

## The Quest for Better Pedagogical and Boosting Learning Outcomes in Mathematics Education: The Enhanced Collaborative Strategy Paradigm

Comfort O. Akinwamide (PhD)

Department of Science Education

Bamidele Olumilua University of Education, Science and Technology, Ikere,  
Ekiti State, Nigeria.

---

**Citation:** Comfort O. Akinwamide (2022) The Quest for Better Pedagogical and Boosting Learning Outcomes in Mathematics Education: The Enhanced Collaborative Strategy Paradigm, *British Journal of Education*, Vol.10, Issue 5, pp. 1-15

---

**ABSTRACT:** *The study investigated the effects of enhanced collaborative teaching strategy on senior secondary school students' learning outcomes in Mathematics in Ekiti State, Nigeria. The research determined the extent to which the application of teaching strategies enhanced better performance in and attitude of students to Mathematics. The study compared the outcomes of the effects of a teaching strategy on students with another set of students that were taught conventionally. The study adopted the quasi-experimental research design of the pre-test, post-test control group design. The population comprised all Senior Secondary Class II students in public secondary schools in Ekiti State. The sample consisted of 117 Senior Secondary School students purposively selected. Two null hypotheses were generated. The instruments used to collect data were Mathematics Performance Test (MPT) and Students' Attitude Towards Mathematics Questionnaire (SATMQ). Hypotheses were tested at 0.05 level of significance and analysed using Analysis of Covariance (ANCOVA). The results of the study showed that there was significant difference between the pre-test and post-test mean scores of the students in the experimental group, while the pre-test and post-test mean scores of the control group showed less significant difference. It was found that there was significant difference in the post-test of the experimental and control group. The results showed that enhanced collaborative strategy improved students' performance in Mathematics and changed students' attitude towards Mathematics. Enhanced collaborative strategy was found to be highly effective in improving students' behaviour during Mathematics classes. Based on the findings of the study, it was recommended that Mathematics teachers should encourage their students to work collaboratively. Teachers should be encouraged to use enhanced collaborative strategy during classroom interaction.*

**KEY WORDS:** enhanced collaborative, performance, attitude, mathematics, experimental, control.

---

### INTRODUCTION

Mathematics is a core subject from primary school to post-primary school levels in the Nigerian educational system. This important position occupied by the subject in the school curricula is borne out of the role of Mathematics in Scientific and technological development. It is the foundation of science and technology, which is the basic requirement for development of a nation. Mathematics is the language of the sciences and a tool of all other subjects. Mathematics is the central intellectual discipline of the

technological societies. It enables us to make scientific predictions that are to be drawn on the basis of logic. Scientific ideas and findings are communicated into the world of works using Mathematical terminologies. Thus, Mathematics is the bedrock of Science and Technology, which is the springboard of national development.

Mathematics is the Science of patterns of; counting, reasoning and communicating, motion and change, shapes, symmetry and regularity and position. However, technology had replaced many of human activities through innovation in curriculum particularly in ICT driven, which has been integrated into Mathematics learning (Oginni & Popoola, 2013). This claim is established in the use of calculator in solving some mathematical problems. Observation showed that the use of ICT could bring a change to students' attitude towards Mathematics if well handled. Allan (2012) explained how the coefficients of an equation were loaded into the counter drum to form addition and subtraction in the counter; this forms the process by which a number of identical operations were performed in parallel which is called vector operation that explains a specific impact of Mathematics in the field of engineering.

According to Popoola (2013, 2014) and Kolawole (2013), Mathematics was described as the backbone of a nation. As a backbone of a nation and in its dynamism, Mathematics has its tentacles spread into all other disciplines. This has been established by many scholars from diverse field of studies, Mathematics is a tool in Astronomy, Navigation, e-commerce, Agriculture, Geography, Economics, even languages. All these are the sources of economy of any nation. So, for a country to be buoyant economically, Mathematics must not be undermined. Not only that, Mathematics is the science that develops explicitly other kind of sciences to apply its capacity for speed and precision, it is also useful in the area of History where figures form most parts of the subject for remembering what had happened in ancient time.

