envisioned for the knowledge-based economy of the 21st century (Jacobs, 2010 cited in Yaki 2022). While the practices in the classroom in Nigeria are keeping the existing state of teaching demand is evolving very fast. The reason can be attributed to the fact that classroom interaction is dominated by the teacher which is characterized by memorization, recall, and rote learning. Innovative instructional strategies that are student-centered and characterized by active learning that could stimulate understanding and motivate students are not adopted.

Teaching and learning of Physics at senior secondary school level have been encountered by many problems which include low interest and motivation when compared to other science subjects, poor students' performance and background to learn physics (Sale, 2014). This problems leave one in doubt about the effectiveness of teaching methods popularly used by teachers for teaching the subjects (Garba, 2016). Some researchers have discourage the use of traditional method of teaching which leads to memorization of fact and concept and there is need to find out the effectiveness of other teaching strategies relative to the traditional (Yaki, 2022; Nwali, 2014). Against this backdrop, the researcher's attention was drawn to investigate the efficacy of scaffolding instructional strategy in enhancing secondary school physics students' motivation in Malumfashi Local Government, Katsina State, Nigeria.

THEORETICAL FRAMEWORK

The theory that underpinned this study is Vygotsky's Developmental Theory (1978). Vygotsky was interested in the development of higher mental functioning such as voluntary attention, logical reasoning, conceptual thinking, categorical perception and self-regulation of learning. He believed that higher mental functioning is acquired through interacting with other people. According to Vygotsky, social interaction is translated into psychological functioning via psychological tools which direct the mind and change the process of thinking Symbol, sign, and language are examples of psychological tools and they differ from culture to culture. During the development, an individual's higher mental function is at different level. Vygotsky, claim that what a child can already do is not a good indicator of his/her mental development. He stated that students can accomplish more difficult task with the assistance of more capable others, which is more accurate indicator of their developmental level. Based on this he introduced the concept of Zone of Proximal Development (ZPD) and believe that it is a more accurate measure to predict learner's cognitive development. According to Vygotsky, the zone of proximal development is the distance between actual developmental levels as determined by independent problem solving and level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peer?

The implication of Vygotsky theory is that every student is able to learn Physics and be motivated if appropriate support is provided in their ZPD, this means that, students differ in the amount of assistance they need for learning to take place. Therefore it is importance to know learner's ZPD before selecting task that are in their ZPD. The researcher is therefore intended to use scaffolding instructional strategy to teach concept of mechanics with the aim to determine motivation level of secondary school Physics students in Malumfashi Local Government, Katsina State, Nigeria.

Another theory that underpinned this study is Maslow's Pyramid Hierarchy of Need (1954). Psychologist Abraham Maslow first introduced the concept of hierarchy of needs in a paper titled "A Theory of Human Motivation" This hierarchy suggests that people are motivated to fulfill basic needs before moving on to other

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needs. Maslow's hierarchy of needs is most often displayed as a pyramid, with lowest levels of the pyramid made up of the most basic needs and more complex needs are at the top of the pyramid. Needs at the bottom of the pyramid are basic physical requirements including the need for food, water, sleep and warmth. Once these lower-level needs have been met, people can move on to the next level of needs, which are for safety and security. As people progress up the pyramid, needs become increasingly psychological and social. Soon, the need for love, friendship and intimacy become important. Further up the pyramid, the need for personal esteem and feelings of accomplishment become important. Hence, Maslow emphasized the importance of self-actualization, which is a process of growing and developing as a person to achieve individual potential.

The hierarchy of needs theory is relevant to this study as the theory is applicable to teaching and learning. The theory is able to suggest how teachers can lead their students to become self-actualized. The idea implies the dual role of the theory first to teachers and second to administrators on the basis that both the teachers and the administrators must decide on the performance of their students. The cultural framework of the teachers should reflect the fact that students' physiological and security needs are paramount; therefore, when such needs became culturally focused, students' performance will be improved tremendously in that school. This argument implies a reversed effect that if the need is not culturally focused on, the performance standard of students will not be met. Therefore researcher is intended to use scaffolding instructional strategy to teach concept of mechanics and examining its efficacy in enhancing motivation to Physics Students across gender.

