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EFFECTS OF MIND MAPPING LEARNING STRATEGY ON ACHIEVEMENT IN BASIC SCIENCE AND TECHNOLOGY AMONG JUNIOR SECONDARY SCHOOL STUDENTS FOR SUSTAINABLE DEVELOPMENT IN NIGER STATE

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ABSTRACT

The study investigated the effects of mind mapping learning strategy on achievement in basic science and technology among junior secondary school students in Niger State. The design of the study was quasi-experimental; specifically the Pre-test, Post-test, Non Equivalent Control Group Design. The sample consisted of one hundred and eleven junior secondary school J.S.S II basic science and technology students (60 males and 51 females) randomly drawn from two junior secondary schools in Niger State. Three research questions and three hypotheses guided the study. The treatment consisted of teaching a selected basic science and technology concept to the experimental group using mind mapping method while the control group was taught the same concept using the lecture method. Basic science and technology achievement test (BSTAT) designed by the researchers, was the instrument used for data collection. The data collected was analyzed using mean and standard deviation to answer the research questions while Analysis of covariance (ANCOVA) was used to test the hypotheses at 0.5 level of significance. The results revealed that mind mapping method was more effective in fostering students' cognitive achievement than the lecture method. The interaction effect between teaching methods and gender of the subjects was not significant. Based on the findings of this study, the use of mind mapping method to foster the psychomotor achievement in basic science and technology students was recommended to basic science and technology teachers.
Keywords: Mind Mapping, Basic Science and Technology, Learning Strategy.

INTRODUCTION

Mind mapping strategy is one of the teachers' strategies in teaching. Not only Mind Maps show facts, but also show the overall structure of a subject and the relative importance of individual parts of it. It helps students to associate ideas, think creatively, and make connections that might not otherwise make (Tony Buzan, 2010). As Alamsyah (2009) explained that Mind maps work well as their visual design enables students to see the relationship between ideas, and encourages them to group certain ideas together as they proceed. Mind maps work especially well when created in groups, since the discussion this engenders aids the production of ideas, and makes the task livelier and more enjoyable *The mind mapping strategy can be used to explore almost any topics in writing and also used in every kind of writing such as : narrative, descriptive, recount, persuasive, argumentative, essay etc. Students can improve their ideas and lend themselves to discussing ideas in groups.

The mind mapping learning strategy approach is expected to enhance the learning of basic science and technology students in junior secondary schools.

Over the years, teaching methods based on behavioural learning theory has been adopted to teach basic science and technology subjects in the junior secondary schools irrespective of the fact that technological advancement in industry requires that students be equipped with workplace basic skills such as thinking skills, problem solving and collaborative work skills which will make them adaptable to changes in work places. According to Epistein (2014) lecture and demonstration methods which are based on behavioural learning theory are the main teaching/learning methods employed for implementing the curriculum in the junior secondary schools. Apart from the fact that these methods are teacher-centred students are not given enough opportunities to participate in the classroom instruction. These methods which are predominantly ustihi teaching basic science and technology in the junior secondary schools emphasize knowledge transmission from the teacher to passive students and encourage rote memorization of fact (Boyle, Duffy & Dimkavy, 2015).

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Besides, teaching methods which are based on behavioural learning theories are directed towards isolating the learner from social interaction and towards seeing education as a one-on-one relationship between the learner and the objective material being learned (Epistein & Ryan 2014). The consequence of the use of these methods in teaching basic science and technology subjects such as basic science and technology in junior secondary schools is that students are unable to retain their learning and apply it in new situations. Rusbult (2015) and Rojewski (2014) indicated that traditional teaching- learning approaches based on behavioural learning theory do not adequately equip students with higher-order thinking skills, collaborative and problem solving skills, but mind mapping learning strategy approach does. Perhaps, if thinking skills, oral discourse, authentic/situated learning, collaborative work and framing instructional techniques are combined during instruction to teach basic science and technology in the junior secondary schools, it will assist in developing students' thinking skills and problem solving abilities which in turn may help them improve their learning methods employed by teachers in the Junior secondary schools thus, seem inadequate for equipping the students studying basic science and technology with the work place basic skills required for work. This raises the questions as to whether beside the teacher-centered method there is no such teaching technique of mind mapping learning strategy approach which can influence this ugly trend in the subject.

Purpose of the Study

- Determine the achievement scores of students taught basic science and technology with mind mapping learning strategy approach and those taught using the conventional teaching methods
- Determine the psychomotor achievement scores of students taught basic science and technology with mind mapping learning strategy approach and those taught using the conventional teaching methods
- Compare the cognitive achievement scores of boys and girls taught basic science and technology using the mind mapping learning strategy approach

Research Question

- What are the mean cognitive achievement scores students taught with the mind mapping learning strategy approach and those taught using the conventional teaching methods?
- What are the mean psychomotor achievement scores students taught basic science and technology with the mind mapping learning strategy approach and those taught using the conventional teaching methods?
- What are the mean cognitive achievement scores of boys and girls taught basic science and technology with the mind mapping learning strategy approach?