Mathematical theories are used daily either by experts in applied Sciences like physicians or by workers in restaurants. It needs to be amplified in education to provide students with skills required to achieve higher education, career aspirations, and reaching personal fulfillment. Nigeria as a developing nation over the years has identified education as a working tool through which the following national objectives can be achieved:

A free and democratic society;

A just and egalitarian society;

A united, strong and self-reliant nation;

A great and dynamic economy, and

A land full of bright opportunities for all citizens (Onyemenam, 2013).

---

For a country to be strong, self-reliant, with great and dynamic economy, and sundry opportunities for all citizens in a technology curious world, the importance of Mathematics cannot be downplayed. It is the foundation for any profit-oriented scientific operation and any nation that must develop in science and technology must have a strong mathematical foundation for her youths. Mathematics as a subject that is widely used and in everywhere, is every breath we take at every second of the day and everything we see. Mathematics encompasses all extremes.

Despite the unique and innumerable importance and uses of this subject, the learning outcomes (performance and attitude) of the subject are not encouraging. Observation showed that mass failure characterized the performance of students in both internal and external examinations in the country. The problem is a global one which is evident in the research carried out by Karp (2016) on American students on 'Mathematics achievement' and the effort made to proffer solutions. Also, Farooq and Shah (2017), carried out findings on Mathematics students in Pakistan because of the perceived incessant poor performance in Mathematics. The result released on the 11<sup>th</sup> August, 2015 by the Head of National office of the West African Examination Council (WAEC) reported that 61% of all candidates in the examination failed Mathematics. The remaining 39% that passed include those candidates who obtained ordinary pass in the subject whereas, the minimum requirement for admission into Science, Engineering and Technology at the tertiary level is a credit pass in Mathematics (Awodeyi and Udo, 2017). All these revealed the fact that the problem of poor performance in Mathematics is not limited to Nigeria. The problem of poor performance in Mathematics could be described as "perennial" which means it is all year round, including internal and external examination results.

The past records of the results of Mathematics from the West African School Certificate Examinations (WASCE) and the National Examinations Council (NECO) in Nigeria dailies clearly displayed the poor performance of students in this core Subject. The researcher as a Mathematics teacher in the public secondary schools in Ekiti state has observed dwindling situation of students' performance in Mathematics. The Mathematics results of WAEC in the years 2012 to 2017 in Ekiti State were said to have been appalling ones. This is shown in the table below.

**Analyses of WAEC Results from 2012 to 2017**

YEARS	NO REGISTERED			A <sub>1</sub> TO B <sub>3</sub>				C <sub>4</sub> TO C <sub>6</sub>				D <sub>7</sub> TO E <sub>8</sub>				FAILURE			
	M	F	T	M	F	T	%	M	F	T	%	M	F	T	%	M	F	T	%
2012	6056	5548	11604	212	207	419	4	2137	2007	4144	36	2336	2002	4338	37	1259	1308	2567	22
2013	5574	5437	11011	668	500	1168	11	2168	2040	4208	38	2001	2057	4058	37	570	603	1177	11
2014	6943	6654	13597	817	848	1665	12.2	3164	3191	6355	47	1742	1567	3309	24	1220	1048	2268	17
2015	6898	6787	13685	1079	990	2069	15	3353	3114	6467	47	1673	1611	3284	24	793	1072	1865	14
2016	5876	5554	11430	1353	1189	2542	22	2792	2672	5464	48	1267	1296	2563	22	464	397	861	8
2017	5852	5808	11660	3327	3560	6887	59	1948	1709	3657	31	248	231	479	4	329	308	637	5

