International Journal of Arts, Humanities and Social Studies
Website: https://www.ijahss.in/
ISSN(*Online*): 2582-3647
Volume 4; Issue 2; Mar-April 2022; Page No. 181-189

Open Access | Original Paper

Investigating the Relative Effectiveness of Collaborative Learning Approach on Students' Achievement in force Concept in the Senior Secondary School Physics

NooraidaYakob[1] & Moses Irekpita Simeon[2]*
[1]Senior Lecturer, School of Education and Human Sciences, Al Bukhary International University, Alor Setar, Kedah, Malaysia
[2]Lecturer, Department of Science and Environment Education, Faculty of Education, University of Abuja, Abuja, Nigeria

ABSTRACT
The study investigated the effectiveness of collaborative learning approach on physics students' achievement in the concept of force at the senior secondary school physics. The study employed a quasi-experimental research design. Study was targeted at students in the senior secondary (SS2) class who offers physics as a subject at a given selected senior secondary school. An intact class was used for the study. The selected class A was used for the experimental design while class B was used for the conventional approach. A total of 28 students were in the experimental group while 36 students were in the conventional group. A pretest was given to each of the two groups to establish their equivalence level. The study adopted a "Think, Pair, and Share" type of collaborative strategy in the learning of force concept for four (4) weeks and thereafter gave the students a post-test to establish the effect of the intervention on the students. The paired t-test and the independent t-test statistical analysis using the SPSS statistical package were used to analyse the generated hypotheses. Study findings shows that there was significant difference between the achievement of students in force concept in physics using collaborative and conventional approach. Finding also shows that there was no significant difference between the achievement of male and female students in physics using collaborative approach. Therefore, Study findings asserts that collaborative instructional approach in physics learning is an indispensable, valuable pedagogical technique in physics learning and a tool for closing gender differences and discrimination in physics classroom. Conclusion and recommendations were such as teachers should encourage physics students to participate in collaborations in physics learning made in the study.

Keywords: *Collaborative, achievement, male, female, physics, learning.*

***Citation*:** NooraidaYakob & Moses Irekpita Simeon. (2022). Investigating the Relative Effectiveness of Collaborative Learning Approach on Students' Achievement in force Concept in the Senior Secondary School Physics. *International Journal of Arts, Humanities and Social Studies*, 4(2), 181-189.

INTRODUCTION

The concept of force is one of the most fundamental concepts in the senior secondary school physics yet the most misunderstood concept so that several studies have shown that the concept of force create some challenges to learn and teach in schools [1]. Conceptual misunderstanding, also known as misconception is common among many learners, especially novice learners, and often results in learners' poor achievements [2].

Several studies have shown that the concept of force is a problem for teaching. Moreover, in Coelho's [1]. Unfortunately, it is generally observed that the teaching and learning of physics in Nigeria is still dominated by teacher-cantered approaches that do not promote students 'active learning. Collaborative learning according to Ismayati[3] improves students' creativity thinking and collaborative working environment . According to him, in physics learning students are expected to utilize the power of reasoning so as to be able to think critically and then act scientifically thereby enhancing national growth and development. Collaborative learning is a learning method where students have the opportunity to share ideas and interact with students of the same or with varied ability in order to get experiences. This is a learning approach where students learn together in groups, contribute ideas solve problems together and encourage one another to be persistent in other to arrive at educational goals[4]. Otherwise known as learners centered method of teaching. The interactions are expected to enhance their performance, build up their self-importance, stimulate them to inquiry and make ideas clear. Thus, they are expected to surmount some of their learning difficulty in some selected physics concepts of force .Purpose of this study therefore was to investigate if students' achievement with respect to gender can be enhanced as they engage in collaborative learning approach..

Purpose of the Study

The study has the following objectives to;

i. Investigate the difference in the mean achievement of male and female students in physics concepts using collaborative method in senior secondary schools.
ii. investigate the difference between the achievement of students in collaborative group and achievement of students in the conventional group,

Research Hypotheses

The following hypotheses were formulated in the study :

HO_1: There is no significant difference between the mean achievement of students in learning physics concepts of force using the collaborative and conventional learning approach.

HO_2: There is no significant difference between the mean achievement of male and female students in learning physics concept of force using collaborative learning approach.