Objectives of the Study

The specific objectives of this study are set to:

i. Determine the effects of scaffolding instructional strategy on secondary schools physics students' motivation.
ii. Investigate the effects of scaffolding instructional strategy on secondary schools physics students' motivation among male and female.

Research Questions

In line with the objectives of the study, the following research questions are raised to guide the study:

i. What is the difference in the mean motivation score between students taught physics using scaffolding instructional strategy and those taught physics using Lecture method.
ii. What is the difference in the mean motivation score between male and female students taught physics using scaffolding instructional strategy?

Research Hypotheses

Based on the stated research questions, the following null hypotheses are formulated and tested at 5%level of significance to guide this study:

H_{01} There is no significant difference in the mean motivation score between students taught physics using scaffolding instructional strategy and those taught physics using Lecture method.

H_{03} There is no significant difference in the mean motivation score between male and female students taught physics using scaffolding instructional strategy.

METHODOLOGY

The study adopted a quasi-experimental of pretest posttest non-equivalent group design; this is because quasi experimental design is a type of experimental design that does not provide for full control of extraneous variable, because of lack of random assignment of subject to group (Creswell, 2012). This design is considered appropriate for this study because intact classes were used to avoid interruption of normal lesson. In this design both groups were subjected to pretest and posttest before and after the treatment respectively. This is illustrated in figure 1:

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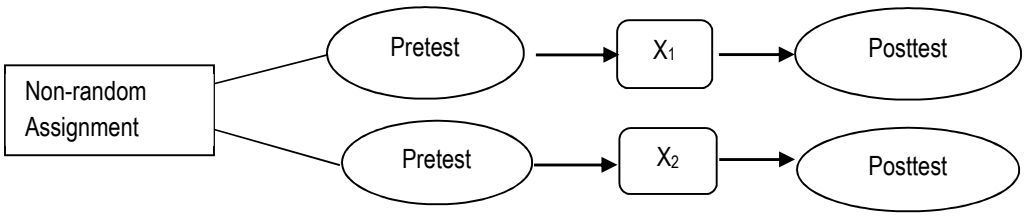

Figure 1: Research Design

Key:

X_1: treatment of Experimental group (using Scaffolding Technique)

X_2: treatment of Control group (using Lecture Method)

The target population of the study comprises all senior secondary school two (SSII) physics students in all (18) public senior secondary school in Malumfashi Local Government, Katsina State. The population for this study consisted of all senior secondary school two (SSII) physics students in nine (9) public co-educational school with a total number of one thousand two hundred and forty two (1242) physics students, comprising 701 males and 541 females. The choice of co-educational school is based on consideration of gender as a variable. Simple random sampling technique was use to select two public schools from the nine schools in the population. One school was assigned as experimental group while the other serve as control group. The schools were selected using balloting. However, an intact senior secondary school two Physics students class from the two selected schools were used in order to avoid interruption of normal lessons. One hundred and twenty three (123) senior secondary school two (SSII) Physics students were sampled comprising seventy six (76) males and forty seven (47) females and took part in the study.

The researcher adapted Science Motivation Questionnaire constructed by Mubeen and Reid (2014). The Questionnaire consisted of 30 items. The questionnaire is designed using a "Four- Choice Likert Scale". These are Strongly Agree (SA), Agree (A), Disagree (DA) and Strongly Disagree (SD). The students were asked to freely indicate their motivation to Physics by simply ticking one of the four options that suit their motivation. The items of the instrument Physics Students Motivation Questionnaire (PSMQ) was carried a weight in the order of priority from four to one in positive motivation responses and from one to four in negative motivation responses. From the items, maximum score is 120, minimum score is 30 and the average score is 75. A score above 75 signifies positive motivation and thus acceptance region. A score of 75 and below indicates no motivation to Physics and therefore rejection region.

Physics Students Motivation Questionnaire (PSMQ) was given to one professor from Physics Department, one senior lecturer from Science and Technology Education Departments, Bayero University Kano; One professor and senior lecturer from Science Education Department, Federal University of Technology, Minna and one experience physics teacher at secondary school level with 16 years teaching experience from a public senior secondary school in Malumfashi for validation. Their corrections were considered in the construction of the final instruments. The internal consistency reliability of Physics Students Motivation Questionnaire (PSMQ) was established and index was calculated using Cronbach's Alpha formula, and the reliability index was found to be 0.88.

