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EFFECTS OF TWO MODELS OF MAPPING STRATEGIES ON STUDENTS ACHIEVEMENT, RETENTION AND INTEREST IN BASIC SCIENCE AND TECHNOLOGY

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Abstract

The study was designed to determine the effects of two models of mapping strategies on students achievement, retention and interest in basic science and technology. The research design for this study is quasi-experimental design using non-equivalent group design. Three research questions and three hypotheses guided the study.The population for the study comprises all the 24,469 students' from 30 co-education junior secondary schools class two (JSSII) in Kontagora Educational zone of Niger state) (Source; Niger State Ministry of Education Minna). Purposive sampling was used to obtain four junior secondary schools that were used for the study. Two instruments were used in collecting data for the study. The two instruments were designed by the researchers. The instruments are Achievement Test on Basic Science and Technology (ATOBST) and Interest Inventory on Basic Science and Technology (IIOBST).A trial test was used to determine the reliability of the instruments (ATOBST, and IIOBST). Forty (40) students were randomly selected for the trial test. The data collected were analyzed using mean and standard deviation to answer the research questions and Analysis of covariance (ANCOVA) was used to test the hypotheses at 0.5 level of significance. The results revealed that mind mapping strategy was more effective in fostering students' cognitive achievement than the argument mapping. Based on the findings, the use of mind mapping strategy to foster achievement in basic science and technology students was recommended to basic science and technology teachers.

Keywords: *Mind Mapping, Argument Mapping, Basic Science and Technology, Learning Strategy*

Introduction

In recent years, academics and educators have begun to use software mapping tools for a number of education-related purposes. Typically, the tools are used to help impart critical and analytical skills to students, to enable students to see relationships between concepts, and also as a method of assessment. The common feature of all these tools is the use of diagrammatic relationships of various kinds in preference to written or verbal descriptions. Pictures and structured diagrams are thought to be more comprehensible than just words, and a clearer way to illustrate understanding of complex topics. Variants of these tools are available under different names: "concept mapping", "mind mapping" and "argument mapping".

The potential of these mapping for educational purposes is only now starting to be realized. Argument mapping has a different purpose entirely from mind maps and concept maps. Argument mapping is concerned with explicating the *inferential* structure of arguments. Where images and topics are the main feature of associative connections, and concepts are the main feature of relationships, inferences are the key feature of arguments. "Arguments" are understood in the philosopher's sense of statements ("premises") joined together to result in claims ("conclusions")

Mind mapping strategy is one of the teachers' strategies in teaching. Not only does Mind Maps show facts, but it 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 they might not otherwise make (Buzan, 2010).As Alamsyah (2009) explained, 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 aids the production of ideas, and makes the task livelier and more enjoyable. The mind mapping strategy can be used to explore almost any topic such as : narrative, descriptive, recounting, persuasive, argumentative, essay, etc. The mind mapping learning strategy is particularly useful in enhancing the learning of basic science and technology. Students can improve their ideas and lend themselves to discussing ideas in groups.

Over the years, teaching method based on behavioural learning theory have 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 Eaisteinand Ryan (2014), lecture and demonstration method which are based on behavioural learning theories,are the main teaching/learning method employed for implementing the curriculum in the junior secondary schools. Apart from the fact that these method are teacher-centered, students are not given enough opportunities to participate in classroom instruction. These method which are predominantly us in teaching basic science and technology in the junior secondary schools emphasize knowledge transmission from the teacher to passive students and encourage rote memorization of facts (Boyle, Duffy & Dunleavy, 2015). Besides, teaching method 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).

Achievement according to Adeyemi (2008) is the scholastic standing of a student at a given moment. It has to do with the successful accomplishment of goal(s). The purpose of testing an achievement is to help the teacher and the students evaluate and estimate the degree of success attained in learning a given concept.

Interest is an important variable in learning because when one is interested in an activity, one is likely to perform positively. Chukwu (2016) stated that interest can be expressed through simple statement made by individuals of their like and dislikes. Lack of interest according to chukwu may be caused by uninteresting teaching methods. Also Obodo (2012) described interest as the attraction which forces or compels a child to respond to a particular stimulus .This point that a child develops interest if a particular stimulus is attractive and arousing or stimulating This shows that interest comes as a result of eagerness to learn not by force (Harbor Peters, 2014). The development of interest in basic science and technology as an objective of the basic science and technology teaching, may likely promote achievement in the course.

