US-China Education Review A 12 (2012) 1006-1021
Earlier title: US-China Education Review, ISSN 1548-6613

Effect of Self-instruction Strategy on the Achievement in Algebra of Students With Learning Difficulty in Mathematics

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This quasi-experimental study examined the effect of self-instruction strategy on the achievement in algebra of students with learning difficulty in mathematics. Two research questions and one null hypothesis were formulated to guide the study. The study adopted a non-randomized pre-test and post-test control group design with one experimental group using self-instruction strategy and a control group, learning through the "normal" conventional way of "teacher-directed" instruction. Two secondary schools in Nsukka education zone were used for the study. The population of the study comprised 855 students with learning difficulty in mathematics in SSI (senior secondary school I) in secondary schools in Nsukka education zone. The sample for the study was 40 students with learning difficulty in mathematics in community secondary school Isienu and community secondary school Umabor. Using the teacher's class achievement record, 40 students with learning difficulty in mathematics were identified, 20 from each school. The result of the study showed that self-instruction was effective in improving the achievement in algebra of students with learning difficulty in mathematics.

Keywords: special education, mathematics difficulty, self-instruction strategy, improvement in achievement in algebra

Introduction

Education is one of the most important factors that distinguish human beings from animals, since it is one of the principal outcomes of human beings' rationality. Okafor (2006) defined education to include all the experiences of the individual through which knowledge is acquired, the intellect enlightened, and the will strengthened to choose and do the good. Consequently, education fosters the worth of the individual, trains his/her character, and engenders his/her development (National Policy on Education, 2004). Through education also, the individual is appropriately prepared and suitably equipped for living in the community. Hence, Eliot (1964, as cited in Okafor, 2006) maintained that education is the process by which the community seeks to open its life to all the individuals within it, enabling them to take part in it, attempting to pass on to them its culture, and making available to them the standard by which they will live. To be able to guarantee all these, the curriculum content of education is usually well planned and various subjects are taught. These subjects help to equip students with knowledge, skills, and attitudes necessary for their development and for their suitable living in the society. In schools, one of the subjects taught is mathematics.

Mathematics is a subject that teaches various concepts like: relationships of quantities, sets, properties,

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measurement, use of numbers, and symbols. It also studies such concepts as structure, space, and change. It is regarded as the science of numbers. As the science of numbers, mathematics is an indispensable foundation to all physical sciences and technology (Olagunju, 2001). It is usually instrumental in aiding the formulation and development of many scientific and technological laws and theories. Mathematics has many branches which mainly include simultaneous equation, arithmetic, analysis, quadratic equation, combinatories, Euclidean and non-Euclidean geometries, game theory, number theory, numerical analysis, optimization, probability, set theory, statistics, topology, construction, small and great circles, trigonometry, and algebra. Algebra as one of the major branches of pure mathematics concerns itself with the study of the rules of operations, relations, constructions, and the concepts arising from them, including terms, polynomials, equations, and algebraic structures (Morris, 2009). According to Brian (2010), algebra is the branch of mathematics which is concerned with structure, relation, and quantity. It is also one of the branches that many secondary school students find difficult to learn (Martin, 2000). Studying mathematics in general, as well as algebraic concepts, variables, processes, and equations, has many advantages.

It appears to be quite impossible to live meaningfully without mathematics in one's daily life. According to Cockcroft (1982), this is because that one needs mathematics skills to plan and organize the home well and to achieve so much in the office or in the workshop. No home or office functions well without a programme or time table. Mathematics skills help to organize the activities well. Furthermore, no home, office, or workshop is self-sufficient, which does not need to buy from, sell to, or transact any business with another company or home. In the context of buying, selling, or transacting any business, mathematics skills are indispensable. In the same vein, the importance of algebra, as a major branch of mathematics for the students, cannot be over emphasized. In addition to the usefulness of mathematics generally, Brian (2010) maintained that algebra, which is a major branch of mathematics, is important for the cognitive, critical, and analytical skills of the brain. It sharpens the critical thinking skills of the students and enables them to solve real life problems logically as well. Also, studying algebra creates mental discipline. It teaches people to think and reach solutions to various problems in a well-structured and logical way. Furthermore, it helps students to learn how to sustain reflection. Yet, many Nigerian secondary school students are observed to have problems with mathematics, especially in the area of algebra (Amoo, 2001).

To have problem with mathematics disadvantages the students. According to Wallace and McLoughlin (1988), mathematics is a very important subject and adequate performance as it is usually considered fundamental to school success, and algebra remains a core branch of mathematics. Consequently, learning mathematics becomes imperative for every student in the secondary education level.

The secondary education is the level after the primary education. It is a sensitive period because it is the time when most of the foundational concepts in most subjects including mathematics are laid and attempts are made to clearly explain them. It is also the time when the students are exposed to variety of subjects in the bid to ascertain their interest and inclination, and know how to best guide them, so that their potentials and capabilities would be maximally developed. Yet, it is at this stage that many students find mathematics difficult.

This was confirmed by Norman and Zigmond (1980) and Mcleod and Armstrong (1982), who demonstrated in their studies that many students experienced more difficulty in learning mathematics than other subjects at the secondary education level. Supporting their findings, Amoo (2001) demonstrated that failure in mathematics in WAEC (West African Examination Council) rose from 43.3% in 1995 through 52.9% in 1996

to 66.16% in 1997. The poor performance of students in mathematics in secondary schools was also expressed in WAEC by the Chief Examiner's Report (2009). NECO (National Examination Council) results for 2001/2002 sessions showed that students recorded the highest number of failures in mathematics, more than in any other subjects, with over 57.8% of the candidates failing in the subject. Meanwhile, according to WASSCE (West African Senior School Certificate Examination) Chief Examiner's Report (2009), algebra was the area that many of the students found it very difficult to handle. Corroborating this, Brian (2010) maintained that the problem is that algebra is an abstract area with so many variables and involving a lot of concepts and calculations. Earlier, Martin (2000) had also observed that even when some students managed to perform well in other aspects of mathematics, they always performed poorly in algebra. It becomes then understandable why Mcleod and Armstrong (1982) earlier indicated that large numbers of students require remedial assistance, especially in algebra, since many of them experience learning difficulty in it.

