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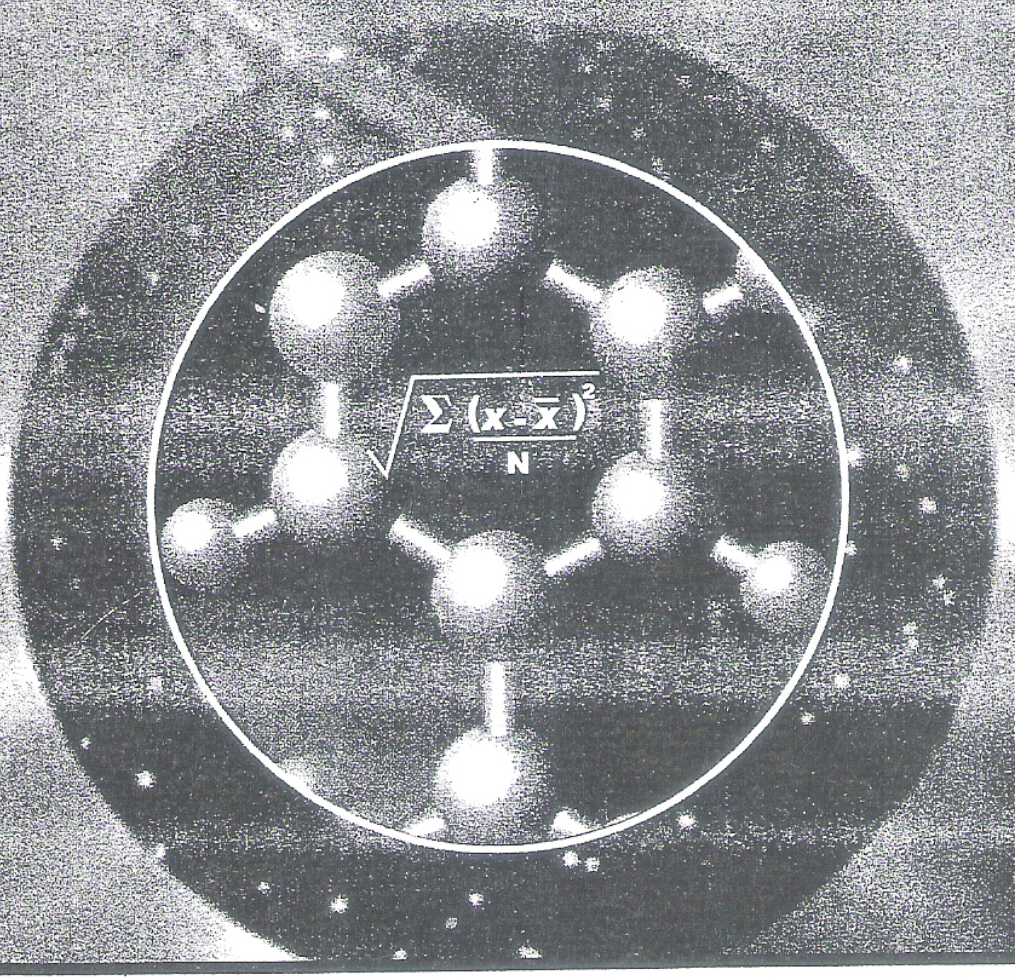

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Effect of Individualized and Cooperative Learning Strategies on Students' Performance in Mathematics