The consequences of the use of these method in teaching basic science and technology in junior secondary schools is that students are unable to retain their learning andapply it in new situations. Rasbult (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 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 capabilities due to the teaching strategy employed by teachers in the Junior secondary schools thus, seem

inadequate for equipping the students studying basic science and technology with the workplace basic skills required for work.

Purpose of the Study

The main purpose of this study is to determine the effect of Mind Mapping and Argument Mapping strategy on achievement, retention and interest in Basic Science and Technology among junior secondary school students in Niger State. Specifically the objectives are to:

1. Determine the effect of Mind Mapping (MM) strategy on the mean achievement score of secondary school students in Basic Science and Technology compared to those taught the same Basic Science and Technology using Argument Mapping?
2. Determine the effect of Mind Mapping strategy on the mean retention score of secondary school students in Basic Science and Technology compared to those taught the same Basic Science and Technology using the Argument Mapping.
3. Determine the effect of Mind Mapping and Argument Mappingstrategy on the mean interest score of secondary school students in Basic Science and Technology compared to those taught the same Basic Science and Technology using the Argument Mapping.

Research Questions

The following research questions will guide the study:

1. What is the mean achievement score of secondary school students taught Basic Science and Technology using the Mind Mapping strategy compared to those taught the same Basic Science and Technology using Argument Mapping?
2. What is the mean retention score of students taught Basic Science and Technology using the Mind Mappingstrategy compared to those taught the same Basic Science and Technology using the Argument Mapping?
3. What is the mean interest score of students taught Basic Science and Technology using the Mind Mapping strategy compared to those taught the same Basic Science and Technology using Argument Mapping?

Hypotheses

The following null hypotheses were formulated tested at 0.05 level of significance.

Ho_1: There is no significant difference in the mean achievement score of secondary school students taught Basic Science and Technology using Mind Mapping strategy and those taught the same Basic Science and Technology using Argument Mapping.

Ho_2: There is no significant difference in the mean retention score of students taught Basic Science and Technology using the Mind Mapping strategy and those taught the same Basic Science and Technology using the Argument Mapping.

Ho_3: There is no significant difference in the mean interest score of students taught Basic Science and Technology using the Mind Mapping strategy and those taught the same Basic Science and Technology using Argument Mapping.

Research Methods

The research design for this study is quasi-experimental design using non- equivalent group design. The study was conducted in Niger state because the state is one of the states where students' poor performance in Basic Science and Technology was repeatedly reported by NECO & Niger State Ministry of Education, 2013-2015. The population for the study comprises all the 24,469 students' from 30 co-education junior secondary schools class two (JSSII) in Kontagora Educational zone of Niger state) (Source; Niger State Ministry of Education Minna). Purposive sampling was used to obtain four junior secondary schools that were used for the study. Two instruments were used in collecting data for the study. The two instruments were designed by the researchers. The instruments are Achievement Test on Basic Science and Technology(ATOBST) and Interest Inventory on Basic Science and Technology (IIOBST).In order to obtain standardized Achievement test on Basic Science and Technology (ATOBST) and Interest Inventory on Basic Science and Technology (IIOBST) instruments developed by the researcher were subjected to face and contents validities. The validity of the instruments ATOBST and (IIOBST) were determined by three experts in Basic Science and Technology Education experts in Industrial and Technology Education Department Federal University of Technology Minna and four Basic Science and Technology teachers from secondary schools in Minna, NigerState. Necessary amendments were made on the instruments based on their suggestions.A trial test was used to determine the reliability of the instruments (ATOBST, and IIOBST). Forty (40) students were randomly selected for the trial test from Government Secondary School, Kuta (JSSII) classes in Shiroro Local Government of Niger State. This school was not used in the actual study. The students used in the trial test study are similar in terms of age. Also, the teaching facilities and environmental conditions are similar to the students that were used in the actual study. The Instruments were personally administered by the researchers with the help of some research assistants who are Basic Science and Technology teachers in the schools involved in the study. The Mind Mapping and Argument mapping groups were taught the concept of Basic Science and Technology for four weeks. The Mind Mapping group

was taught Basic Science and Technology using Mind Mapping and Argument mappingstrategy and the Argument mapping group was taught same Basic Science and Technology using the Argument Mapping. The subjects (students) were pre-tested before treatment using ATOBST and HOBST In order to be sure of the equivalent level of the students and at the end the two groups were post tested using the same instruments used in the pre-test (ATOBST and HOBST). Finally, the students were post tested after four weeks of pre-test. The data collected for the study were analysed using Meanand Standard deviation to answer the research questions while Analysis of covariance (ANCOVA) statistics with the aid of Computer Statistical Strategy for Social Sciences (SPSS) was used to test the hypotheses formulated at 0.05 level of significance.