Students with learning difficulties in mathematics are those who experience more problems with understanding mathematics than any other subject. A good number of people in this group have problems especially in algebra. They include those who have mathematics disability and those who are generally afraid of numbers and/or calculation. Those with mathematics disability are those who exhibit one or more deficits in the essential learning processes of perception, conceptualization, language, memory, attention, and impulse control (Cronin, 1978, as cited in Okeke, 2001). Also, other factors like inattention, difficulty with symbolic language expression, difficulty with understanding of spatial relationships, difficulty with seriation, discrimination, and failure to develop and mobilize cognitive strategies for learning, make the students in this category not achieve well in mathematics (Okeke, 2001). Furthermore, Howell (2007) opined that some students experience great difficulty in mathematics, which is unrelated to their mathematical intelligence. These students have the potential to learn much more than what they are achieving. They are not experiencing emotional, behavioural or severe environmental issues which prevent their learning, they have a learning difference. There are, however, others who experience learning difficulty with mathematics, but who are not having mathematics disability. Meanwhile, it is a common practice to group mathematics difficulty into two categories: mathematics computation difficulty and mathematics reasoning difficulty. These categories are based on the students' performance in class—the outcome of their learning differences (Howell, 2007). There are, however, those who find mathematics difficult as a result of visual-spatial and organizational difficulties, memory difficulties, language related difficulties, attention difficulties, and difficulties with mathematics concepts. So, students with learning difficulty in mathematics include all students who do not find it easy to understand mathematics and even when they attempt to learn it, they do not become proficient in it and as such, they do not achieve well in it.

Achieving well in mathematics, according to Morris (2009), has to do with how students deal with their studies in mathematics and how they cope with or accomplish different tasks given to them by their teachers, bearing in mind the expected standard of performance. Achieving well here then means scoring up to the desirable, acceptable, and expected standard and this will be obviously well above 50% in a given test.

When students score below the acceptable standard, it presupposes that there may be a need for a retraining or the employment of certain learning strategies to help them increase their previous achievement. Learning strategies can be defined as an organized approach to achieving a task of learning. They refer to how learners organize and use a set of skills to acquire content or accomplish a particular task more effectively and efficiently either in or out of school (Schumaker & Deshler, 1984). Teaching students implies teaching them

how to learn by learning strategies. Learning strategies give students ways to think through and plan the solution to problems. They also make students become more effective and independent learners. They even help the students to learn more effectively difficult subjects (Wong, 1993). In fact, learning strategies help to improve the achievement of students. Improving the achievement then means increasing the performances and upgrading it or making it better than it was previously, so that the students achieve more. In this context, in the opinion of Steedly (2009), one needs to ask two questions: What do students need to know how to do mathematically, and what instructional approaches are effective in teaching those skills? One of such learning strategies is self-instruction.

Self-instruction strategy is a self-regulation strategy that students can use to manage themselves as learners and direct their own behavior while learning (Graham & Reid, 1992). It is a strategy by which students self-tutor and self-monitor themselves. This is quite different from the conventional teacher-dominated strategy of teaching, where the teacher dishes out learning content and the learner merely struggles to learn them (Deborah, 1997). In the conventional strategy, the teacher directs the activities of learning, but self-instruction is learner-directed. Here, the student takes charge of the learning activity, while the teacher merely guides. Self-instruction strategy is therefore a cognitive learning strategy, in which learning task is broken into steps and the learner himself/herself directs and appraises himself/herself as he/she goes through the task step by step. Self-instruction strategy takes place in stages: (1) cognitive modeling stage: Where the teacher takes the student's position and models the behavior for the students to copy; (2) overt external guidance: Where the teacher prompts the students on what to do before the student then completely takes over; (3) overt self-guidance: Where the student performs the actions while speaking aloud the actions; (4) faded overt self-guidance: Where the student goes on to perform the action and whispers it instead of talking aloud; Finally, (5) covert self-instruction: Where the student performs the action correctly on his/her own without talking aloud or even whispering (Meichenbaum, 1977).

As a learning strategy, self-instruction seems like a strategy that would be of great help to students with learning difficulty in mathematics. The reason is that it breaks down learning into bits, which makes it easier for learners to comprehend more effectively. It also makes the learner to take active part in the exercise of learning, rather than being passive as could sometimes obtain in other conventional teacher-dominated strategies (Graham et al., 1992). More still, it gives learners opportunity for self-evaluation, self-determination, and self-motivation. Consequently, this study intends to ascertain whether, given all these insights of self-instruction strategy, it can help to increase the achievement in algebra of students with learning difficulty in mathematics, since algebra is one of the branches of mathematics, which the students often find it difficult to learn, in spite of its importance.

So, in spite of the fact that mathematics is a core subject in the curriculum of secondary schools and very relevant for the meaningful development of any nation, many secondary school students perform poorly in it. Records have shown that it is the subject that usually has the highest number of failures in WAEC.

It has been observed that approximately 6% of school age children have significant difficulty with mathematics. As such, learning difficulty in mathematics remains as pervasive as reading problems. It is however suspected that the use of poor strategies by teachers to teach the subject is the lynch pin of the cause of students' poor achievement in the subject. The question then is weather the use of self-instruction strategy would improve the achievement in algebra of students with learning difficulty in mathematics.

Meanwhile, the information processing theory, which involves the schema theory and was formulated by Piaget in 1926 and developed by Anderson (a respected educational psychologist) in 1977, made the point that when what is learnt is clearly categorized, organized into units, and sequenced, then it is easier to store it and to retrieve it from the long-term memory. Also, the theory of constructivism maintains that knowledge construction takes place in functional contexts (where the knowledge is usable), in a social context (where the learners interacts with others), and with visible usefulness (learning must be useful to the learner) (Nwafor, 2007). This means the learner learns better when he/she is actively involved in the construction of knowledge. He/she does this by integrating innate ideas with new experiences. Therefore, given that, self-instruction strategy breaks up learning into units and sequences, and encourages the active participation of the learners in the learning process. It is then the effort of this study to ascertain whether the strategy can improve the achievement in algebra of students with learning difficulty in mathematics.

