SHEEP AND GOAT METHOD OF TEACHING: A POTENT STRATEGY FOR IMPROVING THE LEARNING OF MATHEMATICS

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Abstract

No other subject has greater application than mathematics. It is a prime instrument for understanding and exploring our scientific, economics and social world. Today more than ever before, all fields of knowledge are dependent on mathematics for solving problems, stating theories and predicting outcomes. Although the importance of mathematics, as a subject basic to any scientific and technological development is universally acknowledged, evidences abound that it is a subject most dreaded by students at both primary and secondary levels and one in which students perform poorly. The traditional ways of teaching mathematics, which involve memorizing and reciting facts, rules, and procedures, with an emphasis on the application of well-rehearsed procedures to solve routine problems, are clearly not adequate. This paper therefore advocates for the use of sheep and goat method as a potent strategy for improving the teaching and learning of mathematics.

Introduction

This is a science age, an age when much emphasis is on scientific and technological progress, when nations are looking towards achieving self sufficiency in technological manpower. As the developed countries strive to retain their leadership in space exploration, the developing countries do not also wish to be left far behind. At a time when emphasis is on scientific and technological progress, when nations are looking towards self sufficiency in technological man power, the teaching and learning of any of the sciences and most especially mathematics cannot be taken lightly. It is almost impossible to lead a full and satisfactory life in a society devoid of mathematical culture.

It seems that there is a general consensus among educators that mathematics is an important and basic subject for progress in any country. Mathematics is recognised as the key to technology which in turn is the key to progress and development. It has been rightly described as the queen and servant of all subjects. According to Johnson and Rising (1972) in Awoniyi (1996), no other subject has greater application than mathematics. It is prime instrument for understanding and for exploring our scientific, economic and social world. Today more than ever before, all fields of knowledge are dependent on mathematics for solving problems, stating theories and predicting outcomes. It is an indispensable tool in creating new knowledge.

Although the importance of mathematics, as subject basic to any scientific and technological development is universally acknowledged, evidences abound that it is a subject most dreaded by students at both elementary and the secondary level. According to Adeniyi (1987) in Awoniyi

(2001), apart from having a dread of the subject, it is also one in which students perform poorly. A look at students' termly report sheets from schools show that mathematics is one subject in which most students perform very poorly. The poor performance of students in mathematics has been attributed to factors such as students' negative attitudes, lack of motivation in teachers for teaching the subject, poor teaching of students and physical disabilities of learning situations and so on. It is against this background that this study examined the use of sheep and goat method of teaching as a potent strategy for improving the teaching and learning of mathematics.

Importance of Mathematics

The importance of mathematics in most fields of human endeavour cannot be underestimated. Its usefulness in science and technological activities as well as commerce, economics, education and even humanities is almost at par with the importance of education as a whole. Mathematics is one of the key subjects in the primary and secondary school education system. Fajemidagba (1991) was of the opinion that the teaching of mathematics is very important to all human existence.

Technological development is highly rooted in the study of mathematics. Okebukola (1992) in Olayanju (2008) opined that mathematics is referred to as central intellectual discipline of the technological societies. Kerlinger (1985) described mathematics as the language of science. Aminu (1990) argued that mathematics is not only the language of sciences, but essential nutrient for thought, logical reasoning and progress. Mathematics librates the mind and also gives individuals an assessment of the intellectual abilities by pointing towards direction of improvement. He concluded by saying that mathematics is the basis of all sciences and technology and therefore all human endeavour. Application of mathematics cut across all areas of human knowledge.

Students who choose to ignore Mathematics, or not take it seriously in High School, forfeit many future career opportunities that they could have. They essentially turn their backs on more than half the job market. The vast majority of university degrees require Mathematics. The importance of Mathematics for potential future careers cannot be more emphasized. For example, degrees in the following areas require good knowledge of Mathematics and Statistics:

- the physical sciences (like Chemistry, Physics, Engineering),
- the life and health sciences (like Biology, Psychology, Pharmacy, Nursing, Optometry),
- the social sciences (including Anthropology, Communications, Economics, Linguistics, Education, Geography)
- the technical sciences (like Computer Science, Networking, Software development),
- Business and Commerce,
- Actuarial science (used by insurance companies)
- Medicine

According to an online source Why study Mathematics? (n.d), every area of Mathematics has its own unique applications to the different career options. For example, Algebra is very important for computer science, cryptology, networking, study of symmetry in Chemistry and Physics. Calculus (including differential equations) is used in Chemistry, Biology, Physics, Engineering,

the motion of water (hydrodynamics), rocket science, molecular structure, option price modeling in Business and Economics models, etc.

The everyday use of arithmetic and the display of information by means of graphs are an everyday commonplace. These are the elementary aspects of mathematics. Advanced mathematics is widely used, but often in an unseen and unadvertised way.