The Concept of Collaborative Learning Approach in Physics

Collaborative learning refers to an instructional method in which learners at various performance levels work together in small groups toward a common goal. The students are responsible for one another`s learning as well as their own. Thus, the success of one student helps other students to be successful [5]. Collaborative learning requires learners working together to achieve a learning goal. Collaborative learning is an instructional strategy that establishes a relationship among learners and promotes positive interdependence among the grouped learners [6]. Roschelle and Teasley [7] defined collaborative learning as a process by which learners discuss and share meaning information relevant to the problem-solving task at hand. Collaboration is a coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem. According to collaborative learning is an approach which involve students thinking and doing things together. Collaborative learning refers to an instructional method in which students at various performance levels work together in small groups toward a common goal. The students are responsible for one another`s learning as well as their own. Thus, the success of one student helps other students to be successful [5]. Collaborative learning requires learners working together to achieve a learning goal. Collaborative learning is an instructional strategy that establishes a relationship among learners and promotes positive interdependence among the grouped learners [6]. Roschelle and Teasley [7] defined collaborative learning as a process by which individuals negotiate and share meanings relevant to the problem-solving task at hand.

Many educators and policy makers have observed and commended collaborative strategy as being a good approach. Therefore, in the past few decades till now, collaborative learning approach has become a focus of research in educational practices.

Characteristics and Principles of Collaboration Approach in Physics Classroom

Collaborative learning provides active participation of students in physics learning. In collaborative classrooms, there is an opportunity for every student to learn from other students. No student is deprived of the opportunity for making contributions and appreciating the contributions of other students. Collaborative learning creates an environment where the physics teacher involves students in thinking and doing the things relating to the concept in physics. Stephen [8], observed that a collaborative classroom has the following characteristics:

(1)Ability Sharing : In a collaborative classroom, the physics teacher encourages students on the use of their own knowledge, ensures that students share their knowledge, expertise and their learning strategies, treat each other respectfully with focus on understanding the concept .

(2)Knowledge Sharing : Teachers have vital knowledge about the subject content, skills, and instruction and so provide such information to students. In a collaborative classroom, the teacher also builds upon the knowledge, personal experiences, language, strategies, and culture that students bring to the learning situation.

(3) Mediation: Teachers in a collaborative classroom act as mediators to adjust the type of information since successful mediation helps students connect new information to their experiences thereby learning better. Such teacher's role helps students to discover what to do when they are challenged and help them learn better.

(4) Heterogeneity: In a collaborative classroom, heterogeneous groupings of students enrich learning in the classroom since the perspectives, experiences, and backgrounds of all students are important for enriching learning in the classroom.

The first two characteristics capture the nature of relationships between the teacher and the students in a collaborative classroom. The third characterizes teachers‟ new approaches to instruction. The fourth addresses the composition of a collaborative classroom. The Smart Classroom enhances all the above characteristics of collaborative learning.

According to Orr [9], collaborative learning is based upon the following principles:

i. Working together in a collaborative learning approach results in a greater understanding than what would likely have occurred if one had worked independently.
ii. Provides opportunity to become aware, build relationships through viable social interactions and which could also enhance understanding g of concept.
iii. Spoken and written interactions contribute to increased understanding of concepts.
iv. Some elements of this increased understanding are idiosyncratic and unpredictable.
v. Participation is voluntary and must be freely entered into.

The idea behind collaborative learning is that there is mutual benefit so that all group members gain from each other`s efforts, recognizing that all group members share a common fate, feeling and sharing of ideas and performance. Collaborative learning is an umbrella term of educational approaches which involves joint intellectual effort by students, or students and teachers together, where students will work in groups of two or more, mutually searching for understanding, solutions, or meanings, or creating a product. Alderman [10] stated that there are three conditions for collaborative learning, which include the following:

a) That knowledge is created through interaction and not transferred from educator to a student.
b) Learning is student-centered, with consideration given to the students‟ levels of knowledge, experience and understanding; and
c) The educator`s role is that of facilitator of learning, developer of the structure, creator of the context, and provider of the learning space so that students can take control of their own learning.

Gokhale [5] found that collaborative learning enhances critical thinking of students. He further stated that students who participated in collaborative learning had performed significantly better on the critical-thinking test than those who studied individually. This statement is in agreement with the learning theories proposed by proponents of collaborative learning that is Vygotsky [11], which stated that, students are capable of performing at higher intellectual levels when asked to work in collaborative situations than when asked to work individually.

Models of Collaborative Learning Approach.