Studies conducted by Zimmerman (2001), on the use of self-instruction strategy to transform learners' mental abilities, revealed that self-instruction, which involves self-regulation, is necessary for students to be motivated to actively participate in their own learning process. This transforms the learners' mental abilities. However, he/she did not apply it to students with learning difficulties in mathematics, neither did he/she employ the strategy to help them learn algebra in mathematics. Also, in their own research entitled "Algebraic instruction for students with learning difficulties in mathematics: Implications from a research review", Maccini, McNaughton, and Ruhl (1999) maintained that students with learning difficulties need intervention for them to do well in algebra. They concluded that successful intervention included instruction on domain-specific knowledge, as well as general problem-solving and self-regulation strategies. Their research, therefore, demonstrated that students with learning difficulties in mathematics need special intervention to do well in algebra. While the present study is on the use of self-instruction strategy, theirs was on domain-specific knowledge, as well as general problem-solving and self-regulation strategies. Consequently, there has been limited empirical research on the effect of self-instruction strategy on the achievement in algebra of students with learning difficulties so far.

Research Questions

The following research questions were formulated to guide the study:

(1) To what extent would students with learning difficulty in mathematics acquire the skills in self-instruction strategy?

(2) To what extent will there be a difference in the algebra mean achievement scores of students with learning difficulty in mathematics exposed to self-instruction strategy and those not exposed to it as measured by AAT (algebra achievement test)?

Null Hypothesis

The hypothesis which was tested at 0.05 level of significance is: There is no significant difference in the mean achievement scores of students with learning difficulty in mathematics exposed to self-instruction strategy and those in the control group.

Method

The study is a quasi-experimental study. It adopted a non-randomized pre-test and post-test control group

design with one experimental group using self-instruction strategy and a control group, learning through the "normal" conventional way of "teacher-directed" instruction. The purpose of the study is to investigate the effect of self-instruction strategy on the achievement in algebra of students with learning difficulty.

Population of the Study

The population of the study comprised 855 students with learning difficulty in mathematics in SSI (senior secondary school I) in secondary schools in Nsukka education zone. The reason for using SSI students was that it is at that level that pure algebraic processes are introduced in the secondary school curriculum and it is also the stage where most of the students experience learning difficulty in mathematics.

Sample and Sampling Technique

The sample for the study was 40 students with learning difficulty in mathematics in community secondary school Isienu and community secondary school Umabor. Using the teacher's class achievement record, 40 students with learning difficulty in mathematics were identified, 20 from each school. Coin was tossed to determine which school was the treatment group and which was the control group. For the school that became the experimental group, 10 of the members were boys and the other were 10 girls. The same was applicable to the control group. The experimental group received instructions on skills of self-instruction strategy and they used it to learn algebra on their own, while the control group was taught using the normal conventional, teacher-dominated learning strategy. A pre-test was done using AAT to confirm that the students actually had learning difficulty in mathematics before the commencement of the treatment. The result of this test was recorded and kept.

Instrument for Data Collection

The researcher used two instruments for data collection. These instruments were constructed by the researcher. They are AAT and SRS (self-instruction rating scale). The AAT which was developed from the normal mathematics curriculum for SSI, was used to identify the students who really had learning difficulty in mathematics. The items of the AAT were generated by the researcher with the help of some special education teachers and mathematics teachers. The instrument was given to experts in mathematics, special education, and measurement and evaluation departments of the faculty of education of the University of Nigeria, Nsukka, for their input and moderation. The AAT was drawn from the syllabus for SSI as approved by WAEC and the State Ministry of Education, Enugu.

A blue print of the test was developed and used for constructing the AAT. About 20 questions were generated by the researcher. This helped the researcher to know how appropriate the questions on the instrument were for the study. The questions were constructed in line with the four steps in solving an algebraic equation.

An SRS was also constructed for the study. It was 4-point rating scale which was used to ascertain the level of the student's acquisition of the skills involved in using self-instruction strategy before and after instruction. The scale ranges from 4—SA ("Strongly agree"), 3—A ("Agree"), 2—D ("Disagree"), and 1—SD ("Strongly disagree"). The instrument consisted of 15 researcher generated questions, based on steps and skills of self-instruction strategy.

The AAT and SRS were subjected to face and content validation by three experts. They were taken to one lecturer in the measurement and evaluation department, one lecturer in special education unit and another lecturer in science (mathematics) education unit. They were also given the blue print of the test, which was to

help guarantee the content validity of the test. They were requested to examine the suitability and appropriateness of the questions and the language. Their inputs were used to modify the instruments.

The two instruments—AAT and SRS were trial tested using students with learning difficulty in mathematics from Opi High school. The trial testing helped the researcher to determine the suitability of the test, so as to moderate excessively difficult items and determine the appropriate timing for the test, and whether the language was clear and precise.

The result of the trial testing was used to determine the reliability coefficient for the AAT. The internal consistency reliability coefficient was determined using the K−R-20-formular procedure. The calculated estimate is 0.85, showing that the internal consistency is high and that the instrument was reliable for the study. To test for stability, a test-retest was done and calculated using Pearson Product Moment Correlation Coefficient. The calculated Pearson *r* is 0.75. The test for stability was necessary since the study will involve repeated measurement with the same instrument for pre-test and post-test design.

For the self-instruction strategy and self-evaluating rating scale, a test of internal consistency was carried out using Cronbach Alpha. The internal consistency reliability coefficient of 0.75 was obtained. To test for stability, a test-retest was done and calculated using Pearson Product Moment Correlation Coefficient. An estimate of 0.88 was obtained.

Developing SISIP and CLSIP

One self-instructional programme and a conventional learning programme were used for the study. These include: (1) SISIP (self-instruction strategy instructional programme); and (2) CLSIP (conventional learning strategy (teacher-directed) instructional programme, specifically designed for the control group).

The SISIP was developed by the researcher with the help of experts in special education and science (mathematics) education. The idea was to use it to instruct the students with learning difficulty in mathematics in the effective use of self-instruction strategy to learn algebra. The objective to be achieved was well stated, and what to be done by the teacher and the learner and the method of evaluation to be used were written out.

The researcher also developed the CLSIP to be used for the control group. The students with learning difficulty in mathematics in the control group were exposed to the same number of lessons as those instructed in the use of the skills of self-instruction. The programmes lasted for about four weeks and each lesson lasted for 45 minutes.

Validation of SISIP and CLSIP

The SISIP and CLSIP were face validated by three experts—one expert from (science) mathematics education, the other from special education unit, and the last from measurement and evaluation unit. The SISIP and CLSIP were given to them. Their inputs were used to improve the programmes.