The researcher visited the sampled schools and sought for their permission to conduct the study and addressed the principals and physics teachers on the duration and nature of the treatment of the study. At the beginning of the study, experimental and control group were subjected to pretest to determine their level of motivation before treatment. Experimental group was taught using scaffolding instructional strategy while control group was taught using Lecture method. The students in both groups were taught

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for six week. Immediately after the instruction, the researcher administered the post-test (PSMQ) to both experimental and control group. The data obtained from the pre-test and posttest were marked and subjected to data analysis using (SPSS v. 26.0) for both descriptive and inferential statistical tool. Mean rank and sum of rank were used to answer the research question while the hypotheses were tested at 0.05 significance level using Mann Whitney U-test statistical tool.

RESULTS

The pre-test score was analyzed using mean rank and sum of rank for the data obtained from Physics Students Motivation Questionnaire (PSMQ) to ascertain the homogeneity or otherwise between control and experimental group. Therefore pre-test has no effect on the motivation of experimental and control group and is presented in Table 8.1.

Table 8.1: Analysis of Pre-Test Mean Rank of Motivation Scores of the Experimental and Control Groups Prior to Treatment

Group	N	Mean Rank	Sum of Rank	Mean Rank Difference
Experimental	58	62.54	3627.5	1.02
Control	65	61.52	3998.5	

Table 8.1 shows the pre-test mean rank motivation score of the experimental and control groups prior to treatment. The mean rank and sum of rank of experimental group are 62.54 and 3627.5 while that of control group are 61.52 and 3998.5. The pre-test mean rank difference is 1.02 and this indicates that the experimental and control group have the same levels of motivation. The groups were also comparable and suitable for the experiment since they have very close pre-requisite motivation level before treatment.

Research Question One: What is the difference in the mean motivation score between students taught physics using scaffolding instructional strategy and those taught physics using lecture method in Malumfashi Local Government, Katsina State? Mean rank and sum of rank were used to answer research question neo and is presented in Table 8.2

Table 8.2: Mean Rank and Sum of Rank of Motivation Scores of Physics Students Taught Using Scaffolding and Conventional Teaching Method

Group	N	Mean Rank	Sum of Rank	Mean Rank Difference
Experimental	58	90.54	5251.5	54.01
Control	65	36.53	2374.5	

Table 8.2 presented the result of mean motivation scores of physics students taught using scaffolding instructional strategy and lecture method, from the result students exposed to scaffolding instructional technique had a mean rank of score of 90.54 and sum of rank of 5251.5 while those exposed to conventional teaching method had a mean rank of score of 36.53 and sum of rank of 2374.5. The mean rank difference between the groups is 54.01 and this result indicates that students taught physics using scaffolding instructional strategy had high mean motivation scores than those taught using lecture method. The result revealed that experimental group exposed to scaffolding instructional strategy had better motivation than control group.

Research Question Two: What is the difference in the mean motivation score between male and female students' taught physics using scaffolding instructional strategy in Malumfashi Local Government, Katsina State?

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Table 8.3: Mean Rank and Sum of Rank of Motivation Scores of Male and Female Physics Students Taught Using Scaffolding Instructional Strategy

Group	N	Mean Rank	Sum of Rank	Mean Rank Difference
Male	40	29.25	1170	1.28
Female	18	30.53	541	

Table 8.3 present the result of mean motivation scores of male and female physics students taught using scaffolding technique, from the result, male students exposed to scaffolding instructional strategy had a mean rank of score of 29.25 and sum of rank of 1170 while female students had a mean rank of score of 30.53 and sum of rank of 541. The mean rank difference between male and female motivation score is 1.28 and this result indicates that female students taught physics using scaffolding instructional strategy have slightly high mean motivation scores than male counterpart though the difference is not significant

Hypothesis Testing

H_{02} There is no significant difference in the mean motivation score between students taught physics using scaffolding instructional strategy and those taught physics using lecture method

Table 8.4: Mann-Whitney U-test for Posttest Mean Rank of Motivation Scores of the Experimental and Control Group

Group	N	Mean Rank	Sum of Rank	U-value	P-value	Decision
Experimental	58	90.54	5251.5	229.5	0.000	Significant
Control	65	36.53	2374.5			

Table 8.4 present the result of Mann-Whitney U-test analyses for posttest mean rank of motivation scores of the experimental and control groups, the observed p-value is 0.000 which is less than the alpha-value 0.05 with U-value of 229.5. The null hypothesis is therefore rejected and thus, there is significant difference in the mean rank of motivation score between students taught physics using scaffolding instructional strategy and those taught physics using lecture method in favor of experimental group.