Collaborative learning has several activities, which help to improve students` learning. These activities can be classified into several models. The widely used techniques or models of collaborative learning strategies as stated by Ford [12] and Panitz [13] include:

(i) Think, Pair, and Share: - This strategy encourages students to participate individually with specific responsibilities and collaboratively as they share ideas back with the larger group. There are three distinct steps in the Think, Pair, and Share strategy, this include the following;

Think – students are asked to think independently about the question that has been posed, thus forming independent ideas.

Pair – students are grouped with a partner to discuss their ideas and thoughts. This step is critical as it allows students an opportunity to articulate their own ideas as well as consider the ideas of their partner.

Share – student pairs then share their ideas on the question or topic with the larger group or whole class. This process allows students to clarify their ideas individually, then within a small group before having to present in front of a larger audience.

(ii) Jigsaw: This is a method intended to provide collaborative learning environments. Its development began in the 70s by E. Aronson at University of Texas and University of California. Jigsaw is a face-to-face method, without technological support. It emphasizes interaction among workgroup members. This collaborative learning strategy is appropriate for all levels of students and works well with large or small classes. This strategy encourages and reinforces a variety of skills such as listening, engagement and empathy by establishing an interdependent group where members have both individual and group responsibilities. This strategy also facilitates interaction among all students in the class as they work to accomplish a common goal. It also requires a higher level of understanding of particular topics, since each student will be required to “teach” their group members what they learned. There are three distinct steps in the Jigsaw strategy.

Step 1. Establish “Home” groups. Divide the material to be covered into approximately four to five topics. The home group will consist of the same number of students as you have topics. Each member of the home group will then be assigned to an expert or research group based on your content topics.

Step 2. Assign topic exploration activities so that each member of the expert group will accurately and thoroughly understand the material assigned to their expert group.

Step 3. Once the expert groups have a solid understanding of their topic material, they will return to their home group to teach that information to other members of home group. Success depends on the determination that all group members understood the required topical concepts.

(iii) Buzz Groups. This collaborative learning strategy is appropriate for most grade levels but is particularly appropriate for college-age students and can easily be adapted for both large and small classes. This strategy requires brainstorm ideas as fast as possible within a small group. This encourages critical thinking, but also adds the urgency of time which can be competitively motivating for some students. There are three distinct steps in the Buzz Group strategy.

Step 1. Allow students to self-select into small groups of three to five members. Each group should assign one person to serve as the recorder of the ideas generated.

Step 2. Each small group will share some of the ideas with the whole group, allowing each group to contribute to the conversation.

Step 3. Once all groups have presented, any group can present additional ideas that were not previously presented.

(iv) Standard Teams-Achievement-Divisions (STAD). This is considered one of the basic approaches of introducing learners to collaborative learning. The use of this method is thought as an effective and efficient way to teach well-defined educational subjects. The teams are heterogeneous, made up of learners of diverse academic performance, race, and nationality. The rewarding of the best teams motivates the better students in a team to encourage other members to achieve their mutual goal. The main Goals of this model are to motivate students to encourage and help each other, and to accelerate student performance. The model also helps to facilitate gains in self-esteem, liking of class, which improve the behavior of the learners.

(v) Critical Debates. This collaborative learning strategy is appropriate for most grade levels but is particularly appropriate for college-age students and can easily be adapted for both large and small classes.

This strategy requires students to engage in critical thinking as they research the positives and negatives of a particular topic and reinforces the articulate communication in views of the side for which they are assigned to argue. This strategy also encourages positive competition which can be very engaging for some students. There are four distinct steps in the Critical Debate strategy.

i. Assign debate groups. Groups may be as small as two or up to four maximum participation values. Assign which side of a topic each debate group will argue.
ii. Students in each debate group will explore their topic and identify their strongest points to present their view.
iii. Members of the debate group will have three to five minutes to present their best arguments to the opposing group. Then the opposing group will have three to five minutes to present their best arguments.
iv. After initial arguments are heard, each group will discuss how to counter the points presented by the opposing group. Then each group will have two minutes to present their points. At the end of that time, remaining members of the class can determine which group had the most convincing arguments on the topic.

(vi) Johnson and Johnson`s Model (1975):- Johnson and Johnson Model is another instruction that involves students working in teams to accomplish a common goal. Under the conditions which involves students working in teams to accomplish a common goal, under the following elements, which include positive interdependence, individual accountability, face to face promotive interaction, appropriate use of collaborative skills and grouping processing. In this model, members of the class are grouped into four or five members.