- The mathematics of error-correcting codes is applied to CD players and to computers.
- The stunning pictures of far away planets sent by Voyager II could not have had their crispness and quality without such mathematics.
- Voyager's journey to the planets could not have been calculated without the mathematics of differential equations.
- Whenever it is said that advances are made with supercomputers, there has to be a mathematical theory which instructs the computer what is to be done, so allowing it to apply its capacity for speed and accuracy.
- The development of computers was initiated in this country by mathematicians and logicians, who continue to make important contributions to the theory of computer science.
- The next generation of software requires the latest methods from what is called *category theory*, a theory of mathematical structures which has given new perspectives on the foundations of mathematics and on logic.
- The physical sciences (chemistry, physics, oceanography, astronomy) require mathematics for the development of their theories.
- In ecology, mathematics is used when studying the laws of population change.
- Statistics provides the theory and methodology for the analysis of wide varieties of data.
- Statistics is also essential in medicine, for analyzing data on the causes of illness and on the utility of new drugs. .
- Travel by aeroplane would not be possible without the mathematics of airflow and of control systems.
- Body scanners are the expression of subtle mathematics, discovered in the 19th century, which makes it possible to construct an image of the inside of an object from information on a number of single X-ray views of it. Thus mathematics is often involved in matters of life and death. (Why is mathematics Important? 2004)

Despite these wide applicability and importance of mathematics, many pupils and students are still not finding their feet in the subject, as a result of their perennial failure in the subject. In view of this, strategy such as the sheep and goat method of teaching mathematics need be put in place for improving the learning of mathematics.

Teaching of Mathematics

Mathematics educators and researchers like Ale (1989), Akpan (1987), Alele- Wiliams (1988), Georgwill (1990) and Olayanju (2008) have over the years carried out researches on factors responsible for poor performance in mathematics at primary and secondary schools. These

factors ranges from shortage of qualified mathematics teachers, poor facilities, equipment and instructional materials for effective teaching, use of traditional chalk and talk methods, large pupils to teacher ratio, teacher's self-efficacy, interest, attitude, experience and mathematics fright/phobia to mention but a few.

According to Awoniyi (1996), it is an observed fact that most school students find mathematics difficult and therefore develop apathy against the subject, but it is possible that the difficulty arises from the bewildering way teachers present and teach the subject matter of mathematics. Most people see mathematics learning as an abstract experience for only the few who belong to the group of intellectual elites and therefore the high percentage of pupils/students who exist outside this group and who will constitute the general adult population in future cannot in anyway profit by this experience in this technological age.

The traditional ways of teaching mathematics, which involve memorizing and reciting facts, rules, and procedures, with an emphasis on the application of well-rehearsed procedures to solve routine problems, are clearly not adequate. Students should be encouraged to learn mathematics and teachers should try to start their teaching from simple to complex so that students do not see it as an abstract area. Above all, teachers should realise that individual differences exist in intellectual or mental ability of the students as a result they should not ignore Bruner's assertion that it is possible to teach a child anything provided his language is employed. If teachers show interest in all students, then interest in mathematics will improve.

It is against this background that the author advocates the use of sheep and goat method as a potent tool/ strategy for improving the teaching and learning of mathematics through the paying of attention to individual differences with subsequent institution of remedial action.

Sheep and Goat

Domestic sheep (*Ovis aries*) and goats (*Capra hircus)* are small ruminants, and, as such, their general care and management are often similar. However, because they are a different genus and species, their behaviours, foraging practices, diet selections, uses, and several physiological characteristics can be different. Sheep (*Ovis aries*) have 54 chromosomes, while goats (*Capra hircus*) have 60. Sheep and goats tend to behave differently. Goats are naturally curious and independent, while sheep tend to be more distant and aloof. Sheep have a stronger flocking instinct and become very agitated if they are separated from the rest of the flock. It is easier to keep sheep inside a fence than goats.

The male goat represents strong-mindedness, singleness of purpose, and leadership rather than following. Interestingly, Scripture does not view the goat in nearly as good a light as a sheep. Perhaps this is so because people who exercise these characteristics are frequently offensive to their brethren and tend to go off in their own direction in their drive to achieve their goals. Unfortunately, a great deal of ego often accompanies leadership and initiative.

The Bible contains the good side of goat in the book of Jeremiah 50:8. This contains the curious command to those living in Babylon. "Move from the midst of Babylon, go out of the land of the Chaldeans; and be like the rams [*male goats*] before the flocks." The explanation in the book of

Proverbs 30:29-31 gives the imagery of a he-goat in its positive sense of leadership. If it is among a flock of sheep, it assumes command. Along with this is a sense of dignity, stately bearing, and undaunted courage—but also a strong inclination toward haughtiness.