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Abstract

The paper examined the effect of Individualized and Cooperative Learning Strategies on students' performance in mathematics. As an empirical study 100 senior secondary school one (SS1) students were drawn via purposive and random sampling procedures from two schools in Ibadan North Local Government Area of Oyo State. ***Instruments*** *used included Mathematics Achievement Test (MAT, r = 0.66) and Co-operative Learning Guide (CLG, r = 0.77). Data collected were collated and analyzed using t-test statistical analysis. Findings showed that there was no significant difference in the performance of students that were to be exposed to Individualized and Cooperative learning strategies at the pre-test that (t-cal<t-ratio, df=49; P>0.05) but at the post-test level there was significant difference in the performance of students that were exposed to Individualized and Cooperative learning strategies(t-cal<t-ratio, df=49; P<0.05). The study showed the efficacy of the cooperative learning of mathematics among students as compared to the individualized that makes teacher a sole knowledge dispenser. On the other hand, the study showed a conclusive result in the individualized level which might not be unconnected to the time frame of the two tests, while in the cooperative group could be attributed to an improvement due to treatment(t-cal>t-ratio, df=49; P<0.05). Also, it was found that there was significant gender difference in the performance of students exposed to Individualized and Cooperative learning strategies at both pre-test and post-test levels respectively(t-cal>t-ratio, df=48; P<0.05). By inference it showed that males' performances were significantly better than their female counterparts irrespective of the groups where they belong-to, which is a confirmatory evidence that males tend to skew towards science related subject, mathematics inclusive, than females counterparts.The implication and recommendation of the study were discussed in the paper.*

Introduction

The role which Mathematics plays towards realizing the nation's scientific and technological aspiration is inestimable. The importance of mathematics education in Nigeria's educational system and the nation's technological development has been recognized; and this has further been corroborated by Ezeilo as quoted by Madu (2006) that there could be no meaningful development technologically without a
corresponding development in mathematics. Zekele (2001) points out those education systems throughout the world place much importance in the teaching and learning of mathematics and a lot of resources are allocated to maintain and improve them. He stated that a good background in mathematics is sine-qua-non in the selection of fields of study at the colleges as it affords the mastery of many scientific concepts. By interpretation mathematics could be described as the language through which solid science and technology are built on. According to Abelard, Mills and Shumpt (1993) mathematics is important because its study is associated with more academic and career opportunities, and at the same time acts as a critical "filter" for entry into the higher education programme and even for the world of works (Ernest, 1994).

A critical observation of the school time-table corroborates why mathematics is given much attention and real focus in terms of frequency of its teaching compared to other school's subjects. For example, the international Association for Evaluation of Educational Achievement (I.E.A) estimated that most systems in the world devote at least one fifth of the learner's time to the study of mathematics. As a result, many efforts have been put up to improve the level of learning of mathematics in the school system. These include the formulation of mathematics curricula in harmony with the national objectives and philosophy of the nation's education and formulation of objectives for teaching mathematics, which National Policy on Education (2004) identified as:

(i) Developing accurate, logical and abstract thinking in the learner, (ii) Development of computational skill, (iii) Discovering and appreciating the beauty of mathematics; and (iv) Demonstrating the applicability of mathematics in various fields.

Furthermore, Curriculum Organizations such as Mathematics Association of Nigeria (M.A.N), Science Teachers Association of Nigeria (STAN) and a host of others have continued to make concerted efforts to popularize mathematics. Emenalo (1994) notes that one of the objectives of establishing the Mathematical Association of Nigeria in 1961 was to eliminate innumeracy in Nigeria. The establishment of a mathematical centre at Abuja is also a pointer to the prominent attention given to mathematics (Abdulahi, 1993). To popularize the subject and make it student-friendly, annual mathematics competitions for different stages of primary and secondary school pupils titled "Mathematics Olympiad" is often organized by the mathematical centre to identify and motivate young talents in mathematics. The importance placed on mathematics is also reflected in the way parents and guardians show concern in their wards' performance in mathematics such that although they could not afford to pay extra lessons in any other subject, they often strive to pay for extra lessons in mathematics *(Graham et al, 1996)*. However, this premium position has never been justified as results from different studies (Adamolekun, 2002; Olowojaiye, 2004) have consistently shown that students' performance in the subject has not improved considerably. Diverse reasons advanced for this dismal performance of students in Mathematics ranged from teachers' factors to students background among others (Yee, 1990; Gage, 1994; Wharton MacDonald, Pressley & Hampston, 1998 and Adegoke, 2004). In particular, the traditional methods of instruction in our secondary schools have always been criticized (Okebukola and Ogunniyi, 1994; Decorte, 1992). Decorte, (1992) raised an alarm that students are not equipped with the necessary knowledge, skills, beliefs and motivation to approach mathematical problems and learning tasks in an efficient and successful way. The prevailing learning activities in schools, which consist mainly of listening, watching and imitating the teacher and textbooks, do not support efficient mathematics learning Greeno, as quoted by Madu (2006). Such approach to teaching and learning has been related to the inappropriate view of learning as information absorption in which knowledge is acquired independent of the social and physical context from which mathematics as a subject derives its meaning and usefulness. As a result of