H_{04} There is no significant difference in the mean motivation score between male and female students taught physics using scaffolding instructional strategy.

Table 8.5: Mann-Whitney U-test for Posttest Mean Rank of Motivation Scores of the Male and Female Physics students in Experimental Group

Group	N	Mean Rank	Sum of Rank	U-value	P-value	Decision
Male	40	29.25	1170	350	0.866	Not significant
Female	18	30.53	541			

Table 8.5 presents Mann-Whitney U-test for Posttest Mean Rank of Motivation Scores of the Male and Female Physics students in Experimental Group. The observed p-value is 0.866 which is greater than the alpha value 0.05 with U-value of 350. The null hypothesis two is therefore accepted or retained. The reason for acceptance of the null hypothesis two is because the observe p-value is greater than the alpha value and thus, There was no significant difference in the mean motivation scores between male and female students taught physics using scaffolding instructional strategy.

SUMMARY OF THE FINDINGS

1. There is significant difference in the mean motivation score between physics students taught using scaffolding

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instructional strategy and those taught using Lecture method in favor of experimental group.

2. There is no significant difference in the mean motivation score between male and female physics students taught using scaffolding instructional strategy.

DISCUSSION OF THE FINDINGS

The analysis indicates that there is significant difference in the mean motivation score between physics students taught using scaffolding instructional strategy and those taught using lecture method in favor of experimental group. This means that when scaffolding instructional strategy is used to teach physics concept, it improves the levels of students' motivation. This finding is in agreement with the work of (Saifullahi, 2021; Ayu, et al., 2018; Bansal, 2017; Chukwuagu, 2016; Remalyn & Haidar, 2013). This observation could be attribute to the manner and ways in which lesson was delivered to the physics students through scaffolding instructional strategy. In this model learners participate fully in all the activities. The learning was model by teacher follow by students in small group and then by students individually, therefore student were allowed to learn independently and become self-evaluated. This instructional strategy helps learners to change and improved their level of motivation.

The analysis also indicates that, there is no significant difference in the mean motivation score between male and female physics students taught using scaffolding instructional strategy exist. This is because observations indicated that both male and female physics students that learnt physics concept using scaffolding instructional model had significant equal almost motivation. In this study both the male and female students motivation were equally enhanced because scaffolding instructional strategy is not sex stereotyped. Scaffolding instructional strategy allows both male and female to learn in the same group and individually within their zone of proximal development. This could be the reason why a gender difference was not found in this study after students were exposed to scaffolding instructional strategy. This findings is in line with the findings of the studies carried out by (Ayu, et al., 2018; Garba, 2016; Saleh 2014) who reported that no significant gender difference in the students' motivation was observed after students were exposed to experiment.

CONCLUSION

Based on the findings of this study the following conclusions were drawn:

i. Students taught physics concept using scaffolding instructional strategy possess high level motivation than their counterpart students taught using lecture method. As such scaffolding instructional strategy increases students' motivation level.

ii. Scaffolding instructional strategy help in improving male and female students' motivation as indicated by insignificant difference in their mean motivation when taught using scaffolding instructional strategy.

RECOMMENDATIONS

1. Physics teachers under the study area should be discouraged from teaching physics using lecture method. This is because it was found less effective in enhancing student's motivation to learning physics.
2. Government via ministry of education, curriculum planner and professional bodies should encourage physics teachers to use scaffolding instructional strategy while teaching physics, so as to enable students learn and participate fully in the lesson by allowing students to learn independently and become self-evaluated irrespective of gender. This is because it was found effective in enhancing student's motivation to learning physics irrespective of gender.

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