Sheep are foolish and slow to learn. I do not know what sheep would score in an animal IQ, but I think they would be close to the bottom of the scale. They seem to only know how to do one thing well – eat grass (and produce more grass-eating sheep). Every shepherd will tell you countless stories about how sheep can be taught a very painful lesson, and yet fail to learn the painful lesson. A sheep may get caught in barbed wire trying to break through a fence, and the next day it will try it again, and again

Although the Intelligence Quotient (IQ) of animals have not been properly documented however, Banks and Flora (1977) reported that college students ranked the comparative intelligence of a variety of animals as follows (where 1 = lowest and 10 = highest): apes, 9.2; dogs, 7.4; cats, 6.6; horses, 5.6; cows, 3.6; sheep, 3.4; chickens, 3.4; and fish, 1.7. This seems to confirm the assertion that sheep will be close to the bottom of the scale in an animal IQ. Based on the above characteristics of Sheep and Goat, students who are low achievers in mathematics are designated as Sheep while their high achiever counterparts are Goats.

Sheep and Goat Method: A simple Experiment

This study was based on the assumption that the student (little teacher) can supplement the work of the teacher by communicating to his colleague(s) the lesson taught by the master teacher. For the study, two groups of students' low achievers (Sheep) and high achievers (Goats) in a statistics class were identified and used for the study.

Research Questions

The researcher sought answers to the following research questions:

1. What are the pre-test and post-test mean scores of the two groups (Sheep and Goats)?
2. Is there any significant difference in the pre-test and the post-test scores of the two groups?

Null Hypothesis

H_O 1: There is no significant difference in the pre-test and post-test scores of the two groups.

Methods

The sample for the study consisted of twenty students. Ten low achievers (Sheep) and ten high achievers (Goats) were identified in a statistics class taught by the researcher in year 2011 after

the administration and scoring of a pre-test. A Sheep was attached (assigned) to a Goat, and it was the responsibility of the Goat to coach the attached Sheep on concept(s) discussed in the class on any lesson day. The researcher then monitors to ensure that the assigned tasks are executed. The exercise was carried out for a period of three months after which a post-test was administered. In order to find out if there is any difference in the pre-test and post- test scores of the two groups, the t-test for the difference between two correlated means was employed. The Statistical Packages for Social Sciences (SPSS) was used for the analysis of data.

Results

The results of the students as well as the analysis of data are as shown on tables 1 and 2 below.

Table 1: Pre-test and Post-test scores of the two groups

Serial Number	Pre-test Scores		Post-test Scores	
	Low Achievers (Sheep)	High Achievers (Goats)	Low Achievers (Sheep)	High Achievers (Goats)
1	22	75	50	97
2	27	85	55	93
3	26	69	51	98
4	25	68	46	80
5	17	79	47	77
6	12	73	29	76
7	18	86	35	90
8	28	93	50	96
9	20	76	53	79
10	23	76	55	85

Tables 2a and 2b below presents the mean scores for the pre-test and the post-test for the two groups as well as the paired sample t-test analysis.

Table 2a: Mean Scores of the pre-test and post-test for the two groups

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Sheep Pre-test Scores	21.8000	10	5.07280	1.60416
	Sheep Post-test Scores	47.1000	10	8.60814	2.72213
Pair 2	Goat Pre-test Scores	78.0000	10	7.90218	2.49889
	Goat Post-test Scores	87.1000	10	8.72353	2.75862

From table 2 a above, the mean pre-test score for the Sheep (low achievers) was 21.80 while that of the post-test was 47.10, in the same vein the mean pre-test score for the Goats (high achievers)

was 78.00 while that of the post-test was 87.10. This result indicated improvement in the performances of both groups. This result is in agreement with the assertion of Farrant (1980) that students learn readily from each other by supplementing the work of the teacher and at the same time help encourage bright students to exercise their gifts as well as improve their thinking quality.

Table 2b shows the difference between the pre-test and the post-test scores of the two groups. The t-values of -13.674 and -2.991 for the pre-test and post- test scores for the Sheep (low achievers) and the Goats (high achievers) respectively were found to be significant at 0.05 level of significance an indication that there exists improvement in the performance of the two groups after the experiment. The stated null hypothesis was therefore rejected. This result suggests that allowing students to learn one from another may result in net gain in academic performance and hence the advocacy for the Sheep and Goat method of teaching

Table 2b: t-test Analysis for the difference between the pre-test and the post-test scores

Paired Samples Test

		Paired Differences					t	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Sheep Pre-test Scores - Sheep Post-test Scores	-2.53000E1	5.85093	1.85023	-29.48550	-21.11450	-13.674	9	.000
Pair 2	Goat Pre-test Scores - Goat Post test Scores	-9.10000	9.62000	3.04211	-15.98174	-2.21826	-2.991	9	.015

Conclusion

It was evident from the study that there exist significant differences in the academic performance of the two groups under study after the experiment. It is noteworthy that the performance of the Sheep (low achievers) improved tremendously after their attachment to the Goats (high achievers). The coaches received from their high achiever counterparts might have contributed to their improved scores. It was therefore recommended that if teachers of mathematics could supplement their traditional way of teaching mathematical concepts with sheep and goat method, this could serve as a potent strategy for improving the teaching and learning of mathematics in schools. The success of this method however depends on teachers having the interest of each student at heart as is implied by the profession. It was further recommended that a follow up study be carried out to determine the extent to which this method contributes to improved performance of students by taking other moderator variables into consideration.

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