alarming dismal students' performance, Adeye-Oluwa (2003) called for the review of teacher education with emphasis on core subject, mathematics inclusive. In contrast, these studies have not observed the ways and manner by which these students learn mathematics; and it is based on this premise that the study tried to examine the effect of individualized and cooperative learning strategies on students' performance in mathematics.

Theoretical Framework and Empirical Studies on Cooperative Learning

Cooperative learning is a successful teaching and learning strategy in which small teams, each with students of different levels of ability, use a variety of learning activities to improve their understanding of the subject. Each member of a team is responsible not only for learning what is taught but helping other team members to learn, thus creating an atmosphere of achievement (Bandura, 1982). The essential features in cooperative learning are group goals and individual accountability (Slavin, 1989). Apart from positive enhancement of achievement by this method, it also promotes social interaction and racial integration (Bossert, 1989; Joyce & Weil, 1996).

Arends (1994), as well as Joyce and Weils (1996) classified cooperative learning in to social family models of teaching. Arends in particular believed that cooperative learning strategy portrays the interactive function of teaching with its utilization that goes beyond helping students to learn academic content and skills but simultaneously addresses important social goals and objectives. He gave some historical perspectives to cooperative learning model. According to him, cooperative learning is not the result of any single stream of pedagogical thought. Its root goes back to the early Greeks but its contemporary developments started with early twentieth- century educational psychologists and pedagogical theorists. According to Madu (2006), John Dewey advocate for classroom learning to be a mirror of a larger society and a laboratory for real life learning. Dewey's Pedagogy required teachers to create, within their learning environments, a social system characterized by democratic setting. The specific classroom procedures emphasized small problem-solving groups. Thelen (1994)

puts a structure in-group investigation due to his interest in-group dynamics. Cooperative behaviour and processes were viewed as a basis to human endeavour and the foundation on which strong democratic communities could be built and maintained.

Allport (1994) proposed inter-group relationship as a way of countering racial prejudice, which Sharan (1992) summarized to fall within three basic considerations:

(i) Unmediated inter-ethnic contact, (ii) Occurring under conditions of equal status between members of the various groups participating in a given sitting, and (iii) Where the setting officially sanctions inter-ethnic cooperation

Joyce and Weils (1996) however traced the historical background of cooperative learning to be reflective in the writings of Aristotle, Plato, and Marcus Aurelus as well as those of Christian educators such as Thomas Aquinas, John Amos Commenius, Jean-Jacques Rousseau in France, John Locke in England and Thomas Jefferson and Benjamin Franklin in the United State of America. He noted that John Dewey only gave a forceful voice to it in the twentieth century. Jacobs and Ball (1996) refer to cooperative learning as a subject of group work, methods and the approach supported by literature in the field of social psychology, group dynamics and social facilitation. Cooperative learning affects the achievements as well as attitude positively. Bossert (1989) referred to cooperative learning as the cornerstone of modern democracy, which is the processes that characterize the environment and students actively participate in cooperative learning, which have been highlighted as follows:

i) The members of cooperative groups learn from one another. Each learner has more helping hands than in a structure that brings isolation; (ii) Interacting with one another produces cognitive as well as social complexity, creating more intellectual activity that increases learning when contrasted with solitary study; (iii) Cooperation increases self-esteem not only through increased learning but also through the feeling of being respected and cared for by the others in the environment. (iv)Students can respond to experience in task requiring cooperative by increasing their capacity to work productively together. As for the conduct of cooperative learning Arends (1994) suggests that:

(i) There must be free instructional table; (ii) Students must be allowed to choose appropriate content;
(iii) They must be allowed to form teams (iv) They must be allowed to develop materials and directive
(v) Makes transition from whole class to learning teams, (vi) Managed and helped students during teamwork only.