*Source: Ministry of Education, Ekiti State (2018)*

These Mathematics results are unacceptable, since this subject is a core subject that a student must pass before gaining admission into any tertiary institution. The number of A<sub>1</sub> to B<sub>3</sub> and their percentages in each year compared with the total number registered each year clearly showed the extent of poor performance in Mathematics. The percentages of C<sub>4</sub> to C<sub>6</sub> in each year is less than average (50%) and this are within the range of the least acceptable marks for admission into higher institution, especially for science courses. Considering the performances from A<sub>1</sub> to C<sub>6</sub>, in each year, it is observed that there is steady increase in the performance of the students though not statistically significant except year 2017. This might be as a result of efforts of educators in the area of research findings and the efforts of the concerned teachers to reduce the rate of failure in Mathematics. This minute increment yearly is a pointer to the fact that if researchers and the Mathematics teachers increase their efforts in solving the problem of Mathematics, it will become a thing of the past. One could deduce that even the Primary schools are not left out of this appalling performance in Mathematics and when the foundation is weak, the whole building will be at the risk of collapsing. Failure in Mathematics according to Popoola (2011) has become a recurring decimal which may establish a kind of belief in the mind of some people in the society that, it is not possible for learners to perform excellently in the subject. As a result of the poor performance in Mathematics, many students had developed hatred towards the subject and lose all confidence in their ability to excel at it, it is unfortunate.

Despite the recognition accorded Mathematics due to its relevance, students exhibit non-challant attitude towards it, even when they know that they need it to forge ahead in their studies and in life. Attitude towards Mathematics plays an important role in the teaching and learning of Mathematics, as it can affect the learners' performance either positively or negatively. Negative attitude make students' performance

---

very discouraging and in turns bring non challant behaviour to doings of class work or assignment. Students are caused to develop negative attitude towards Mathematics when their efforts earn then low performance, and this negative disposition is being passed across to younger generations.

Negative attitude to Mathematics by the students makes Mathematics teachers to be seen by the students as evil and it causes less friendly relationship between the teacher and students. Hatred for the subject can affect students' attitude to school. The researcher observed the situation where a student stopped coming to the class because of Mathematics teacher who would always give assignments and punish whosoever that failed to do the assignment, whereas, positive attitude towards Mathematics leads students towards success in Mathematics. The attitude of some Mathematics teachers in terms of teaching strategies and ability to impact knowledge may have great consequences on the performance of students in Mathematics. The researcher observed the unconcern attitude of some Mathematics teachers towards the selection of appropriate strategies and adequate preparation. This could be strong factors that aggravate consistent poor performance in Mathematics.

Poor primary school background in Mathematics is another very important reason why students perform poorly in Mathematic in secondary schools. In the Nigeria primary school system, a teacher mans a class and teaches all subjects in the primary level, a teacher who studied language will teach Mathematics in primary school, this makes the pupils' knowledge of Mathematics shallow as they would not be well taught. It is vivid that teachers use diverse strategies for teaching, such as; teacher-centered, assignment, lecture, discussion, simulation, conversation and competitive strategies and the use of instructional aids towards improving the performance of students in Mathematics, nevertheless, the expected level of performance has not been attained. Omenka (2010) buttressed this when he found out that the low performance and retention rate in Mathematics is as a result of instructional modality adopted by some Mathematics teachers.

Improving the quality of teaching in Mathematics is needful. This can be possible by bringing fundamental changes through innovative approaches by which skilful teachers' strategies can assist to improve students' centered learning environment. According to Kolade (2011), there had been several meetings of the stakeholders with the view to finding better ways of improvement on the part of the students. The Government, at both local and state levels had expressed concern about this yearly failure. This is evident in the occasional seminars organised by the government for Mathematics teachers, giving of learning materials such as text books and Mathematical charts, induction courses by organisations such as Mathematics Association of Nigeria (MAN), National Teachers' Institute (NTI) organising re-training programs for primary school Mathematics teachers yearly, in which the main purpose of all these activities is to bring about improvement to students' performance in Mathematics.

Despite the efforts of researchers and other concerned bodies, the expected performance seems elusive. The question comes to the mind as to which strategy will be considered effective, efficient and reliable

---

if improvement would be experienced in terms of students' performance and attitude to Mathematics? unsatisfying performance of students in Mathematics generally is like sickness that needs urgent treatment, in search of drugs for the treatment, the researcher realised that enhanced collaborative strategy has not been put into consideration in order to examine what influence this would have on students' performance. The nature and language of Mathematics warrant sharing of ideas as people say 'two or more good heads are better than one,' for ground knowledge about the subject and its application, interaction is inevitable. Based on this fact, the researcher examined the aftermath of enhanced collaborative strategy on senior secondary school students' learning outcomes in Mathematics in Ekiti State, Nigeria, in order to bringing out facts that will help in changing the orientation of the teachers and learners towards Mathematics vis-a-vis the strategies of teaching this subject.