Results

Research Question 1

What is the mean achievement score of secondary school students taught Basic Science and Technology using the Mind Mapping strategy compared to those taught the same Basic Science and Technology using Argument Mapping?

Table 1: Mean and Standard Deviation Scores of the Achievement Scores for Mind Mapping and Argument Mapping

		Pre - Test		Post - Test		
Groups	N	Mean $(\overline{X})$	S.D	Mean $(\overline{X})$	S.D	Mean Gain
Mind Mapping	157	26.86	8.4	860.25	1.22	33.39
Argument Mapping	143	30.24	9.27	31.15	1.04	0.91

Table 1 shows mean and standard deviation of the achievement scores for Mind Mapping and Argument Mapping groups. From the result, the mean and standard deviation of pre-test and post-test scores of the Mind Mapping group are 26.86 ±8.48 and 60.25 ± 1.22 respectively. This gives a mean gain score of 33.39 in favour of post-test. Similarly, the mean and standard deviation of pre-test and post-test scores of the Argument Mapping group are 30.24 ±9.27 and 31.15 ± 1.04 respectively. The Mind Mapping group had a pre-test / post-test mean gain of 33.39 which is higher than that of the Argument Mapping group with a mean gain difference of 32.48. This indicated that the Mind Mapping group which were taught with Mind Mapping strategy achieved higher than the Argument Mapping group taught using Argument Mapping.

Research Question 2

What is the mean retention score of students taught Basic Science and Technology using the Mind Mapping strategy compared to those taught the same Basic Science and Technology using Argument Mapping?

Table 2: Mean and Standard Deviation Scores of the Retention Scores for Mind Mapping and Argument Mapping Groups

		Post - Test		Retention		
Groups	N	Mean $(\overline{X})$	S.D	Mean $(\overline{X})$	S.D	Mean Gain
Mind Mapping	157	60.25	1.22	69.94	11.7	89.6
Argument mapping	143	31.15	1.04	34.48	9.8	63.3

Table 2 shows mean and standard deviation of the retention scores for Mind Mapping and Argument mapping groups. From the result, the mean and standard deviation of post-test and retention scores of the Mind Mapping group are 60.25 ±1.22 and 69.94 ± 11.78 respectively. The mean retention score (69.94) is higher than that of the post-test mean score (60.25). This gives a mean gain score of 9.69 from retention. However, the mean and standard deviation of post-test and retention scores of the Argument mapping group are 31.15 ±1.04 and 34.48 ± 9.86 respectively. The mean retention score (34.48) is higher than that of the post-test (31.15). This gives a mean retention gain of 3.33 which is less than the mean retention gain of the Mind Mapping group (9.69) with a mean gain difference of 3.36. This indicated that the Mind Mapping group taught using Mind Mapping strategy retained more than the Argument mapping group taught using Argument Mapping.

Research Question 3

What is the mean interest score of students taught Basic Science and Technology using the Mind Mapping strategy compared to those taught the same Basic Science and Technology using Argument Mapping?

Table 3: Mean and Standard Deviation Scores of the Interest Scores for Mind Mapping and Argument Mapping Groups

		Pre - Test		Post - Test		
Groups	N	Mean (X)	S.D	Mean (X)	S.D	Mean Gain
Mind Mapping	157	49.56	5.38	69.58	4.4	220.0 2
Argument mapping	143	31.15	5.45	50.23	5.6	40.0 7

Table 3 shows mean and standard deviation of the interest scores for Mind Mapping and Argument mapping groups. From the result, the mean and standard deviation of pre-test and post-test scores of the Mind Mapping group is 49.56 ±5.38 and 69.58 ± 4.42 respectively. This gives a mean gain score of 20.02 in favour of post-test. Similarly, the mean and standard deviation of pre-test and post-test scores of the Argument mapping group is 31.15 ± 5.45 and 50.23 ± 5.64 respectively. The Mind Mapping group had a pre-test / post-test mean gain of 20.02 which is higher than that of the Argument mapping group with mean gain difference of 19.95. This indicated that the Mind Mapping group which were taught with Mind Mapping strategy have more interest than the Argument mapping group taught using Argument Mapping.

