EXAMINING AND CLEARING SOME ALGEBRA MISCONCEPTIONS AMONG SECONDARY SCHOOL STUDENTS: A CASE STUDY OF OBAZU GIRLS' SECONDARY SCHOOL, MBIERI, IMO STATE

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Abstract

Holding misconceptions about key problem features affects students' ability to solve Algebraic equations correctly and to learn correct procedures for problem solution. This in turn affects their performance in mathematics and other subjects, especially the sciences. This study examined algebra-related misconceptions and errors among SS2 students in Obazu Girls Secondary Shool, Mbieri, Imo State and explores a means of clearing these misconceptions 30 SS2 students from the school took part in the study. The study involved a pre test and a post test. When the pre test was administered to all 30 students, 80% of the students failed one question or the other as a result of misconceptions. When the misconceptions were cleared and the post test administered, there was significant improvement in the performance of the students. The paper recommended that mathematics teachers in secondary schools should be more vigilant in the process of teaching in order to discover the areas of misconceptions in Algebra on time and promptly clear them to avoid poor performance both in mathematics and in other science subjects.

Key words: Misconceptions, Algebra, strategy, procedure.

Students in secondary and even tertiary institutions often have difficulty with algebra because of misconceptions in various areas. When these are corrected, the students seem to grasp the concepts more clearly thereby improving their performances both in Algebra and in other subjects/courses. Misconceptions about problem features likely influence both the number of related errors they make and their ability to construct a correct strategy that takes into account all of the important features in the problem.

Use of incorrect procedures is common when learning Algebra (Lerch, 2004), and by nature, this behaviour inhibits accurate solution of problems. One reason why use of these incorrect strategies may persist is that many of the procedures that students attempt to use are ones that will lead to a successful solution for some problem situations. Unfortunately, without adequate knowledge of the problem features, students are unable to distinguish between the situations in which the strategy will work and the ones where it is not applicable. Having good conceptual knowledge may thus be necessary for students to solve equations correctly, as deep strategy construction relies on inclusion of sufficient information about the problem features that make them appropriate or inappropriate. Unfortunately, for students with incorrect or incomplete conceptual knowledge about problem features, shallow strategies, such as the one described above, will likely prevail. Thus, students who do not have sufficient knowledge of problem features will likely only be capable of making shallow, surface analogies. If this activity leads to any learning at all, it can only be that of shallow procedures, which may be useful in some problem situations, but are not generally applicable.

Background of the Study

Currently, algebra proficiency is the mathematics gatekeeper for success in high school, postsecondary, and many career paths (Capraro & Joffrion, 2006).Previous research has proposed that student misconceptions or gaps in conceptual knowledge of Algebra lead to use of incorrect, buggy procedures for solving problems (Anderson, 1989 & Van Lehn & Jones, 1993). Booth & Kenneth (2007) observed that at various points in the learning process, misconceptions or gaps in conceptual knowledge of relevant features inhibit students' performance and learning, but getting this crucial knowledge, is key to closing some of the gaps. Their results suggest that providing students with these conceptual prerequisites should be an important goal for Algebra courses, and perhaps the mathematics courses that lead up to it.

The learning and teaching of algebraic equations, both writing and solving, can be challenging because of the multiple interpretations, representations, and methods for solving. Due to this complexity, it is not surprising that students have misconceptions and make many different types of errors when formulating and solving equations. Ashlock (2006) suggested that students make errors when solving equations because they incorrectly combine (or not combine) like terms, they perform the inverse operations incorrectly, and they do not correctly use the distributive property.

Conception in this context refers to students' beliefs, theories, meanings and understandings, while a misconception is a mistaken idea resulting from a misunderstanding of something. When those conceptions are in conflict with the accepted meanings in mathematics, then a misconception has occurred. The paper examined ways of correcting some mistaken ideas in Algebra in order to improve students' performances both in Algebra and other subjects/courses.

In order to "understand students' algebraic reasoning and development, educators need to pay attention to classroom interactions and student preconceptions, about mathematics and learning ... "(Nathan & Koellner, 2007, 180). Skemp (1976/2006) discussed the differences between relational understanding (knowing how to do something and why) and instrumental understanding (knowing rules without reasons). Skemp (1976/2006, 95) opined that relational mathematics was more advantageous because it was adaptable to new tasks, easier to remember over time, an effective goal in and of itself, and its relational schemas foster mathematical growth.

Ashlock (2006) defined conceptual mathematics understanding as the understanding of both ideas and the ability to make generalizations connecting mathematics ideas. He defined procedural knowledge as the step-by-step skills and procedures to do mathematics. He believed misconceptions often occur because students over generalize or over specialize, of which both are related to conceptual understanding."Students need a balance of conceptual (comprehension) and procedural (vocabulary) skills as they begin to develop algebraic understanding" (Capraro & Joffrion, 2006). A benefit of having conceptual knowledge is the ability to apply existing knowledge to new and altered situations. Additionally, in order for students to be successful in algebra, they need to understand concepts and be able to perform necessary procedures (Capraro & Joffrion, 2006). Hiebert and Grouws (2007) and Skemp (1976/2006, 95) argued that the key to students gaining conceptual knowledge, instead of just knowing the procedures needed to "get the answer", is to focus and place a priority on the meaning of mathematical ideas and linking these ideas to other contexts in mathematics. Teachers wishing to improve student achievement in their classrooms should therefore seek ways to explicitly target the meaning of important ideas in algebra and the connections between these ideas. (Rakes, Valentine, McGatha, & Ronau,2010, 388).