### **The Enhanced Collaborative Teaching Strategy**

Enhanced collaborative is a teaching strategy that combines both the components of collaborative and Think-pair-share teaching strategies. It is a teaching strategy that gives room for individual to think on a given task for few minutes after which the learner pairs with another learner to discuss the given task, then learners fall into groups for group consideration of the same task before the whole class will share ideas on the given task for general consensus. Collaborative learning is a teaching strategy in which peers work together on a given learning task with the goal of all participants benefiting from the interaction. The group is sizeable. Grouping could be weekly or be sustained for the period that a particular topic will lapse. Collaborative learning involves learner-learner interaction and teacher-learner interaction. This approach may be triangular dimensioned. Students interact with fellow students in the group and groups interact together as a class.

The teacher (a facilitator of knowledge) gives tasks to the learners and also explains difficult areas. The teacher's role as a facilitator is to organize the learning environment and make it conducive for collaborative work for learners. He does the grouping by considering students individual differences, by making it heterogeneous grouping. Leadership role in each group is being rotated as directed by the facilitator. Every student is allowed to participate by contributing to the discussion and also ask question when necessary. The group can come together if there are individual problem for collaboration. For instance, when a student raises a problem in a given assignment, he can through the group leader call other group members so that he could be assisted during their free period. This does not require the presence of the teacher before they can come together to solve the individual's problem(s). This is a major point of difference between collaborative and cooperative teaching strategies. Cooperative strategy is a strategy where work is done together only when it concerns every member of the group, someone's problem is not everyone problem. The group work helps the learners to better understand the learning materials, and also stimulates learners' thinking processes. Collaborative learning strategies improve students' performance especially in Mathematics which in turn brings positive change in the

attitude of the learners towards the subject. Evaluation is carried out on the individual learner and the average score is for the group.

**Think-Pair-Share** is a learning strategy where the learner is given an opportunity to think personally over a given problem (task) for few minutes, and after a short while pair with another person to work together on the same task. The whole class jointly considered the solutions to the problem by sharing. It is a learning strategy proposed by Frank Lyman and his colleagues in the University of Maryland in the year 1981. Think-Pair-Share gets its name from three components, as the name is indicated in students' actions, with emphasis on what students are to be doing at each of those stages which are to; Think alone, students come in pairs to think about the problem and then share the ideas about the solution (Think-Pair- Share).

**Think:** This is the stage where the learner is opportune by the instructor to ponder or ruminate over a given task alone without any discussion with any partner or anybody. Every student thinks independently about the question that has been posed to bring out what he/she concludes to be the correct solution to the problem. This time of thinking is called "wait time" by some instructors.

**Pair:** The teacher does the pairing using his discretions, either by randomly selecting the partners, pairing according to the sitting arrangement or pairing using ability level, gender and economic and racial/cultural background. The teacher at will may ask the student to choose his/her own partner. When the teacher assigns partners ahead of time, it will alleviate stress because of some students' experiences during peer interaction. It will ease the problem of class control, and ensure a smooth transition during implementation. The paired students now review what they have thought in the first stage. Eventually, they agree on a submission.

**Share:** Pairs share their ideas with one another, asking questions from one another if needs be, jointly identifying areas where they need explanations and then the class generally discuss together the solution which may involve writing the solutions on the board as the case may be. Each group may choose who will present their thoughts, ideas, and questions they have to the rest of the class.

Think-pair-share aims at helping students to form individual ideas, discuss and share with others. The teacher directs the stages as a facilitator. He organizes students to encourage a high degree of classroom participation and assists students in developing a conceptual understanding of a topic through the use of think-pair-share. This strategy provides students time and structure for thinking on a given topic, enabling them to formulate individual ideals and share these ideals with a peer. This learning strategy promotes classroom participation, encourages a high degree of students' responses and promotes critiquing arguments both in small and large groups, on like recitation strategy (conventional strategy) in which a teacher poses questions, only one student offers a response and the teacher continues. The teacher as a

---

facilitator creates and establishes an atmosphere that is conducive for learner and learning. This will make learners have interest and actively participate in the lesson.