Hypothesis

Ho_1: There is no significant difference in the mean achievement scores of secondary school students taught Basic Science and Technology using the Mind Mapping strategy and those taught the same Basic Science and Technology using the Argument mapping.

Table 4: ANCOVA Result of Mind Mapping and Argument Mapping Group

Source	Type III Sum Square	df	Mean Square	F	Sig.
Corrected Model	63543.484[a]	2	31771.742	245.129	.000
Pretest	166.991	1	166.991	1.288	.257
Treatment	59947.625	1	59947.625	462.514	.000
Error	38494.933	297	129.613		
Corrected Total	102038.417	299			

a. Adjusted value

Table 4 reveals that the main effect treatment of secondary school students taught Basic Science and Technology using the Mind Mappingstrategy (Mind Mapping) and those taught the same Basic Science and Technology using the Argument Mapping (AM) produced F = 462.514 and this value is significant at 0.000. The value of F is equally significant at 0.05. That is ($p = 0.000$; $p < 0.05$). The treatment using Mind Mappingstrategy produced significant difference on achievement, hence the hypothesis which states that there is no significant difference in the mean achievement score of secondary school students taught Basic Science and Technology using the Mind Mappingstrategy and those taught the same Basic Science and Technology using the Argument Mapping method was therefore rejected.

Ho_2: There is no significant difference in the mean retention scores of students taught Basic Science and Technology using the Mind Mappingstrategy and those taught the same Basic Science and Technology using the Argument Mapping.

Table 5: ANCOVA Result of the Mean Retention Score of Mind Mapping and Argument Mapping Group

Source	Type III Sum Square	df	Mean Square	F	Sig.
Corrected Model	55967.351[a]	4	13991.838	117.617	.000
Posttest(covariate)	5462.146	1	5462.146	45.915	.000
Group	681.681	1	681.681	5.730	.017
Error	35093.565	295	118.961		
Corrected Total	91060.917	299			

a: Adjusted value

Table 5 reveals the main effect treatment on retention score of students taught Basic Science and Technology using the Mind Mappingstrategy (MM) and those taught the same Basic Science and Technology using Argument Mapping (AM) produced F = 5.730 and this value is significant at 0.017. The value of F is equally significant at 0.05. That is ($p = 0.017$; $p < 0.05$). The treatment using Mind Mapping and Argument Mapping significant difference on retention. Hence, the hypothesis two which states that there is no significant difference in the mean retention score of students taught Basic Science and Technology using the Mind Mappingstrategy and those taught the same Basic Science and Technology using Argument Mapping was therefore rejected.

Ho_3: There is no significant difference in the mean interest score of students taught Basic Science and Technology using the Mind Mappingstrategy and those taught the same Basic Science and Technology using Argument Mapping.

Table 6: ANCOVA Result of the Mean Interest Score of Mind Mapping and Argument Mapping Group

Source	Type III Sum Square	df	Mean Square	F	Sig.
Corrected Model	71.981[a]	4	17.995	303.550	.000
Pretest	.321	1	.321	5.411	.021
Group	1.200	1	1.200	20.240	.000
Error	17.488	295	.059		
Corrected Total	89.469	299			

a: Adjusted value

Table 6 reveals that the main effect treatment of interest score of students taught Basic Science and Technology using the Mind Mappingstrategy and those taught the same Basic Science and Technology using the Argument Mapping produced F = 20.240 and this value is significant at 0.000. The value of F is equally significant at 0.05. That is ($p = 0.000; p < 0.05$). The treatment using computer strategy produced significant difference on interest, hence the hypothesis which states that there is no significant difference in the mean interest score of students taught Basic Science and Technology using the Mind Mappingstrategy and those taught the same Basic Science and Technology using Argument Mapping was therefore rejected.

Discussions of Findings

The results in table 1 show the post-test mean achievement score of students taught with Mind Mappingstrategy (Mind Mapping Group) is higher than the post-test mean achievement score of students taught with Argument Mapping (Argument mapping Group). This is further confirmed by the result in table 7 which revealed that the achievement of Mind Mapping and Argument mapping groups differ significantly. The result indicated that treatment using Mind Mappingstrategy produced significant difference on students' achievement in Basic Science and Technology. Alamsyah (2009) pointed out that introduction of suitable instructional materials like Mind Mappingstrategy are likely solution to poor achievement of students in Basic Science and Technology. This result is in support of Chukwu, (2016), Obodo (2012) and Abdullahi (2015) who showed that the achievement of students exposed to Mind Mappingwas better than their counterparts exposed to conventional classroom instruction.