On the basis of empirical study, Nattir (1994) recognised that more than 80 strategies in which students work are carried out cooperatively. However most of these methods revolve around these four strategies presented by Slavin (1994) which include;

(a) Student team learning where students work together to learn and be responsible to one another's learning as well as their own. Three components are central to all student team-learning methods namely "team rewards", individual accountability and equal opportunity for success. Other sub-strategies in the student team learning are *(i) Students' Team Achievement Division, (ii) Team-Games- Tournament, (iii)Team Assisted Individualization (TAI) and, (iv)Cooperative reading and composition.* As part of cooperative learning is Jigsaw (I) and Jigsaw (II). Jigsaw (I) was developed by Aronson, Blaney, Stephen, Sikas and Snapp (1978). In this strategy, students are assigned to teams with each team members working on an academic material that has been broken into sections. Members of different teams who have studied the same sections meet in "expert groups" to discuss their sections. Then the students return to their teams and take turns teaching their team-mates about their sections. The problem with such form of cooperative learning is that it promotes experts in certain aspects of the learning domain while they are weak in other areas. However, Slavin (1994) modified this into Jigsaw (II). In this model, instead of each student being assigned a unique section, he goes through all area of learning topics to be covered. Meanwhile, each student receives a topic in which he becomes an expert. Students with the same topics meet in expert groups to discus before they teach their team members. The students take individual quizzes, which result in team scores.

Another aspect of cooperative learning is often referred to as learning together as corroborated by Johnson and Johnson (1987). This involves students working on
assignment in four or five heterogeneous members/ groups. At the end, each member receives praise and rewards based on the group learning products. Another aspect of cooperative learning is the group investigation as developed by Sharan & Sharan (1992) whereby a general classroom organization's plan in which students work in small groups using inquiry, group discussion and cooperative planning and projects. In this method, students form their own member groups and after choosing sub-topics from a unit being studied by the entire class, the groups break sub-topics into individual tasks and carry out the activities necessary to prepare group reports. Each group makes presentation or display to communicate its findings to the entire class.

Another related instruction model associated with cooperative learning is peer tutoring, which is an instructional arrangement where students serve as tutors, providing individualized instruction to other students for skill, remediation or as supplement instruction. The present study is related to the learning model where students work together on assignments given by the teacher and make an individual reward and attached to group reward. Meanwhile, an attempt to eradicate the negative effects associated with these 'pure' forms of cooperative strategy, in the study is conducted with some modifications. Individuals attempt tests but the mean score of the group is used as the score of the individual. This procedure is preferred because of the possibility of practising within time constraint and is very necessary in a natural class environment with school timetable. In fact, educators seem to agree that cooperative learning enhances educational outcomes. Joyce and Weils (1996), the important thing is the question of whether cooperative groups do generate the energy that results in improved learning; and he stated that the evidence is largely affirmative. He noted further that in classrooms where students work in pairs and large groupings, tutoring each other and sharing rewards, there is a greater mastery than with the individual study cum-recitation pattern. Joyce and Weils (1996) also discussed the importance of