In this Group work, a common assignment is given to group and submit a group report of their results. Class work was based on the group work. Apart from assigning the group tasks, the teacher`s role was to provide group relationship and encouragement between members of the groups. Johnson and Johnson [14] proposed that learning exercise and qualities of this learning strategy have a relationship with the five elements earlier mentioned. This model of Johnson et al. [14] is more effective at providing meaningful learning than competition or individualization. Therefore, in this study, Johnson et al. [14] model was adopted. Panitz [13], stated that model of cooperative learning is also used in collaborative learning. In addition, this learning strategy involves students working in teams to accomplish a common goal, under the conditions, which involves students working in teams to accomplish common goals.

Collaborative Learning and Achievement in Physics Learning

A number of researches on collaborative learning have been carried out in the world. These studies have shown that collaborative learning lead to improve students` learning and revitalized teaching methods [15]. Another benefit identified by researches includes higher academic achievement and when students of different racial or ethnic backgrounds work together towards a common goal, liking and respect for one another is increased [16]. Johnson [15], stated that working together with peers and valuing would result in greater psychological health that does competing with peer or working independently.

Gokhale [5] conducted a study titled ``Collaborative Learning Enhances Critical Thinking`` and found that students critical thinking skills improve positively in collaborative learning environment than those working individually. This is in accordance with the opinion of Vygotsky [11], which says that the intellectual students will perform higher in collaborative situations than individual. Jantii [17], found that when students work together in a complex task, they help each other, resulting in a focused dialogue, and can solve a difficult problem, which cannot be done individually. Tudge [18] suggests that collaboration has strong impact on student performance, and change the reasoning ability of the students. Collaborative learning is believed to prepare students for modern participative workplace. Lakkala [19], further pointed out that students are active agents who share ideas, solve problems, use various information sources and create knowledge together.

However, recent studies have indicated that there are other factors that can be useful predictors of academic performance in physics which one of the factors is personality [20]. Personality can be said to be the sum total of the behavior and mental characteristics that are distinctive of an individual. Personality is also a categorized set of attributes that is found in a person that influences and defines the individual`s cognition, motivations and behaviors, personality as a set of psychological traits and mechanisms within an individual that are organized and relatively enduring and that influence his/her interactions with, and adaptations to the environment. However, based on the above studies, which show that collaborative learning enhanced the students` academic achievement, this study would be conducted using physics students to see if this learning strategy would help physics students to perform better academically.

Bani [21] found in a research that the academic achievement of low ability students increased as a result of coaching by high ability students in collaborative groups while the act of being coached helps the higher ability students to internalize the content much better. Accordingly, study on group composition and learning generally shows that when students of varied abilities actively participate in group collaboration, low ability students learn best in groups with high ability students, high ability students perform well in group composition, and medium-ability students learn most in relatively homogeneous groups.

Similarly, for medium-ability students, study conducted by Webb [22] shows that they learn less in heterogeneous groups than in homogeneous groups. Possible causes for this may be excluded from the teacher/ learner relationships that develop between high and lows; they may not be allowed to actively participate. Learning in collaborative groups could be beneficial to high, medium and low ability students. Meanwhile, in other direction O`Donnel [23], found that students in heterogeneous ability have high academic achievement than students who learn in homogeneous ability. Collaborative learning usually involves heterogeneous group, that is, groups are formed by combining students of disparate ability, gender, or ethnic background. However, there is a considerable disagreement regarding the effects of heterogeneous group on the performance and attitudes of students representing different abilities. Advocates of heterogeneous group claimed that there might be great advantages to having students with different abilities work together on collaborative tasks. They argued that while high ability students benefit from providing explanations to partners, low-ability students benefit from the increased opportunities for support and encouragement.

Bandura [24] also suggests that low-ability students may learn Meta cognitive skills more effectively in groups through model than when learning alone. The results of some experimental studies show that students of all abilities benefit from participating in a heterogeneous collaborative groups compared to students of similar ability who worked alone [25]. Therefore, some critics claim that heterogeneous group promotes personal gains at the expense of others. For example, Dalton [25], found that heterogeneous group benefited the most, but did little for the least able students. In addition, Hannafin [26] found that low-ability students demonstrated higher performance in heterogeneous groups, but high-ability students performed better when grouped homogeneously. Webb [22] reported that average students in homogeneous groups showed higher performance and received more explanations than average students in heterogeneous groups. We can thus infer from the aforesaid that there is a clear relationship between the collaborative learning strategy and academic achievement of varied ability students.