Trial Testing

The SISIP and CLSIP were trial tested by the researcher with the help of research assistants. The SISIP was used to instruct the students with learning difficulty in mathematics SSI from Opi High School, on the skills in the use of self-instruction strategy to learn algebra. This was done to ensure the appropriateness and suitability of the instruments in terms of content, language, and timing.

Two research assistants were trained by the researcher, one in the use of SISIP and the other in the use of the CLSIP who assisted in the study.

Treatment Procedure

The treatment was designed to last for four weeks. With the help of the class performance records, the researcher and research assistants were able to know the students who have learning difficulty in mathematics. Further interviews and other tests helped to reveal those who have real difficulties with algebra among them.

The AAT was first administered to all the students in SSI in the two schools by each of the research assistants accordingly and the score obtained by each of the students before the commencement of the treatment was recorded by the research assistants. This made the students view the test as a normal class test. It also helped to confirm those who really had learning difficulty with algebra.

The research assistants carried out the exercise in the two schools used for the study. Each research assistant handled one school. One research assistant instructed the experimental group in the acquisition and use of skills of self-instruction strategy in the school and the other taught the control group algebra using the conventional method.

After four weeks, the self-instruction rating scale was administered to the experimental group immediately after treatment to find out how well they have acquired the skills involved in the use of the strategy. It was also structured on a 4-point Likert type rating scale of 4—SA ("Strongly agree"), 3—A ("Agree"), 2—D ("Disagree"), and 1—SD ("Strongly disagree"), and their responses showed their level of agreement or disagreement to the acquisition of the skills. The AAT was then reshuffled and administered to the students in the two schools two weeks after the training programme by the research assistants.

To ensure that the researcher got an objective result from the study, the extraneous variables which could affect the study were controlled, so that any change in behaviour occurred as a result of the acquisition and use of the skills of the self-instruction strategy, and not as a result of other factors.

At the end of the test, the scripts were scored using the face validated marking scheme. The self-instruction strategy rating scale was read ministered to the students in the experimental group, immediately after the instructional programme to ascertain whether the students really acquired the skills involved in the use of the strategy.

Method of Data Analysis

The data collected from the respondents were analyzed in line with each research question and hypothesis. Mean and *SD* (standard deviation) were used in answering the research questions. ANCOVA (analysis of covariance) was used to test the hypothesis at $p < 0.05$ level of significance.

Results

The results of the study are presented below based on research questions and the hypothesis tested.

Research Question One: To What Extent Would Students With Learning Difficulty in Mathematics Acquire the Skills in Self-instruction Strategy

The data answering research question one were presented in Table 1.

Table 1 shows to what extent students with learning difficulty in mathematics, who were taught the skills of self-instruction strategy, acquired the skills. The data show that 15 persons strongly agree that the skills of listening attentively to the modeling, whispering to oneself while performing the activity was imperative, while five agree with the view, with a mean of 3.75. Sixteen persons strongly agree that the skills of observing keenly as the teacher performs, talking aloud while performing the instruction were required, while four persons agree

with the view, with a mean of 3.80. Nineteen persons strongly agree that the skills of asking questions where one needed clarification and performing the activities over and over to perfect in them were needed, while one agrees with the view, with a mean of 3.95. As regards the skills of performing the activity exactly as they saw it, listening to correction if one made mistakes, taking one's time to perform the activities in sequence as one verbalized them, striving to perform the activities more independently, and going on to use the method to solve other questions in the absence of the teacher, 18 persons strongly agree to them while two persons agree with the view, with a mean of 3.90. Twenty persons completely strongly agree that one should obey the rules of performing the activities with a mean of 4.00. Fourteen agree that once the student has learnt the activities, he/she should be completely silent while performing the activities, while six persons agree with the view with a mean of 3.60.

Table 1

Mean Ratings x of the Responses of Students With Learning Difficulty in Mathematics Exposed to the Skills of Self-instruction Strategy

S/N	Item description	SA			A			D			SD			Mean	Decision (2.5)
		F	*N*	%	*F*	*N*	%	*F*	*N*	%	*F*	*N*	%		
To learn algebra well using self-instruction strategy the students should be able to acquire these skills:															
1	Listen attentively to the modeling	15	60	75	5	15	25	-	-	-	-	-	-	3.75	Agree
2	Observe keenly as the teacher performs	16	64	80	4	12	20	-	-	-	-	-	-	3.8	Agree
3	Ask questions where they needed clarification	19	76	95	1	3	5	-	-	-	-	-	-	3.95	Agree
4	Perform the activity exactly as they saw it	18	72	90	2	6	10	-	-	-	-	-	-	3.9	Agree
5	Listen to correction if they make mistake	18	72	90	2	6	10	-	-	-	-	-	-	3.9	Agree
6	Perform the activity only once	-	-	-	-	-	-	4	8	20	16	16	80	1.2	Disagree
7	Talk aloud while performing the instruction	16	64	80	4	12	20	-	-	-	-	-	-	3.9	Agree
8	Obey the rules of performing the activities	20	80	100	-	-	-	-	-	-	-	-	-	4	Agree
9	Take their time to perform the activities in sequence as they verbalize them	18	72	90	2	6	10	-	-	-	-	-	-	3.9	Agree
10	Be whispering the instruction to themselves while performing the activities	15	60	75	5	15	25	-	-	-	-	-	-	3.75	Agree
11	Strive to perform the activity more independently	18	72	90	2	6	10	-	-	-	-	-	-	3.9	Agree
12	Jump some stages while performing the activities	-	-	-	-	-	-	2	4	10	18	18	90	1.1	Disagree
13	Perform the activities over and over to perfect in them	19	76	95	1	3	5	-	-	-	-	-	-	3.95	Agree
14	Be completely silent as they perform them	14	56	90	4	12	20	2	4	10	-	-	-	3.6	Agree
15	Go on to use the method to try other question in the absence of the teacher	18	72	90	2	6	10	-	-	-	-	-	-	3.9	Agree

To confirm that the students acquired the skills, 16 of them strongly disagree that the activities should be

performed only once while four of them disagree to it with a mean of 1.20. Also 18 persons strongly disagree that one should jump some stages while performing the activities, while two disagree to it with a mean of 1.10. It is then clear that the high mean scores in a 4-point rating scale, with a mean of 2.5 indicate how strongly the student with learning difficulty in mathematics acquired the skills in self-instruction strategy.