Enhanced collaborative strategy can add much-needed variety to the standard of learning an abstract subject such as Mathematics. The idea of giving learner the chance to think over a given task before group discussion gives such learner the opportunity of meaningful contribution without wasting time. Enhanced collaborative strategy involves learner-task interaction; learner-learner-task interaction; group-task interaction and class-task interaction. Learner-task interaction occurs when the teacher allows each learner to first think over the task at hand. This personal opportunity of considering the task brings about critical thinking which is needed in performing any mathematical operation. The learner is fully engaged and this helps him in bringing new ideas that could be useful for the whole class. It encourages self-confidence as each student can provide solution to the problem. Learner-learner-task interaction occurs when a learner has the opportunity to discuss with another learner his opinion and views about the given task. It enacts friendliness and intimacy. More seriousness is imputed as each of the two will not want to be onlooker while the other acts as the leader, there will be no room for laziness. Group-task interaction occurs when the learners break into groups. Learners in each group had got the opportunity to identify their areas of difficulties in the previous stage. The time of group interaction on the task is for such difficulties to be considered and solved together, difficult problems are reserved till the last step which is class-task interaction. It does not necessarily mean that two people that discussed should be in the same group.

At the stage of class-task interaction, representative comes from each group to discuss with the class any surfaced problem and how it was tackled while harmonizing group members' ideas about the given task. New ideas are also share with other members of the class. The teacher's role as a facilitator is to organize the learning environment and make it conducive for enhanced collaborative work. He leads the students on how to solve any difficult task by giving them guidelines towards the solution not to supply the answer or does all the workings alone. The teacher encourages all the learners to participate actively in order to extend the chance of maximum benefit of enhanced collaborative. He does the grouping by considering the individual differences of the learners by making the class a heterogeneous one. Leadership role in each group is being rotated as directed by the facilitator.

A lot have been found and identified to be problems confronting the teaching and learning of Mathematics in secondary schools. These problems have also been found to cause some dwindling and erratic results of students in Mathematics at the end of secondary school certificate examination while many of these problems have been found to be due to strategies being adopted and used by the teacher in the classroom which resulted into poor performance at the end of the school program.

---

## Statement of the Problem

The report from WAEC statistical data (Table1) and the observation of the researcher as a Mathematics teacher in some of the secondary schools in Ekiti State revealed that students' performance in Mathematics over the years till date have not been satisfying. Among many reasons that could be attributed to this include the problem of teaching strategy. The researcher personal experience showed that Mathematics teachers are used to conventional chalk and talk strategy of teaching such as competitive, individualistic, teacher-centred strategies that are of low profit. It was observed that some Mathematics teachers do not allow interaction and sharing of ideas among the learners. It is also observed that students demonstrate laziness due to the lack of commitment on the part of the Mathematics teachers in giving tasks to the students and also leading them on how to generate more tasks and solve them. Some few teachers that ventured into giving of tasks are not painstaking; they supplied the solutions without giving the learners the opportunity of thinking critically on how to solve the problems. The dwindling performance in Mathematics had caused students' negative attitude to the subject which is been transferred to the generation of the younger ones. For these reasons, the study examined the effects of Enhanced Collaborative strategy on senior secondary school students' learning outcomes in Mathematics in Ekiti State, Nigeria.

## Research Hypotheses

Hypotheses generated are as follows:

1. There is no significant difference in the performance scores of students exposed to enhanced collaborative strategy and those in control group
2. There is no significant difference in attitudinal scores of students exposed to enhanced collaborative strategy and those in control group.