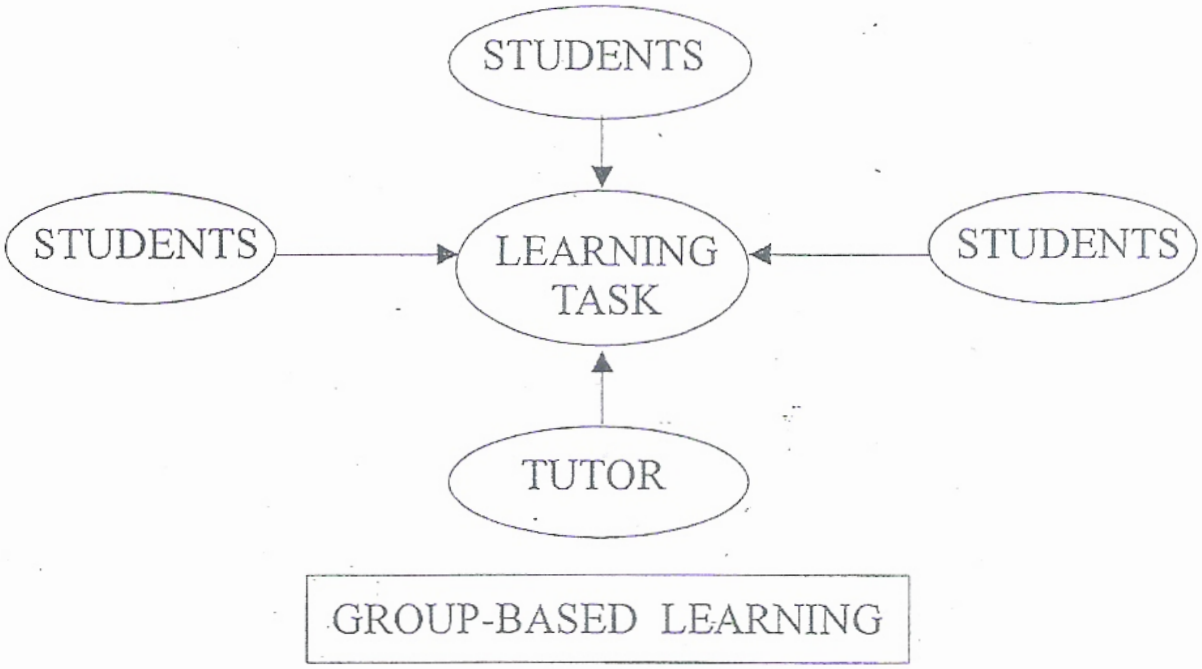

Figure 1: Comparative Model of Group- Based Learning

In the model shown in Figure 2 above, the group based learning put the learning task at the centre of focus where the teacher draws the attention of learners to the learning tasks and learners equally draw themselves to the learning task. On the other hand, the conventional teaching has the centre of attention on the teacher with the students learning from whatever the teacher provides. Contributing to the cooperative learning strategy Susan (1993) posited that multi-age grouping and peer tutoring improves students learning outcomes, which include better attitudes toward education and school, increased self esteem and cultural pride, with better attendance to school and improved writing skills. Studies in Nigeria have indicated that cooperative learning strategy sustains learning (Okebukola & Ogunniyi, 1994; Pressley & Woloshyn, 1995; Onabanjo, 2000). Okebukola & Ogunniyi (1994) find cooperative group to be superior on an achievement measure with no difference between competitive and individualistic structures.

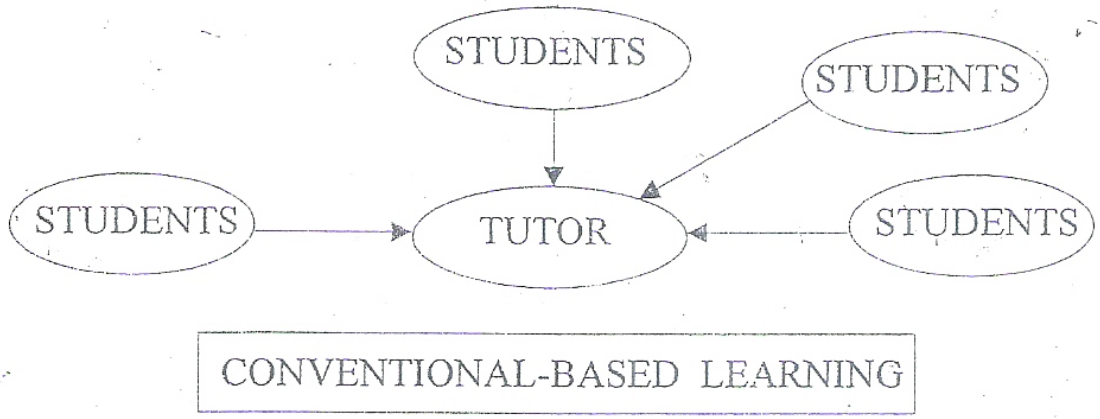

Figure 2: Conventional teaching strategy.