Hypothesis

Ho_1: There is no significant difference between the mean cognitive achievement scores of students taught basic science and technology with the mind mapping learning strategy approach and those taught using conventional teaching methods.

Ho_2: There is no significant difference between the mean psychomotor achievement scores of students taught basic science and technology with the mind mapping learning strategy approach and those taught using the conventional teaching methods.

Ho_3: There is no significant difference between the mean cognitive achievement scores of boys and girls taught basic science and technology using the mind mapping learning strategy

METHODOLOGY

The design of this study was Quasi-Experimental. The specific design was Pre-test, Post-test, Non-Equivalent Control Group Design. The study was carried out in Chachaga Local Government Area of Niger State. The Niger State is made up of 25 Local Government Areas. The Chanchaga Local Government Area is Consist of 17 senior secondary schools. The target population comprised of the year two junior secondary (J S S II) basic science and technology students in Niger State of the Niger State. This comprises the entire 17 co-educational, government junior secondary one (J.S.S II) students offering basic science and technology in Niger State. The sample consist of 111 students randomly selected from 17 co-educational secondary schools Chanchaga Local Government Area. 2 schools were randomly sampled due to the experimental nature of the study. One of the schools sampled was assigned to experimental treatment while the other was for control. In each of the schools sampled a stream of J S S II was randomly sampled for

experimental treatment and control respectively. The instrument used for data collection was Basic Science and Technology Achievement Test (BSTAT) developed by the researchers. The characteristics of each especially in problem solving were considered. The instrument consists of twenty (20) items designed to measure the levels of each. The items were distributed among the process skills of measuring experimenting, classifying, observing, and communicating. BSTAT was used for both pre-test and post-test. It was made up of two sections. The validation of BSTAT took the following procedure. The content validation of the BSTAT was accomplished by making sure that the test items reflected the specifications on the test blue print. The first draft of BSTAT consisting of 25 items was subjected to face validation by giving it to two experts in (who are familiar with Basic science and technology) one from the Department of Science Education, Federal University of Technology, Minna, Niger State and the other from the Department of Industrial and technology Education. The scores obtained from the trial testing were used to determine the reliability coefficients of the instruments. Split-half reliability technique was used to estimate the reliability of BSTAT. The split-half was done by splitting the test into two equal halves using odd and even numbers. 40 scripts used in the trial testing were scored by the researcher. The scores awarded were correlated using Spearman Rank Order Coefficient of Correlation. The split-half reliability coefficient was found to be 0.93. The data for both pre-test and pos-test were collected immediately after the administration of BSTAT. The scores were recorded for analytical purposes. The scores obtained from the pre-test and post-test were analyzed using Mean and Standard Deviation to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

RESULTS

Research Question 1: What are the mean cognitive achievement scores students taught with the mind mapping learning strategy approach and those taught using the conventional teaching methods?

Table 1: Mean and Standard Deviation for the Experimental and Control Groups

Groups	N	Pretest		Posttest	
		Mean	Std. Deviation	Mean	Std. Deviation
Experimental	41	8.1463	2.91171	17.3659	2.74551
Control	70	7.1571	2.31339	10.6714	2.67420
Mean Difference		.98920		6.69443	

Table 1 shows that the experimental pre-test and post-test mean scores are 8.1463 and 17.3659 with standard deviation scores of 2.91171 and of 2.74551 respectively. However the control group has pre-test and post-test mean scores of 7.1571 and 10.6714 with standard deviations scores of 2.31339 and 2.67420 respectively. The mean difference for pre-test is .98920 and that of posttest is 6.69443.

Research Question 2: What are the mean psychomotor achievement scores students taught basic science and technology with the mind mapping learning strategy approach and those taught using the conventional teaching methods?

Table 2: Mean and Standard Deviation for the Psychomotor Achievement Test

Groups	N	Pretest Mean	Std. Deviation	Posttest Mean	Std. Deviation
Experimental	41	24.92	6.26	57.05	17.84
Control	70	23.12	5.25	51.51	23.03
Mean Difference		32.13		28.39	

Table 2 shows that lecture method group had a mean score of 23.12 and standard deviation of 5.25 in the pre-test and a mean score of 51.51 and standard deviation of 23.03 in the post-test making a pre-test, post-test mean difference of 28.39, mind mapping learning strategy approach had a mean score of 24.92 and standard deviation of 6.26 in the pre-test and a post-test mean of 57.05 and standard deviation of 17.84 with a pre-test, post-test mean difference of 32.12 with this result, both lecture method and mind mapping

learning strategy approach are effective in improving students psychomotor achievement in basic science and technology but the effect of mind mapping learning strategy in improving students psychomotor achievement in basic science and technology is higher than the lecture method.