Research Question Two: To What Extent Will There Be a Difference in the Algebra Mean Achievement Scores of Students With Learning Difficulty in Mathematics Who Used Self-instruction Strategy and Those Who Did Not Use It to Learn Algebra as Measured by AAT

The data answering research question two were presented in Table 2.

Table 2

Pre-test/Post-test Mean Scores and SD of Students With Learning Difficulty in Mathematics Who Used Self-instruction Strategy and Those Who Did Not Use It

Experimental	Gender		Pre-test score	Post-test score	Mean gain score
Treatment	Male	Mean	17.00	57.50	40.50
		SD	6.33	13.39	
	Female	Mean	17.60	55.50	37.90
		SD	9.30	12.57	
	Total	Mean	17.30	56.50	39.20
		SD	7.75	12.68	
Control	Male	Mean	12.60	39.50	26.90
		SD	9.06	9.27	
	Female	Mean	16.50	39.00	22.50
		SD	9.44	11.26	
	Total	Mean	14.55	39.25	24.70
		SD	9.23	10.04	

The data in Table 2 show that students with learning difficulty in mathematics who were exposed to self-instruction strategy had a pre-test mean score of 17.30 and *SD* of 7.75 in their AAT; while their post-test mean score was 56.50 and *SD* was 12.68. The mean gain score between the pre-test and the post-test was 39.20. The *SD* was 7.75 for the pre-test and 12.68 for the post-test. The pre-test mean score for the control group exposed to the conventional method of learning algebra was 14.55 and *SD* was 9.23; whereas their post-test mean gain score between the pre-test and the post-test was 24.70. The *SD* was 9.23 for the pre-test and 10.04 for the post-test.

Since the mean gain score between the pre-test and the post-test of students with learning difficulty in mathematics exposed to self-instruction strategy was 39.20, and the mean gain score between the pre-test and the post-test of those with learning difficulty in mathematics exposed to conventional method of learning algebra was only 24.70, then it means that those exposed to self-instruction strategy achieved better.

A Corresponding Hypothesis Formulated to Further Answer This Research Question Two is H1: There Is No Significant Difference in the Mean Achievement Scores of Students With Learning Difficulty in Mathematics Exposed to Self-instruction Strategy and Those in the Control Group

The data testing hypothesis 1 were presented in Table 3.

Table 3

Summary of the Univariate ANCOVA on the Students With Learning Difficulty in Mathematics Post-Test Scores on AAT

Source	Type III sum of squares	*df*	Mean square	*F*	Sig.
Corrected model	4,281.175[a]	4	1,070.294	10.226	0.000
Intercept	11,348.407	1	11,348.407	108.428	0.000
Pre-test	1,284.300	1	1,284.300	12.271	0.001
Experimental	2,290.366	1	2,290.366	21.883	0.000
Gender	77.374	1	77.374	0.739	0.396
Experimental* gender	1.524	1	1.524	0.015	0.905
Error	3,663.200	35	104.663		
Total	99,625.000	40			
Corrected total	7,944.375	39			

Results in Table 3 indicate that the treatment as the main factor has a significant effect on the students with learning difficulty in mathematics achievement in algebra. The *F*-value of 21.88 is significant at 0.05 level. This implies that the null hypothesis of self-instruction strategy not being a significant factor in the mean achievement scores in algebra of students with learning difficulty in mathematics is rejected. This shows that there is a significant difference in the post-test mean achievement scores of students with learning difficulty in mathematics exposed to self-instruction strategy and those in the control group, who were exposed to the conventional learning method.

So, the results show that:

(1) Students with learning difficulty in mathematics were able to significantly acquire the skills of self-instruction strategy;

(2) The mean achievement scores of students with learning difficulty in mathematics who used self-instruction strategy to learn algebra are significantly higher than those who used conventional method.

Discussion of Results

The results of the study in Table 1 reveal that the students with learning difficulty in mathematics can acquire the skills of self-instruction strategy. Corroborating this, Hughes (1992) observed that self-instruction is a self-management strategy that contributes to an individual's self-determination skills and it is an easy procedure to develop, learn, and use. What also makes self-instruction easier to acquire, according to Wehemeyer (2006), is that it is a strategy that can be practiced inside and outside a classroom or training room and it allows a learner to self-direct his/her learning activities, even in settings where instructional support is not always available. In the opinion of Deborah (2004), skills of self-instruction strategy can be acquired by students, because of its influence on them. Generally, it has three powerful influences: the learning and modeling of materials, the ability of verbalization, and self-regulation meta-cognition. Furthermore, it can be acquired because of its obvious advantages to learners (Hughes, 1992; Deborah, 2004; Lang, Margo, Scruggs, & Porter, 2004). Some of those advantages include: Self-instruction is more efficient than classroom instruction in terms of development and teaching time. Also, once a self-instructional course is developed, only minimal time needs to be spent on it to direct the learners on how to use it.

Again, self-instruction strategy has the capacity of providing learners some control over instruction. This type of learner control can range from simply controlling the pace of the instruction, to letting learners set their

own learning goals and find their own instructional materials. Meanwhile, learners become active by having a purpose for learning, finding motivation, being aware of the most effective way to learn, and finding a way to practice and use learning materials. And if self-instruction strategy has any disadvantage, it is the lack of other students with whom to share ideas. However, Zimmerman (2001) asserted that students achieve more when they view learning as an activity that they do for themselves in a proactive manner, rather than view it as a covert event that happens to them as a result of instruction. This is because allowing students to take more active role in their education puts students in the driver's seat and in charge and makes them perform better.

Furthermore, Zimmerman (2001) maintained that individual differences also affect the rate of acquisition of the skills of self-instruction strategy. Skilled adults, such as college students or university graduates are already self-motivated. They can also set their own objectives, adopt an attentional set, use efficient coding system, demonstrate to themselves the performances of which they are capable, and verify the products so as to provide feedback. So acquiring the skills may be easier for them. However, high school students including those with disabilities can also acquire the skills with much practice and dedication.

So, from the foregoing, it is clear that students with learning difficulty in mathematics can acquire the skills of self-instruction strategy and doing so is highly advantageous for them.