The above discussion calls for some other strategies to combine with cooperative learning to fully benefit from its vantage position. The study was conducted to examine the effect of Individualized and Cooperative learning strategies on student's performance in mathematics.

The study sought for an effective and comparative application of an individualized and cooperative learning strategies on academic performance of students in mathematics due to perennial failure syndrome of the learners coupled with the exalted position in which mathematics occupies in the nation's curriculum, with the hope of suggesting a better and appropriate strategy to use by the mathematics teachers towards demystifying mathematical problems in the nation's classroom.

Null hypotheses

Ho_1: There is no significant difference in the performance of students exposed to Individualized and Cooperative learning strategies.

Ho_2: There is no significant gender difference in the performance of students exposed to Individualized and Cooperative learning strategies.

Methodology

The study is an empirical study that examined the effect of Individualized and Cooperative learning strategies on students' performance in mathematics. Variables in the study included learning strategy, gender and achievement test in

mathematics. The target population for the study consisted of the entire senior secondary one (SS1) students in Ibadan North Local Government Area of Oyo State.

Sample and sampling procedure

The target sample consisted of senior secondary schools from Ibadan North Local Government Area of Oyo State. Two schools were selected due to logistic and cooperation of their mathematics teachers. In the selected schools, 100 senior secondary one (SS1) students were chosen for the study by the researcher via simple random techniques. The individualized and cooperative groups had 50 students each.

Instruments

The study made use of Mathematics Achievement Test (MAT) which was multiple-choice in nature and Co-operative Learning Guide (SLG). These instruments were used to carry out the study with the trained mathematics teacher on how to guide the students in the course of learning during the school period. Some of the instruments were developed by the researcher and subjected to scrutiny of experts to check how related the test items were to the aims and objectives of the study. The amended versions were trial- tested among some student' teachers of Sandwich Degree programme of Lagos State University. These students were not part of the entire students that were used in the main study. To ascertain the reliability of the instruments they were administered to SS1 students in one public secondary school as earlier reported within interval of weeks and their responses were correlated using the Pearson moment correlation formula. For these instruments the coefficient of reliability obtained were 0.71 and 0.77 for the achievement test in mathematics and Cooperative Learning Guide (CLG) respectively.

Administration of the instruments

The pre-test was administered to the students via their mathematics teachers to find out their initial entry knowledge and achievement in mathematics for equivalent placement on one hand, and to determine the difference that might

come up at the end of the treatment. The mathematics teacher that handled the cooperative group was given a comprehensive training on how to handle the group, and the training exercise lasted for the first one week.

Procedures

Prior to the administration of the treatment an achievement tests was given to all students in the experimental (Cooperative) and control (Conventional) groups. The two groups selected were both exposed to achievement test in mathematics as post-test in the sixth week. This was feasible via the assistance of their mathematics teachers.

Data coding and analysis

In scoring the achievement test, each correct answer attracted one mark and wrong answer attracted zero. The data collected were collated and analyzed using student t-test statistical analysis by W.S. Gasset and as quoted by Abimbade (1995).

Results

Ho_1: There is no significant difference in the performance of students exposed to Individualized and Cooperative learning strategies.