Research Question 3: What are the mean cognitive achievement scores of boys and girls taught basic science and technology with the mind mapping learning strategy approach?

Table 3: Mean and Standard Deviation for the Experimental and Control Groups across the Sex

Groups	Sex	N	Pretest		Posttest	
			Mean	Std. Deviation	Mean	Std. Deviation
Experimental	Male	23	8.2174	2.64500	17.5217	2.72813
	Female	18	8.0556	3.29835	17.1667	2.83362
	Mean Difference		.1618		.3550	
Control	Male	37	6.8378	2.23002	10.8919	2.13156
	Female	33	7.5152	2.38644	10.4242	3.19208
	Mean Difference		-1.3226		.4677	

Table 3 shows that the pre-test mean scores and standard deviation score for the experimental male and female are 8.2174 and 2.64500; 8.0556 and 3.29835 respectively. Similarly, the post-test means scores and standard deviation scores for the experimental male and female are 17.5217 and 2.72813; 17.1667 and 2.83362 respectively. Also, the pre-test means scores and standard deviation scores for the control male and female are 6.8378 and 2.23002; 7.5152 and 2.38644 respectively. Also, the post-test means scores and standard deviation score for the control male and female are 10.8919 and 2.13156; 10.4242 and 3.19208 respectively. The mean difference for experimental pre-test and post-test are .1618 and .3550 respectively. Finally, the mean differences for control pre-test and post-test are -1.3226 and .4677 respectively.

Hypothesis

Ho_1: There is no significant difference between the mean cognitive achievement scores of students taught basic science and technology with the mind mapping learning strategy approach and those taught using conventional teaching methods.

Ho_2: There is no significant difference between the mean psychomotor achievement scores of students taught basic science and technology with the mind mapping learning strategy approach and those taught using the conventional teaching methods.

Ho_3: There is no significant difference between the mean cognitive achievement scores of boys and girls taught basic science and technology using the mind mapping learning strategy

Table 3: Summary of ANCOVA table

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1164.896(a)	4	291.224	39.135	.000
Intercept	2007.870	1	2007.870	269.821	.000
Pretest	1.069	1	1.069	.144	.705
Group	1093.965	1	1093.965	147.009	.000
Sex	4.532	1	4.532	.609	.437
Group * Sex	.134	1	.134	.018	.893
Error	788.798	106	7.441		
Total	21131.000	111			
Corrected Total	1953.694	110			

Table 3 shows that F (147.009) is significant at .000 for the methods, at 1 and 110 degrees of freedom (Df). This is because, .000 is less than .05 significant level earlier set for the hypothesis. Hence, the hypothesis is not accepted. That is, there is significant difference between the science process skills acquisition test scores of students taught basic science and technology using practical activities method and those taught using lecture method.

Hypothesis 2: There is no significant difference between the male and female students mean scores on a science process skills acquisition test (BSTAT)

Table 5 shows that F (.609) is not significant at .437 for the sex, at 1 and 110 degrees of freedom (Df). This is because, .437 is more than .05 significant level earlier set for the hypothesis. Hence, the hypothesis is accepted. That is, there is no significant difference between the male and female student's mean scores on a science process skills acquisition test (BSTAT)

Hypothesis 3: The interaction effect between teaching methods and gender of the subjects is not significant. Table 3 shows that F (.018) is not significant at .893 for the interaction between groups and sex at 1 and 110 degrees of freedom (Df). This is because, .893 is more than .05 significant level earlier set for the hypothesis. Hence, the hypothesis is not rejected. That is, the interaction effect between teaching methods and gender of the subject are not significant.

DISCUSSION OF FINDINGS

The data presented in Table 1 provided answer to research question one, finding revealed that students taught with mind mapping learning strategy approach had a higher mean score than those students taught using the conventional teaching method in cognitive achievement test. In the same vein, the analysis of covariance presented in Table 4 confirmed that (lie difference between the mean scores of students taught with mind mapping learning strategy approach and conventional teaching method was significant. The significant difference is attributed to the treatment given to the experimental group. This finding indicated that the mind mapping learning strategy approach has a positive effect on students cognitive achievement in Basic science and technology. This implies that the mind mapping learning strategy approach (collaborative learning, oral discourse, thinking skill, authentic task and learning frame) is more effective than the conventional teaching method in enhancing students' cognitive achievement in Basic science and technology. The findings shows that mind mapping learning strategy approach has positive effect on students achievement is similar to the finding of Epistien and Ryan (2014), who in (her study found out that the adoption of mind mapping learning strategy approach in the teaching of basic science and technology students improved the students' achievement in electronics than the students taught with traditional instructional method.