The literature reviewed shows that low ability students benefit more when mixed in a collaborative learning group with high ability students. In addition, homogenous ability group helps in motivating low ability students, because Adodo and Agbayewa [27] conducted a study on the effect of homogenous and heterogeneous ability grouping class teaching on students‟ interest, attitude and achievement in integrated science and found that homogenous ability grouping is superior for promoting academic performance of low ability students. Therefore, this study would be conducted using homogenous Basic Science students in order to find out if collaborative learning strategy would help this homogenous ability group in learning.

RESEARCH METHODOLOGY

The study adopted a quasi-experimental research design in the bid to investigate the effectiveness of collaborative approach on students' achievements in physics concept in the senior secondary school in Nigeria. Study was targeted at students in SS2 class who offers Physics as a subject at the senior secondary school. Intact classes were used. Class A was used for the experimental design while class B was used for the conventional approach (Usual teacher-student learning style). This is in line with the observation of Houser [28] that a quasi-experimental design which is one that involves the use of an invention on a target population lack the element of random assignment and makes use of intact classes. A total of 64 students were used in the study with 28 students in the experimental group while 36 were in the conventional group. An achievement test on the concept of force with twenty –five items validated by experts was administered as pretest to each of the two groups to establish their equivalence. This was done before the study intervention of using the collaborative learning approach in physics. Besides, this became necessary so as to be able to generalize the heterogeneous ability of study participants and consequently, mitigate interaction effects of selection biases and treatment. Students in the two groups were all exposed to physics concepts of force for four weeks during the study intervention. The study adopted a "Think, Pair, and Share" type of collaborative strategy in the concept of force at the senior secondary school at study intervention.

Students were thereafter administered a post-test which was the same test administered in the pretest but reshuffled to establish the effect of the intervention on the students.

DATA ANALYSIS AND RESULT

In this study, two hypotheses were formulated. In a bid to test these hypotheses the tables of data analysis were presented as follows:

Table 1: Comparing the Mean, Standard Deviation of Students' Achievement in Physics Using Collaborative Approach and Conventional Approach.

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Achievement in collaborative method	74.35	28	20.18	3.37
	Achievement in convention method	50.16	36	29.11	5.23

From Table 1 , the mean, standard deviation of students 'achievement in physics using collaborative approach was (M=74.35,SD=20.18) while for conventional approach was (M=50.16, SD=29.11) .

Table 2: Mean, Standard Deviation of Male and Female Students' Achievement in Physics using Collaborative Approach

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Achievement in collaborative method	male	13	51.25	28.77	8.31
	female	15	42.41	29.66	4.88

From Table 2, using collaborative approach, the mean, standard deviation of male students 'achievement in physics was (M=51.25,SD=28.77) for male and (M=42.41, SD=29.66) for female students .

Research Hypothesis 1: There is no significant difference between the mean achievement of students in learning physics concepts of force using the collaborative and conventional learning approach.

Table 3: Result of Paired Sample t-test for Significant Difference Between Students' Achievement in Physics using Collaborative Approach and Conventional Approach .

		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	t	Df	Sig. (2-tailed)
Pair 1	Achievement in collaborative method Achievement in convention method	5.81	45.08	8.10	-22.34	10.73	.72	30	.04

From table 3, a paired-samples t-test was conducted to evaluate the impact of the intervention on students' achievement scores on the use of collaborative method. Collaborative scores was (M =50.16, SD = 29.88) and

conventional scores was (M =44.35, SD = 29.11), t (30) = .7, p <. 05 =.04 (two-tailed). The mean difference in scores was 5.81 with a 95% confidence interval ranging from -22.34 to 10.73..This implies there was significant difference between the achievement of students in the collaborative and conventional groups. The null hypothesis 1 was therefore rejected.

Research Hypothesis 2: There is no significant difference between the mean achievement of male and female students in learning physics concept of force using collaborative learning approach.

Table 4: Result of Independent Sample t-test for Significant Difference between Male and Female Students' Achievement in Physics using Collaborative Approach..