The data in Table 2 indicate that students exposed to self-instruction strategy achieved better in algebra than those in control group. This supports the earlier findings by Lang, Margo, Scruggs, and Porter (2004), on the effect of self-instruction strategy on problem-solving in algebra of students with special needs. In that study, it was found out that the self-instructional group significantly outperformed the traditional instruction group, indicating that students who used the self-instruction strategy had better performance on the mathematic problem-solving tests. This is also in line with the findings of Oloyede and Ojo (2006), who asserted that low ability mathematics students can improve, if they are taught to use appropriate learning strategies. The finding of this study is also in agreement with the finding of Wehemeyer (2006), that self-instruction strategy enhanced the performance of low achieving students in mathematics. Also, the finding of the study is in line with the opinion of Reed and Giessler (1995) that self-instruction engenders self-regulation and self-regulation has been viewed as a desirable quality throughout history because of its positive effects on behaviour and the acquisition of skills. In this connection, Zimmerman (2001) observed that the use of self-instruction strategy assists students in performing tasks more effectively and independently. It actively engages otherwise passive students in their academic instruction. Corroborating the positive effect of self-instruction strategy on the achievement of low performing students, Hughes and Carter (2000) affirmed that self-instruction strategy has the purpose of stimulating, actively supporting and facilitating the internal processes of learning. Also by using "self-talk" or stating the instruction out loud, responsibility for the instruction moves from the facilitator to the consumer. So self-instruction strategy improved the achievement in algebra of students with learning difficulty in mathematics.

Conclusions and Recommendations

Based on the findings and discussions of this study, the following conclusions are made:

(1) Acquisition of skills of self-instruction strategy is possible for students with learning difficulty in mathematics and it is an advantage for them. The 4-point rating scale showed that it was possible for these students with learning difficulty in mathematics to acquire the skills and use the skills to learn algebra;

(2) Using self-instruction strategy to learn algebra was effective in improving the achievement in algebra

of students with learning difficulty in mathematics. The finding of the study showed that there was a significant difference in the post-test mean scores in AAT of students with learning difficulty in mathematics exposed to self-instruction strategy and those who used the conventional learning method.

Based on the findings of this study, the following recommendations are made:

(1) Students, especially the low achieving ones and persons with disabilities should be exposed to appropriate learning strategies like self-instruction. This will help to improve their achievement, and make learning experiences less stressful and more attractive for them. To achieve this, the teachers should explain, demonstrate, and model the strategy to the students. They should also monitor and ensure that the students properly use the strategies and reinforce them when and where necessary;

(2) Given that self-instruction strategy is very effective in improving the achievement in algebra of students with learning difficulties in mathematics as well as those with learning disabilities, it should be incorporated in the teacher education programmes to prepare the prospective teachers, who may teach the low achieving students as well as the students with disabilities;

(3) Again, workshops and seminars should be organized by the government and school administrators for mathematics teachers to sensitize them on the importance and use of appropriate learning strategies, such as self-instruction;

(4) All stake holders in education, the federal and state government as well as the education boards, such as UBEB (Universal Basic Education Board) should organize enlightenment programmes like workshops and seminars for teachers and students on learning strategies and their use for effectiveness in learning;

(5) Curriculum planners should plan the school and class activities to be more student-centered. This will help the students, especially, those with learning disabilities, to achieve better academically. It will also help the students to develop confidence in their abilities to handle any learning task or problem they meet.

So, once an appropriate learning strategy like self-instruction is employed for students, including those with learning difficulty in mathematics or persons with learning disabilities, they will achieve better. This will help them to realize themselves, contribute their quota to the society, and be of benefit to themselves and to the society.

References

Abdulloh, M. H. (2001). *Self directed learning*. ERIC Digest. Bloomington, I. N.: ERIC Clearing House on Reading English and Communication.

Aburime, E. F. (2007). Optimization of mathematics pedagogy in Nigerian schools: An improvisation strategy. In *Optimization of service delivery in the education sector: Issues and strategies*. Nsukka: University Trust Publishers.

Adprima, L. (2010). *Educational information for new and future teachers*. New York: Teachers College Press.

Akanwa, U. N., & Olatunji, S. O. (2008). Comparative analysis of students' performance in May/June SSCE organized by WAEC and NECO: The issue of standards. In D. N. Eze (Ed.), *Review of Education, 19*(1), 109.

Ale, S. O. (1989). *Combating poor achievement in mathematics* (A key note address). *Abacus, 19*(1), 26-40.

Ale, S. O. (2003). *Global view of mathematics improvement programme and its Mission* (A welcome address on the opening ceremony, orientation programme for mathematics improvement). Abuja: National Mathematical Centre.

Allen, & Schwartz (1999). *Neurotherapy does not qualify as an empirically supported behavioural treatment for psychological disorders in science and pseudoscience review in mental health*. New Orleans.

Amazigo, J. O. (2000). *Mathematics phobia: Diagnosis and prescription* (First unpublished annual lecture of National Mathematical Centre Abuja). Abuja: National Mathematical Centre.

American Psychological Association. (1995). Current issues in research on self-regulated learning: A discussion with commentaries. *Educational Psychologist (special issue), 30*(4), 15-20.

Amoo, S. A. (2001). Curriculum ideals and realities for sustainable educational development. A paper presented at *The 14th Annual Conference of the Curriculum Organization of Nigeria*, Abuja, September 18-21, 2001.

Anderson, J. B. (1980). *Biographical directory of the United States Congress*. New York: Columbia University Press.

Awofala, T. (2009). Effects of three modes of personalization on students achievement in mathematics word problems in Nigeria. *International Journal of Educational Management (IJEM), 6*(7), 53-55.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W. H. Freeman.

Barker, S., Gersten, R., & Lee. (2002). A synthesis of empirical research on teaching mathematics to low achieving students. *The Elementary School Journal, 103*(1), 51-73.

Barr, R. B., & Tagg, J. (1995). A new paradigm for undergraduate education. *Change, 277*(6), 13-25.

Boud, D. (1995). *Enhancing learning through self-assessment*. London: Kegan Paul, Trench, Turbner and co..