Table 1: Students' performance in Mathematics according to the strategies employed

Strategies	t-cal	t-value	Count	df	Mean	SD	Sig. Test	
Individualized			50	49	48.18	4.12	P>0.05	Pre-test
Cooperative	0.215	±1.658	50	49	47.02	3.50		
Individualized			50	49	52.42	2.94	P<0.05*	Post-test
Cooperative	-2.963		50	49	54.30	3.39		
Individualized	-5.735		25	24	48.18	4.12	P<0.05*	Pre-test
			25	24	54.30	3.39		Post-test
Cooperative	3.068	±1.671	25	24	47.02	3.50	P<0.05*	Pre-test
			25	24	54.30	3.39		Post-test

* Significantss

Table 1 shows the t-test of students' academic performance of the two groups at the different test levels. At the pre-test level there was no significant difference in the performance of students that were to be exposed to Individualized and Cooperative learning strategies(t-cal<t-ratio, df=49; P>0.05) but at the post-test level there was significant difference in the performance of students that were exposed to Individualized and Cooperative learning strategies(t-cal<t-ratio, df=49; P<0.05). The finding showed the efficacy of cooperative learning of mathematics among students as compared to the individualized learning that makes teacher a sole knowledge dispenser.

On the other hand, a comparison of the two tests within each group was carried out, and it was found that there was significant difference in the performance of students that were exposed to Individualized and Cooperative learning strategies at pre-test and post-test levels respectively. The individualized level might not be unconnected to the rule of interference of the results and time frame of the two tests, but difference in the cooperative group could be attributed to an improvement of the treatment(t-cal>t-ratio, df=49; P<0.05)

Ho_2: There is no significant gender difference in the performance of students exposed to Individualized and Cooperative learning strategies.

Table 2: Students' gender performance in Mathematics according to the strategies employed per test

Gender	Strategies	t-cal	t-value	Count	df	Mean	SD	Sig.	Test
Male		-1.86		25	24	46.12	3.14		
Female	**Cooperative**		±1.671	25	24	47.92	3.67	P<0.05*	Pretest
Male		2.04		25	24	49.36	3.55		
Female	**Individualized**			25	24	47.00	4.38	P<0.05*	Pre-test
Male				25	24	55.12	3.43		
Female	**Cooperative**	1.75		25	24	53.48	3.20	P<0.05*	Posttest
Male				25	24	52.84	3.36		
Female	**Individualized**	1.01		25	24	52.00	2.43	P>0.05	Post-test

* Significant

Table 2 describes the gender t-test of students' academic performance where it was found that there was significant gender difference in the performance of students exposed to Individualized and Cooperative learning strategies at both pre-test and post-test levels respectively(t-cal>t-ratio, df=48; P<0.05). By inference it showed that males' performances were significantly better than their female counterparts irrespective of the groups where they belong-to, which is a confirmatory evidence that males tend to skew towards science related subject, mathematics inclusive, than females counterparts.

Discussion and Implications

The study demonstrated that meaningful learning is not restricted to whatever teacher teaches in the classroom alone, instead it could be obtained from the peer where the language which is often used would be at the level of the students' understanding. One important thing to learn in this study lies in the interaction which the cooperative learning promotes as against the individualized learning strategy where all students look at the teacher as sole custodian of knowledge. The role of teacher has been simplified in such away that she becomes the facilitator by making the environment conducive for the learning to take place. An attempt by the teacher not to move along with the contemporary learning strategies means creating problems more than she could solve for the students.

Conclusion

Many activities that transpire in the classroom setting go beyond learning of mathematics alone. Every teacher has to realize the interwoven and interactive analysis of variables involved. More importantly, mathematics teachers should ensure meaningful interaction that promotes learning among students. Instead of seeing themselves as knowledge providers, they should see their work as knowledge facilitators. As a result the study provides empirical information that may enhance the training and re-training of teachers. More-over, with basis/ framework for policy makers and educational administrators in curriculum development, process and implementation to pursue a strategy that promotes meaningful teacher training methodology as half-baked teacher without understanding pedagogy might not bring out useful mathematics concepts successfully.

Recommendation

As a result of the findings subsequent study should be carried out in a large class where students find mathematics to be difficult with these strategies tried out. Apart from this, the same study could be conducted at the lower level of education to authenticate the real problem facing the learning of mathematics, as the foundation determines the interest of students to pursue mathematics further in life. Similar study could be extended to different subjects where students' dismal performance has been continuously discovered.

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