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Achievementin collaborative method	Equal variances assumed	.435	.513	.90	47	.57	8.845	9.785	-10.840	28.529
	Equal variances not assumed			.918	19.192	.63	8.845	9.631	-11.300	28.989

From Table 4, for the Levene's test of Equality of Error Variances for achievement of Male and Female Students using collaborative in Physics Learning p<0.05 thus implying that the assumption on equality of variance was not violated. Therefore, the assumption of homogeneity of variance was not violated.

From table 4, the independent-samples t-test result was shown which compared the achievement scores for males and females in the collaborative group. For males (M=51.25, SD=28.77) and female (M=42.41, SD=29.66).t(47)=.90,p=.37(two –tailed). Since p=.57 >.05, there is no significant difference. The magnitude of the differences in the means (mean difference = 8.85, 95% *CI*: –10.84 to 28.53) was very small (eta squared = .002). This therefore affirmed the research hypothesis that there was no significant difference between the mean achievement of male and female students in physics using collaborative approach. This implies there was no significant difference between the achievement of male and female students in physics when using collaborative method. Thus the null hypothesis 2 was therefore accepted**.**

Summary of Findings

In this study, the following findings were obtained:

1. There was significant difference between the achievement of students in physics using collaborative and conventional approach in learning the concept of force.
2. There was no significant difference between the achievement of male and female students in physics using collaborative approach in the learning of concept of force.

DISCUSSION OF FINDINGS

The finding in table 3 shows that there was significant difference between the achievement of students in collaborative and conventional groups. This is in collaboration with Hannafin [26] who opined that every method of teaching is relevant and beneficial to the teacher and the students when it is properly applied in the classroom. Johnson [15] also added that teaching and learning becomes better when more than one method of teaching is being utilized.
The finding in table 3 shows that there was significant difference between the achievement of students in physics using collaborative and conventional method. This is in consonant with O`Donnel [23] who observed that every learning strategy has the potential for improving teaching and learning process when effectively used.

In table 4, result shows that for students exposed to collaborative learning approach, the male did not perform better than their female counterpart. Thus, there was no significant difference between the mean achievement of male and female students in physics using the collaborative method. This is in agreement with Lawrence [29] who opined that when students work in collaborative learning, they engage in active learning which required them to use critical thinking, and fostered the development of critical thinking. Joseph [30] also highlighted that collaborative learning increases students‟‟ abilities in leadership and effective communication as well as enable them to manage conflicts constructively. Study findings collaborates the assertions of that physics education research has shown that interactive engagements(IE) and instructional strategies are more effective and potent than traditional modes of instruction for optimal conceptual understanding in physics. Study findings therefore asserts that collaborative instructional approach in physics learning is

an indispensable ,valuable pedagogical technique in physics learning and a tool for closing gender differences and discrimination in physics classroom as findings shows that there was no significant difference between the achievement of male and female students in physics using collaborative approach.

CONCLUSION AND RECOMMENDATION

Finding shows that there was significant difference between the achievement of students in collaborative and conventional groups with the mean score of students in collaborative group higher than those in the conventional group. For students exposed to collaborative learning approach, the male did not perform better than their female counterpart. Thus, there was no significant difference between the mean achievement of male and female students in physics using the collaborative method. It is therefore recommended that the collaborative teaching strategy should be used as a viable instructional strategy to enhance students' learning in physics at the senior secondary school especially in the learning of difficult concepts such as force concept. The strategy is also observed to be potent from the study findings to close supposedly gender gap existing among students in their achievement in physics concepts such as force concept.