Brian, J. (2010). *Studying algebra*. Retrieved March 28th, 2011, from http://www.articles base.com/

Brookfield, S. (1985). *Self-directed learning: From theory to practice*. San Francisco: Jossey-Bass.

Catsambis, S. (1994). The path to math: Gender and racial-ethnic differences in mathematics participation from middle school to high school. *Sociology of Education, 67*(3), 18-21.

Cho, Y. (1995). The nature of learner's cognitive processes hyper text learning environments (Unpublished doctoral dissertation, University of Texas at Austin).

Cockcroft, W. H. (1982). *Mathematics counts* (Report of the committee of inquiry into the teaching of mathematics in schools). Scotland: Queen's Printer.

Cohen, A. D. (1990). *Language learning: Insight for learners, teachers and researchers*. Rowley, M. A.: Newburg.

Cronin, P. (1978). *Discover down under*. New York: University Press.

Daris, P. M. (1998). *Learning theories*. London: Kegan Paul, Trench, Turbner and Co..

Deborah, A. S. (1997; 2004). Self-regulated learning during non-linear self-instruction. In *Educational psychology*. Michigan: Michigan State University.

Ellen, S. (2010). *Math remediation learning strategies*. Retrieved March 28th, 2011, from http://www.Grockit.com/

Eze, U. N. (2003). Effect of elaborative interrogation strategy on schooling adolescents perceived science concepts. *The Educational Psychologists, 1*(1), 62-74.

Ezeahurukwe, J. N. (2010). Effects of elaborative interrogation and self-assessment strategies on mathematics achievement, test anxiety and self-efficacy of low achieving students (Unpublished doctoral dissertation, Dept. of education , UNN).

Fennema, E. (1980). Teachers and sex bias in mathematics. *The Mathematics Teacher, 73*(3), 16-17.

Foegen, A. (2008). Progress monitoring in middle school mathematics: Options and issues. *Remedial and Special Education, 29*, 195-207.

Foegen, A., Olson, J., & Impecoven-lind, L. (2008). Developing progress monitoring measures for secondary mathematics: An illustration in algebra. *Assessment for Effective Intervention, 33*, 240-249.

Fuchs, L. S., & Fuchs, D. (2002). Principles for the prevention and intervention of mathematics difficulties. *Learning Disabilities Research and Practice, 16*(2), 85-95.

Garnett, K. (1998). Mathematics learning disabilities. *Division for Learning Disabilities Journal of CEC*. Retrieved from http://www.ldonline.org/ld indepth/math skills/ garnett.html

Gerald, O. (1996). Serving the strategic reader: Reader response theory and its implications for the teaching of writing (An expanded version of a paper presented to the Qualitative Division of the Association for Educators). In *Journalism and mass communication*. Atlanta.

Gernett, K. (1998). *Math learning disabilities.* Retrieved November, 2010, from http://www.idonline.org/article5896

Graham, H., & Reid (1992). Self-regulated strategy development model. *Focus on Exceptional Children, 24*(6), 1-16.

Hall, T. (2002). *Explicit instruction*. Retrieved March 20, 2010, from http://www.aim.cast.org/learn/history archieve/background papers/explicit instruction

Harbor-Ibeaja, V. F., & Nworgu, B. G. (1989). Mode of task presentation and pupils' performance on mathematical task involving addition and subtractions, ABACUS. *Journal of Mathematical Association of Nigeria (Silver Jubilee Edition), 19*(1), 48-54.

Harbor-Peters, V. F. A. (2001). Inaugural lecture: Unmasking some aversive aspect of schools mathematics and strategies for averting them.

Harris, K. R. (1990). Developing self regulated learners: The role of private speech and self instruction. *Educational Psychologist, 15*(3), 35-49.

Harry, D. (1985). Self-instruction—An approach to staff training. *Education and Training, 27*(6), 160-170.

Heward, W. L. (2006). Exceptional children: An introduction to special education. *Journal of Exceptional Children,* 184-185.

HR Dictionary of Human Resources. (n.d.). Retrieved from http://www hrdictionary.com

Hughes, C., & Carter. (2000). *Teaching students to use self-instruction: Self-instruction statements, management and self-determination strategies: Promoting independence in the transition to adult life*. Retrieved June 14, 2005, from http//www.vcu.edu/ntcweb/techlink/GEB/Hughesste7d.3.html

Hyde, S. J., & Fennema, E. (2006). Gender comparisons of mathematics attitudes and affect: A meta-analysis. *Psychology of Women Quarterly, 14*(3), 10-15.

Iheanacho, J. I. (1998). *Introduction to special education administration: Management and planning issue*. Jos: Government Printers.

Impcoven-Lind, L. (2010). Teaching algebra to students with learning disabilities. *A Journal of Hammill Institute on Disabilities*, *15*(8), 36-40.

Jahun, U., & Momoh, J. (2001). The effect of environment and sex on mathematics students in Kwara State. *Journal of Mathematics Association of Nigeria, 26*(1), 53-58.

Jeremiah, E. (2007). The relationship between students' achievement in junior and senior secondary school certificate examinations in mathematics (Unpublished M.Ed. project, Department of Education, University of Nigeria, Nsukka).

Kanter, D. (1978). The Europeanization of America: A study in changing values. *Advances in Consumer Research, 5*(7), 18-21.

Kerka, S. (1997). *Constructivism, workshop learning and vocational education*. Columbus, O. H.: ERIC Clearing House on Adult Careers and Vocational Education.

Kilpatrick, J. (2001). *Adding it up: Helping children learn mathematics*. Washington, D. C.: The National Academic Press.

Lassa, P. N. (1981). *The sorry state of mathematics education in Nigeria*. Nigeria: University of Jos.

Lee, D. (2002). A synthesis of empirical research on teaching mathematics to low achieving students. *The Elementary School Journal, 103*(1), 51-73.

Lee, J., Grigg, W. S., & Dion, G. S. (2007). *The nation's report card: Mathematics 2007 in national assessment of educational progress (NAEP)*. India: Pub. and Products Staff.

Linn, M. C. (2006). Gender mathematics and science. *Education Researcher, 18*(8), 17-27.

Linn, M. C., & Hyde, J. S. (2006). Gender similarities in mathematics and science. *Science Magazine, 14*(5), 59-60.

Martin, A. (2000). A national survey of teachers' promotion of self-determination and student directed learning. *Journal of Special Education, 34*(2), 13-18.