## Research Method

This study adopted quasi-experimental of pre-test, post-test, control group design. The design employed examined the effects of the independent variable on the dependent variables. The performance and attitude of students that were used for the study were established by pre-tests that were conducted on both the experimental and the control groups to ascertain homogeneity. Post-tests after the treatment were used to measure improvement on performance and change in attitude in the two groups. The experimental group was exposed to treatment, using enhanced collaborative teaching strategy while the control group was exposed to conventional strategy of teaching.

The design is represented diagrammatically thus:

(Experimental Group)             $O_1 X O_2$

(Control Group)                 $O_3 C O_4$

$O_1$  and  $O_2$  represent the pre-test and post-test of the experimental group,

$O_3$  and  $O_4$  represent the pre-test and post-test of the conventional group,

X- Enhanced collaborative strategy

C- Conventional strategy.

The population for this study consisted of all the Senior Secondary School Class two students, numbered to 14,780 in all the public secondary schools in Ekiti State while the sample for the study consisted of 117 Senior Secondary School class two (SSSII) students. Multistage sampling procedure was adopted in selecting the samples. At the first stage, simple random sampling technique was adopted in selecting a Local Government Area (LGA) out of each Senatorial District in Ekiti State to make three LGAs that were used for the study. Two schools were purposively selected from the three selected schools for experimental while the third school was used for control group. At the third stage, an intact class was randomly selected from each selected schools making 60 students for experimental and 57 students for control groups. Two research instruments developed by the researcher were used to collect data, namely (i) Mathematics performance Test (MPT) and (ii) Students' Attitude Towards Mathematics Questionnaire (SATMQ). MPT was the test item used to determine the selected students' performance in Mathematics before and after treatment. Mathematics Performance Test (MPT) contains two sections: A and B. Section A solicited for demographic variables of the learner while, section B contained 40 multiple choice objective questions.

Pre-tests were administered on the two groups. Then, selected topics were taught for four weeks in both groups. Enhanced collaborative teaching method was used to teach students in experimental group while conventional method was used in teaching the control group. In testing for the hypotheses, Analysis of Covariance (ANCOVA) was used. Hypotheses were tested at 0.05 level of significant.

## RESULTS AND DISCUSSION

Testing of Hypotheses and Discussion of Findings are presented thus:

*Hypothesis 1:* There is no significant difference in the performance scores of students exposed to enhanced collaborative strategy and those in the control group. In testing the hypothesis, performance scores of students exposed to enhanced collaborative strategy and those in the control group were computed and compared for statistical significance at 0.05 level. The result is presented in Table 2

**Table 2: ANCOVA of Students’ Performance in Enhanced Collaborative and Control Groups**

Source	SS	Df	MS	F	P-value
Corrected Model	3742.031	2	1871.015	89.349	.000
Covariate(Pretest)	29.808	1	29.808	1.423	.235
Group	3585.951	1	3585.951	171.245*	.000
Error	2387.217	114	20.941		
Total	83566.000	117			
Corrected Total	6129.248	116			

\*Significant= $p < 0.05$       **SS**=Sum of Squares, **DF**=Degree of Freedom, **MS**=Mean Squares  
**F**=calculated value.

Source: Author’s computation

Table 2 reveals that there is significant difference in the performance scores of students exposed to enhanced collaborative strategy and those in the control group ( $F_{1,114}=171.245$ ,  $p < 0.05$ ). The null hypothesis is rejected. In order to determine the effect of the treatment on the performance of students in Mathematics, Multiple Classification Analysis (MCA) was carried out. The result is presented in Table 3.

**Table 3: Multiple Classification Analysis of Students’ Performance in Enhanced Collaborative and Control Groups**

Grand mean=25.73						
Variable Category	+	N	Unadjusted Devn’	Eta <sup>2</sup>	Adjusted For Covariate	Independent + Beta
Enhanced Collaborative		60	5.49	.61	5.29	.16
Control		57	-5.78		-6.16	
Multiple R						0.160
Multiple R <sup>2</sup>						0.025

Source: Author’s computation

Table 3 reveals that, with a grand mean of 25.73; students exposed to enhanced collaborative strategy had higher adjusted mean score of 31.02 (25.73+5.29) than those in the control group; 19.57 (25.73+(-6.16)). This implies that the use of enhanced collaborative teaching strategy improved students' performances in Mathematics. About 61% ( $\eta^2=0.61$ ) of the observed variance in students' performance in Mathematics is largely due to the effectiveness of the treatment.