REFERENCES

1. Coelho, R. (2010). On the Concept of Force: How Understanding its History can Improve Physics Teaching. *Science and Education. 19. 91-113.* 10.1007/s11191-008-9183-1.
2. Liu, G & Fang, N. (2016). Student Misconceptions about Force and Acceleration in Physics and Engineering Mechanics Education. *International Journal of Engineering Education. 32. 19-29*
3. Ismayati, E.(2018).The design of Collaborative Learning for Teaching Physics in Vocational Secondary School..IOP Conf. Series: Materials Science and Engineering 336(2018)012040 doi:10.1088/1757-899x/336/1/0122040
4. Ishaq, U. (2015). Effects of Collaborative Learning Strategy on Performance among Low Ability Junior Secondary School Basic Science Students in Kano Nigeria. Unpublished Med. Thesis Department of Science Education Ahmadu Bello University, Zaria, Nigeria
5. Gokhale, A. A. (2015) Collaborative Learning Enhances Critical Thinking. *Journal of Technology Education, 7(1), 22–30.*
6. Srinivas, G. (2010). Reform in Science, Technology and Mathematics (STEM) Education: A diagnostic Approach. *Sokoto Journal Review. 13 (2)*
7. Roschelle W. & Teasley F. (2015). Active Learning; Creating Excitement in the Classroom. (ASHE- ERIC Higher Education Report No.1). Washington, DC; George Washington University, Retrieved from brownf@mopipi.ub.bw
8. Stephen, Y. (2017), Poor Performance in Science Among African Students. An Alternative explanation to the African World view Thesis. *Journal of Research in Science Teaching 36 (3). 387-403*
9. Orr, J.O. (2017) Effects of a Conceptual Change Model on Students Achievement, Retention and Attitudes to physics Concepts. Unpublished PhD Dissertation. Ahmadu Bello University, Zaria.
10. Alderman, F. (2017). Get Real! Collaborative Learning in Higher Education, 4(1). Retrieved from: http://www.gu.edu.au/school/art/text
11. Vygotsky W. (2017) Effects of Peer Interaction during Computer-based physics Instruction. *Journal of Educational Research, 85(3), 180-189*
12. Ford, (2013) Why some Groups Fail: A survey of Students‟ Experiences with Learning Groups.*The Organizational Behavior Teaching Review, 9 {4) 75-88.*
13. Panitz I.P. (2013) Structuring Asynchronous Discussions to Incorporate Learning Principles in an Online Class. One Professor‟s course Analysis. Journal of Online Learning and Teaching, 4(2) 217–225.
14. Johnson, D.W. & Johnson, R.T. (1975) Learning together and alone: cooperation, competition and individualization. Engle-wood Cliffs. NJ: Prentice Hall.
15. Johnson F. (2018), Teacher-guided Inquiry, Guided-discussion and Students‟ Learning Outcomes in Some Aspects of Social Studies. Unpublished PhD Thesis University of Ibadan, Ibadan.
16. Slavin, E. (2019). Intellectual Ability, Learning style, Achievement Motivation and Academic success of Psychology Students in Higher Education. *Personality and Individual Differences, 29, 1057–1068.*
17. Jantii Y. (2017), Science and Technology Education in Secondary Schools. Need for Man Power Development. Journal of Science Teacher Association Of Nigeria. 40(1&2), 63-67.
18. Tudge T. (2019) The Making of Nigerian Scientist and Technologist. *Journal of Career Development, Colombia, 71-80.*
19. Lakkala R. (2017) The Effect of Gender on Academic Achievement in Education Concepts among Secondary School Students using Problem Solving Instructional Strategy. *Zaria Journal of Studies in Education 3. (1) 123-138.*
20. Furnham, 2018) Developing the Potentials of the Girl-Child-A National Challenge. Nigeria: The REGENT Printing & Publishing Ltd.
21. Bani U. (2012). Collaborative Learninig in Distance Education: A Case Study. Retrieved From http://www.onlineresearchjournals.org/IJER
22. Webb R. (2017) Knowledge Convergence and Collaborative Learning. *Instructional Science, 35(4), 287–315.*

23. O`Donnel G. (2017) Assessment of Teachers Level of Implementation of Science Curriculum: Implications for Professional Development. 53th Annual Conference. Proceeding of STAN . 190-193.
24. Bandura, A. (2017), Social Learning Theory. Prentice Hall, Englewood Cliffs, New Jersey.
25. Dalton, W.Y. (2018), Effects of Class Size on Students Academic Achievement In Basic Science in Zaria Educational Zone, Kaduna State Nigeria. Department of Science Education
26. Hannafin, H. (2019) *A Gender inclusive multi dimension approach to the empowerment of learners in science education*. Mauritus: M.I.E. Publishers.
27. Adodo S & Agbayewa Y. (2018). Effect of Homogenous and Heterogeneous Ability Grouping Class Teaching on Students Interest, Attitude and Achievement in Integrated Science. Retrieved from : http://www.academicjournals.org/IJPC
28. Houser, R.A. (2015). *Counselling and educational research: Evaluation and application* (3rd ed), California. SAGE Publications Inc.
29. Lawrence, H. (2017) Cooperative Learning Methods; Meta Analysis of Minneapolis, Mannsota.
30. Joseph, et al. (2019) Effects of Games on Mathematics Achievement of low Ability Pupils in Nigeria Primary Schools. Ibadan Journal of Educational Studies. 1 (1), 96-105