Mazzocco, M., & Thompson, R. E. (2005). Kindergarten predictors of math learning disability. *Learning Disability Research and Practice, 5*(2), 142-155.

Mcleod, T. M., & Armstrong, S. W. (1982). Learning disabilities in mathematics: Skill deficit and remedial approaches at the intermediate and secondary level. *Learning Disabilities Quarterly, 5*(3), 140-141.

Medinat, S. (2008). Analysis of gender influence on performance and techniques of Nigerian JSS students in solving simultaneous linear equation by graphic method. *International Journal of Education Management (IJEM), 5*(6), 15-20.

Meichenbaum, D. (1977). *Cognitive behaviour modification: An integrative approach*. New York: Plenum Press.

Miller, P. (1993). *Theories of development psychology* (3rd ed.). New York: W. H. Freeman and Co..

Montague, M. (1998). Mathematics instruction in diverse classrooms. In K. R. Harris, S. Graham, & D. Deshler (Eds.), *Teaching every child, every day: Learning in diverse schools and classrooms*. Cambridge, M. A.: Brook Line Books.

Morison, S. (2008). *Self-directed language learning*. ERIC Clearing House on Languages and Linguistics.

Nicol, D. J. (2006). *Research on learning and higher education teaching* (UCOSAD, briefing paper 45). Sheffield: Universities and Colleges Staff Development Agency.

Norman, C. A., & Zigmond, N. (1980). Students with learning disabilities at primary, intermediate and secondary grade levels: Identification and characteristics. *Learning Disability Quarterly, 15*(1), 21-25.

Nwafor, O. (2007). *Educational innovation: Process and products*. Enugu: Magnet Business Enterprises.

Okeke, B. A. (2001). *Essentials of special education*. Nsukka: Afro Orb Is Pub. Co. Ltd..

Okeke, B. A. (2003). *Principles of guidance and counseling: An outline for beginners*. Enugu: Snaap Press Ltd..

Olagunju, O. S. (2001). Sex, age and performance in mathematics abacus. *Journal of Mathematical Association of Nigeria, 26*(1), 8-15.

Onu, V. C. (2008). *Counseling families with special needs children*. Nsukka: Great AP Express Pub. Ltd..

Onyeanu, U. (2001). Effect of consecration of numbers on performance in mathematics of students in secondary schools in Enugu State (Unpublished M.Ed. Project, Department of Education, University of Nigeria, Nsukka).

Palkes, H., Stewart, M., & Kahana, B. (1968). Effects of self-instruction and self-correction procedures on handwriting performance in learning disability. *Learning Disability Quarterly, 5*(1), 10-12.

Park, S. (1995). Implications of learning strategy research for designing computer-assisted instruction. *Journal of Research on Computing in Education, 41*(3), 63-65.

Paula, M., McNaughton, D., & Ruhlk. (1999). Learning disability. *Quarterly, 2*(22), 220-222.

Piaget, J. (1952). *The origin of intelligence in children*. New York: International University Press.

Piaget, J., & Inhelder, B. (1965). *The growth of logical thinking from childhood to adolescence*. New York: Basic Books.

Pintrich, P. R. (1995). *Understanding self-regulated learning*. San Francisco: Jossey-Bass.

Reed, M., & Giessler, S. (1995). Prior computer related experiences and hyper-media meta-cognition. *Computers in Human Behaviour, 11*(3-4), 581-600.

Sadler, D. (1998). Formative assessment: Revisiting the territory. *Assessment in Education, 5*(1), 77-84.

Schunk, D. (1991). Self efficacy and academic motivation. *Educational Psychologist, 26*, 207-231.

Scruggs, E., & Mastropieri, M. (1993). Special education for the twenty first century: Integrating learning strategies and thinking skills. *Journal of Learning Disabilities, 26*, 392-398.

Secada, W. G. (1992). Race, ethnicity, social class, language and achievement in mathematics. In D. Grouws (Ed.), *Handbook of research on mathematics*. New York: University Press.

Spear-Swerling, L. (2005). *Components of effective mathematics instruction*. Retrieved November, 2011, from http://www.idonline.org/article/5588

Steedly, M. M. (2009). Hanging without a rope. *American Ethnologist, 23*(1), 197-198.

Tymms, S. (2001). Secondary school students' attitudes towards mathematics. *Academic Exchange Quarterly, 10*(5), 50-54.

Umezuike, A. I. (2005). Gender and ethnic bias in multiple choice objective questions in senior secondary school certificate examinations (Unpublished M.Ed. project, Department of Education, University of Nigeria, Nsukka).

Usman, K., & Memoh, M. (2007). Using guided teaching strategy to improve students' achievement in chemistry at secondary school level in Nigeria. *Journal of the Science Teachers Association of Nigeria, 42*(1&2), 60-65.

Usman, K., & Uba, A. (2007). Improving students' achievement in further chemistry using team teaching approach. *Review of Education, 18*(1), 15-21.

Van de Walle, J. A. (1998). *Elementary and middle school mathematics: Teaching developmentally*. New York: Addison Wesley Longman.

Wallace, G., & McLoughlin, J. (1988). *Learning disabilities: Concepts and characteristics*. Ohio: Memil Pub. Co..

Wehemeyer, M. L. (2006). Self instruction skills. In *Education psychology*. Michigan.

Wehemeyer, M. L., Agran, M., & Hughes, C. (1999). Teaching self-instruction skills. In *Teaching self-determination to students with disabilities: Basic skills for successful transition* (pp. 157-183). Baltimore: Paul H. Brookes.

Weinstein, C. E., & McDonald, J. D. (1986). What does a school psychologist need to know about learning strategies? *Journal of School Psychology, 24*, 257-265.

Winne, P. (1995). Inherent details in self regulated learning. *Educational Psychologist (special issue), 30*(4), 1773-1188.

Wong, L. (1993). Pursuing an elusive goal: Moulding strategic teachers and learners. *Journal of Learning Disabilities, 26*, 354-357.

Yorke, M., & Knight, P. (2004). Self theories: Some implications for teaching and learning in higher education studies. *Higher Education, 29*(1), 25-37.

Zimmerman, B. J. (2001). *Theories of self regulated learning and academic achievement: An over view and analysis*. Lawrence Erlbaum Associates.