*Hypothesis 2:* There is no significant difference in attitudinal scores of students exposed to enhanced collaborative strategy and those in the control group.

In testing the hypothesis, attitudinal scores of students exposed to enhanced collaborative strategy and those in the control group were computed and compared for statistical significance at 0.05 level. The result is presented in Table 4.

**Table 4: ANCOVA of Students' Attitude in Enhanced Collaborative and Control Groups**

Source	SS	Df	MS	F	P-value
Corrected Model	44863.900	2	22431.950	133.584	.000
Covariate (Pretest)	113.427	1	113.427	.675	.413
Group	44256.422	1	44256.422	263.551*	.000
Error	19143.297	114	167.924		
Total	1366774.000	117			
Corrected Total	64007.197	116			

\*Significant= $p<0.05$       **SS**=Sum of Squares, **DF**=Degree of Freedom, **MS**=Mean Squares  
**F**=calculated value.

Source: Author's computation

Table 4 reveals that there is significant difference in attitudinal scores of students exposed to enhanced collaborative strategy and those in the control group ( $F_{1,114}=263.551, p<0.05$ ). The null hypothesis is rejected. In order to determine the effect of the treatment on the attitude of students towards Mathematics, Multiple Classification Analysis (MCA) was carried out. The result is presented in Table 5.

**Table 5: Multiple Classification Analysis of Students’ Attitude in Enhanced Collaborative and Control Groups**

Grand mean=101.73						
Variable Category	+	N	Unadjusted Devn’	Eta <sup>2</sup>	Adjusted For Independent Covariate	+ Beta
Enhanced Collaborative		60	16.44	.70	16.56	.04
Control		57	-17.31		-17.18	
Multiple R						0.037
Multiple R <sup>2</sup>						0.001

Source: Author’s computation

Table 5 reveals that students exposed to enhanced collaborative teaching strategy had higher adjusted mean score of 118.29(101.73+16.56) than those in the control group; 84.55

(101.73+(-17.18). This implies that the use of enhanced collaborative instructional strategy changed students’ attitude towards Mathematics. About 70% (Eta<sup>2</sup>=0.70) of the observed variance in students’ attitude towards Mathematics is largely due to the effectiveness of the treatment.

**CONCLUSION**

This study examined the quest for better pedagogical and boosting learning outcomes in mathematics education: the enhanced collaborative strategy paradigm. The findings of this study revealed that performance and attitude of the students towards Mathematics were improved upon their exposure to treatment. The findings further showed the effectiveness and reliability of enhanced collaborative strategy on the increase in the performance of students learning of Mathematics at the secondary school level. This established the effect of peer study in Mathematics. Students’ participation does not only enhance their interest but also promote positive interactive pattern among them. This invariably brings about positive improvement in learners’ performance in Mathematics. This is buttressed by Sampsel (2013), that described enhanced collaborative as an instructional strategy in which peers work together on a learning task with the goal of all participants benefiting from the interaction. Zackaria & Yusuff (2010), in their research work titled “The effects of collaborative learning on students’ attitude and

achievement in Mathematics” also buttressed the fact that enhanced collaborative strategy influenced students’ performance positively. The results of this research revealed the positive change in the attitude of students exposed to enhanced collaborative strategy which was the result of interaction while solving problems.

Based on the findings, it was concluded that enhanced collaborative strategy is effective for the teaching of Mathematics. It was also concluded that the use of enhanced collaborative strategy changed attitude of students towards Mathematics. Enhanced collaborative strategy, which encouraged sheering of ideas among the students fostered cordiality and friendliness in the class and this made lesson interested for the students. The study serves as eye opener to teachers in selecting meaningful, relevant and result oriented instructional strategy in the teaching and learning of Mathematics. It shows to learners, the importance of working in collaboration.