MacGregor and Stacey (1997) suggested that the root of the misconceptions and errors often lie in teachers' instructional styles and the materials they select. To counteract the misconceptions of algebra notation and symbolism, teachers should look for misunderstandings and address them immediately. Teachers must use algebra notation often and integrate it into other mathematics topics in a precise and practical way (Stacey & MacGregor, 1997).

On the other hand, some students may have superficial knowledge of solving equations but can make no connections and establish no meaning to the equations which they are solving (as also found in Capraro & Joffrion, 2006; Kalchman & Koedinger, 2005). Ashlock (2006) suggested that students make errors when solving equations because they incorrectly combined (or not combine) like terms, they performed the inverse operations incorrectly, and they did not correctly use the distributive property.

Assumptions

The main assumption for this study was that the student responses analyzed in this study accurately reflect students' true knowledge and skill level for each problem.

Purpose of the study

The purpose of the study was to find out the existence of misconceptions in Algebra among secondary school students and how such misconceptions affected their performance in mathematics.

Research Questions

The study is guided by the following research questions:

1. Do misconceptions exist in Algebra among secondary school students?
2. How do these misconceptions in Algebra affect the performance of the students in Mathematics?

Population for the study

The population for the study consists of all 120 SS2 students of Obazu Girls' Secondary School Mbieri, Imo State.

Sample and Sampling Techniques

The sample consists of a total of thirty SS2 students of Obazu Girls' Secondary School Mbieri, who were randomly selected to participate in the study. 10 students were randomly selected from each of the three arms of SS2 class, i.e, SS2A, SS2B & SS2C

Methodology

10 experimenter-designed multiple choice items on Algebra were administered to the students in a pretest in order to identify whether or not misconceptions existed as regarding the procedures used in solving those problems. The validity of the instruments was established through experts' judgment and modifications. Participants were well spread out in the hall to avoid copying from one another. The participants were put through a process of clearing the misconceptions at the end of which a posttest was administered.

The method involved was to identify the point of misconception and clearing the misconception by assigning specific values to the variables involved and checking out the ones which yielded the correct result, and also by proving it algebraically. Participants were able to recognize where they made use of wrong strategies. Consequently, applying the correct strategy yielded the correct result in each case.

Data Analysis and Discussion of Findings

The table below shows the scores of thirty (30) students in the pretest and the percentage of the sample that scored each mark.

Table 1: Results of pre-test

Scores	**No of students**	**Percentage**
1	6	20
2	15	50
3	4	13.33
4	3	10
5	2	6.67
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
Total	30	100

Table 1 shows that 20% of the students scored 1 mark,, 50% scored 2 marks, 13.33% scored 3marks, 10% scored 4marks, 6.67% scored 5marks while none of the participants scored above 5 marks. The table also shows that the mean and modal marks are 2.33 and 2 respectively. These are definitely not pass marks out of 10.

At the end of the post test 100% of the participants got all questions right. All thirty students that constitute the sample took part in both the pre test and the post test. The results of the post test clearly indicate that students performed poorly in algebra tests not necessarily because of lack of knowledge but majorly because of misconceptions.

Misconceptions exist in Algebra among secondary school students, as shown from the results of the pre test and post test. These misconceptions negatively affect the performance of secondary school students in Algebra.

Conclusions

Algebra is a language used to express mathematical relationships. Students' therefore, need to understand how algebra can be used to concisely express and analyze those relationships. The aim of the study was to ascertain if misconceptions existed in Algebra among senior secondary school students and also to explore how these misconceptions in Algebra affected their performance in the subject. The study revealed that there exist many misconceptions in algebra among senior secondary school students which eventually lead to their poor performance in mathematics.

Algebra is so significant as a part of mathematics that its foundations must be built firmly and solidly from secondary school. The onus rests on teachers to employ the use of the right techniques to ensure that these misconceptions are cleared early enough..All students' can learn well if instructions are systematically approached. In addition, assessment items should not just be routine exercises but should also include tasks to be investigated to avoid boredom and indifference.

Recommendations

Based on the findings of the study, the paper recommends the following:

(i) Mathematics teachers should design learning experiences for students 'in such a way as to avoid drudgery, boredom and frustration.

(ii) Teaching of topics in algebra should involve more of learning by doing by the students' with the teacher as en expert guide,

(iii) Mistakes and errors made by the students' should be corrected. Correction to these must be checked and marked accordingly.

(iv) Students' should be exposed to the four freedoms of the mathematics classroom, ie.freedom to make mistakes, to ask questions, to think for one-self and to choose methods of solution.

(v) Ideas and statements that were introduced in lower levels must be consolidated and elaborated upon at higher levels along with their applications to a new range of problems, in order to ensure continuity.

This paper is of the view that the learning difficulties in solving algebraic problems in secondary schools can be reduced to the barest minimum if most or all of the above enumerated recommendations are taken into consideration.

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