The analysis of the result of the psychomotor achievement test presented in Table 3 which provided answer to research question three showed that students taught with mind mapping learning strategy approach had a higher mean score than those students taught using the conventional teaching method in psychomotor achievement test. The analysis of covariance presented in Table 2 confirmed that the difference between mean score of the students in both groups was significant. These findings indicated that the mind mapping learning strategy approach has a positive effect on technical college students psychomotor achievement in Basic science and technology. This finding may be attributed to the fact that those students taught with mind mapping learning strategy approach engaged in an authentic task in an authentic environment using real objects such as tools and machines. There has been a great deal written about authentic activities in recent times as the influences of mind mapping learning strategy approach philosophy. According to Rasbult (2015) authentic activities is anything that students are expected to do, beyond getting input through reading or listening, in order to learn, practice, apply, evaluate, or in any other way respond to curricular content. Similarly, Abdullahi (2015) stated that authentic activities 'encourage and affirm learning but essentially, they encourage the learner to respond to the classroom teaching and learning rather than remain passive.

The analysis of covariance between the mean scores of boys and girls in the cognitive achievement test presented on Table 3 showed that the null hypothesis was accepted. This means that there was no significant difference between the mean score of boys and girls in (the experimental group taught with the mind mapping learning strategy approach instructional approach. Although, the mean score of boys was found to be higher than that of the girls as shown in Table 3, but the difference was not high enough to be significant. Similarly, the analysis of covariance of the mean score of boys and girls in the psychomotor achievement test, presented in Table 3 showed that there was no significant difference between the mean scores of boys and girls in the experimental group taught with the mind mapping learning strategy approach, instructional approach in the psychomotor achievement test. Although, the mean score of boys was higher than the mean score of girls as shown in Table 3, but the difference was not significant. The superiority of the mean score

of boys over that of girls in both the cognitive achievement test and the psychomotor achievement test could be explained by the fact that boys are naturally better and more interested in technical subjects than girls since these subjects require more muscle power and alot of activities.

EDUCATIONAL IMPLICATIONS

The findings of this study have some educational implications for students, teachers and curriculum planners.

The findings of this study call on the teachers to adopt mind mapping method of teaching which is the student centered method. Students learn better when they are involved in the activity. Activity-based methods enhance understanding basic science and technology concepts and increase the ability to engender knowledge and skills in the learner.

The findings of this study call on the curriculum planners to plan for conceptual change over period of years. This is because learning involves the restructuring of prior knowledge to gain new ones for effective learning to take place. Therefore, since the use of mind mapping enhances students knowledge and skills, it follows that curriculum planners can create the awareness of this method in teachers by including it in the basic science and technology curricula. Also, they should include within the existing subjects contents of the basic science and technology curriculum, some corresponding indigenous knowledge. They can do this by re-examining the existing units of the subject matter taught in schools and identifying their corresponding indigenous knowledge. This will make the teaching of basic science and technology interesting and more meaningful to the students.

CONCLUSION

This study set out to determine the effects of mind mapping learning strategy on achievement in basic science and technology among junior secondary school students. Mind mapping used in this study greatly affected the students learning of basic science and technology. This was reflected in the students' cognitive and psychomotor achievement of learning. In other words, students learnt Basic science and technology and acquired psychomotor skills better when they were allowed to participate actively in the classroom teaching and learning by interacting with teacher, learning environment and their colleagues, work and learn together in groups. Also, students retained their learning for a longer time when they were allowed to think on possible solutions to a problem while engaging in practical activities with real objects. It is hoped therefore, that if the mind mapping learning strategy approach is taken into consideration in the teaching of Basic science and technology in the Junior secondary schools, students will graduate from the Junior secondary schools with knowledge, psychomotor skills, strong problem solving, creative thinking, collaborative work, and independent decision making skills which will make them adaptable to the present and envisaged changes in the education, science and technology industries occasioned by science and technological advancement. Consequently, the students will be able to improve on their learning and pass their examinations with better grades, contribute their own quota to industrial development of this nation, and become employers of labour instead of hoping solely on paid employment.

RECOMMENDATIONS

Based on the findings of this research, the following are recommended:

- Ministry of Education and science educators should organize workshops, seminars and conferences from time to time for basic science and technology teachers. This is to prepare the teachers on the effective use of mind mapping in teaching basic science and technology, in order to sustain students' interest and make their lesson more interesting.
- Basic science and technology teachers should adopt the use of mind mapping instructional strategy to teach basic science and technology
- Federal Ministry of Education, Science and Technical School Board should consider review of curriculum for basic science and technology programme with a view to incorporating mind mapping instructional strategy approach
- Basic science and technology concepts should be taught with mind mapping so that the students will do science instead of learning about science.

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