Enhanced collaborative strategy closes communication gap among learners and help students to have better understanding of the concepts or tasks as some students will understand the task better when it is explained by their peers. Enhanced collaborative strategy makes easy the achievement of the set goals because of positive bonding experience that occurs among the members of each group when everyone is contributing to a common goal. Above all, this pedagogical paradigm is capable of paving way for inclusive education, where no one is side-tracked as a result of colour, ethnicity, language, gender or religion.

### **RECOMMENDATIONS**

Teachers should encourage their students to work collaboratively.

Teachers should be encouraged to use enhanced collaborative strategy during classroom interaction by putting this strategy in the curriculum.

### **ACKNOWLEDGEMENT:**

The author warmly acknowledges TETFund for sponsoring this article.

### **References**

- Allan, M. (2012). Scientific Advisory Committee. *Society of Mathematical Biology Annual Meeting*. July.
- Awodeyi, F. & Udo J. (2017), Strategy Combination Therapy as Instructional Strategy for Teaching Secondary School Geometry and Effects on Students’ Achievement and Retention in Mathematics. *Mathematics Theory and Modeling*. University of Uyo, Nigeria.

- Farooq, M.S. & Shah. S. U. (2017). Students' Attitude Towards Mathematics. *Pakistan Economic and Social Review*. 46(14). 75-83.
- Karp, A. (2016). Current Issues in Mathematics Education. *The American-Russian Work*. Moscow State Pedagogical University. Published by Bedford.www.comap.com. U.S.A
- Kolade, T. A. (2011). *The Effects of Process Approach on Students' Creativity in Essay Writing*. Adekunle Ajasin University, Akungba, Ondo State, Nigeria.
- Kolawole, E.B. (2013), Kolawole's Problem Solving Strategy (KPS). A Panacea to Mathematical and Life's Problems. *Standard Journal of Educational and Essay* 1(8) 131-141, <http://standardresjournal.org/journal/SJERE>
- Ministry of Education (2018). Ekiti State Ministry of Education, Ekiti State, Nigeria.
- Oginni O.I. & Popoola A.A. (2013), *Effects of Mathematics Innovation and Technology on Students' Academic Performance in Open and Distance Learning (ODL) Ekiti State University, Ado-Ekiti*.
- Omenka, J.E. (2010). *Effects of Ethno-mathematics Approach on Achievement and Attitude Towards Number and Numeration Among the Junior Secondary School Students*. Benue State University, Makudi.
- Onyemenam, C. T. (2013). *The Importance of Education to National Development- A Case Study of Nigeria*. Walden University.
- Popoola, A. A. (2011). A Survey of Instructional Strategies used by Primary School Teachers for the Attainment of Millennium Development Goals in Basic Mathematics Education. *Articles Based Journal of Education*. 1-9. USA
- Popoola, A. A. (2013). *Teachers' Level of Understanding the Language of Mathematics as a Determinant of Students' Achievement in Mathematics in Nigeria*. *Journal of Education and Practice*. 4(22): 97-104. Published by the International Institute for Science Technology and Education (IISTE), USA.
- Popoola. A. A. (2014). Effects of Play Way Strategy on the Numeracy Skill of Early Basic Education School Pupils in Ekiti State Nigeria. *Mediterranean Journal of Social Sciences(MJSS)*. 5(10):318-325. Rome, Italy
- Popoola, A. A. (2014). Secondary School Mathematics Teachers' Skills and Students' Achievement Using Innovative and Model Teaching Approaches. *IOSR Journal of Research & Strategy in Education*. Department of Curriculum Studies, Faculty of Education, Ekiti State University, Ado Ekiti, Ekiti State.
- Sampsel. A. (2013), *Finding the Effects of Think-Pair-Share on Students' Confidence and Participation*. Bowling Green State University. ScholarWorks@BGSU.Spring4-29-201. <http://scholarworks.bgsu.edu/honorsprojects>
- Zakaria, A. & Yusuff, H. (2010). The Effects of Cooperative Learning on Students' Mathematics. Effandi Zakaria: The Learning. [www.ukm. my/pfpend/index.php/penerbitan/jurnal-antarabangsa](http://www.ukm.my/pfpend/index.php/penerbitan/jurnal-antarabangsa).