The results in table 2 show the post-post-test mean retention score of students taught with Mind Mappingstrategy (Mind Mapping Group) is higher than the post-post-test mean retention score of students taught with traditional teaching method (Argument mapping Group). This is further confirmed by the result in table 8 which revealed that the retention of Mind Mapping and Argument mapping groups differs significantly. The result indicated that treatment using Mind Mappingstrategy produced significant difference on students' retention in Basic Science and Technology. This result agrees with Cheminson (2014) who reported that students taught with Mind Mappingstrategy retained more than students taught with the conventional method. More so, Obodo (2012), observed that students who used Mind Mapping method retained more than students who used conventional method.

The results in Table 3 show the post-test mean interest score of students taught with Mind ts' interest in Basic Science and Technology through the concept mapping technique, and Chukwu (2016) who used logo and basic programmes to ascertain junior secondary school one student's interest in geometry and found that there was an improvement in the student's interest in Basic Science and Technology.

Mappingstrategy (Mind Mapping Group) is higher than the post-test mean interest score of students taught with traditional teaching method (Argument mapping Group). This is further confirmed by the result in table 6 which indicated that the interest of Mind Mapping and Argument mapping groups differs significantly. The result revealed that treatment using Mind Mappingstrategy produced significant difference on students' interest in Basic Science and Technology. This result agrees with Chukwu (2016) who carried out a research and found out that learning resulting from seeing is 75%, which is in support of the use of Mind Mappingstrategy to arouse students' interest. That is visual materials supported by audio and animations are more effective on students' achievement and interest. This result is also in support of Abdullahi (2015) who carried out a research on improving students' interest in Basic Science and Technology through the concept mapping technique, and Chukwu (2016) who used logo and basic programmes to ascertain junior secondary school one student's interest in geometry and found that there was an improvement in the student's interest in Basic Science and Technology.

Educational Implication of the Study

The results of this study have implications to the teacher in the sense that the teacher will now know that using Mind Mapping strategy for teaching and learning is better than using Argument Mapping. Therefore, teachers should apply this knowledge from the findings of this research in their teachings.

Since there is a positive effect on the use of Mind Mappingstrategy from the results of this study, State and Federal ministries of Education should organize seminars and workshops to keep teachers, textbook authors and curriculum planners on feet with various ways of developing Mind Mappingstrategy and using Mind Mapping for effective teaching and learning of Basic Science and Technology.

The findings from this study also calls for a critical review of the secondary school Basic Science and Technology curriculum with the aim of including Mind Mapping in classroom teaching and learning, this could also provide an alternative instructional method that could be employed by teachers to enhance gender equity in Basic Science and Technology achievement, retention and interest. Finally, other researchers will use these findings as reference point for other studies.

Conclusion

The following conclusions were made based on

the findings of this study. The result of this study provides empirical evidence that the use of Mind Mappingstrategy enhanced students achievement, retention and interest in Basic Science and Technology more than the use of Argument Mapping.

Secondly, students taught Basic Science and Technology with the use of Mind Mappingstrategy (Mind Mapping group) performed better than their counterpart taught same Basic Science and Technology using Argument Mapping. Female students performed higher than male students in the ATOBST, RETOST and HOBST. There was no significant difference in gender achievement and retention of student taught Basic Science and Technology with Mind Mappingstrategy. This implies that gender has no significant effect on achievement and retention of students in Basic Science and Technology but there was a significant difference in gender interest of students taught Basic Science and Technology with Mind Mappingstrategy. Therefore, the use of Mind Mappingstrategy enhanced the teaching and learning of Basic Science and Technology.

Recommendations

The following recommendations were made based on the findings of this study.

1. Since the use of Mind mapping strategy enhances achievement, retention and interest of students in Basic Science and Technology, the Basic Science and Technology teachers should use it as one of the strategies to be employed in classroom teaching and learning.
2. Workshops / Seminars should be organized by the Government for Basic Science and Technology teachers to enable them learn how to use Mind Mapping in teaching Basic Science and Technology.
3. Textbook writers should shift emphasis from teacher-centred to learners' centred activities that will promote learning by doing such as the use of Mind Mappingstrategies in the teacher's manual/teachers guide.
4. Curriculum developers should embrace and include Mind strategies that will bring about improvement in learning, acquisition of critical thinking, problem solving and performance skills in students into the curriculum.

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