

ABSTRACT

The investigation presented here is aimed at developing a battery of diagnostic tests that are used to identify specific weak skills or areas of difficulties in computation and problem solving based on the set of whole numbers. Through these tests an authentic basis for remediation is provided. Information processing errors are identified and probed. In particular systematic errors and to a lesser extent, careless errors are diagnosed.

There are five (5) principal questions to which answers are given. These are

1. Have the students mastered number facts pre-requisites?
2. Are computational errors mainly related to algorithms, regrouping and zero?
3. What aspects of place value knowledge and skill have the students not mastered?
4. What are the main areas of difficulties in problem solving?
5. In what ways , if any, do the teachers contribute to the errors of the student?

The subjects in the study were a class of 12 and 13 year old grade 7 students who could read fluently but were described by their teachers as requiring remediation in mathematics. These subjects were enrolled in a New Secondary school.

The general strategy employed in the investigation involved (i) event sampling of behaviour in mathematics classes (ii) designing and administering a battery of diagnostic tests, all criterion-referenced and related to explicitly stated instructional objectives, (iii) interviewing the students and through probing, evaluating their

responses on the tests, (iv) designing and administering a teacher questionnaire which seeks to tap information on the teachers and the curriculum. The batteries were designated as follows:-

M1 - Addition and Subtraction Facts

M2 - Multiplication and Division Facts

M3 - Addition and Subtraction Computation

M4 - Multiplication and Division Computation

M5 - Place Value and Algorithms M6 - Problem-Solving.

The methods of analysis included the listing of error type and calculation of error frequency and percentage contribution to total errors. Also there was a setting of mastery levels of between 66% and 83% against which students' performances on the objectives were assessed. Certain other quantitative measures including correlation coefficient measures were applied where appropriate. A qualitative analysis of the teacher questionnaire data was done.

The main findings from the investigation were;

- (1) The students have not mastered number facts pre-requisites in multiplication and division. Number bonds involving the factor '7' pose particular difficulty. There was an incorrect response rate of 100% to ' 0×7 ', ' 7×7 ', ' 8×7 ', ' $42 + 7$ ' and ' $63 + 7$ '.
- (2) Computational errors are predominantly systematic and are mainly related to algorithmic procedures, regrouping and zero. There was a positive rank correlation (i) $p = 0.2$ and (ii) $p = 0.35$ between (a) frequency of errors and (b) number of students

making the error over the error categories in division and multiplication respectively.

'Algorithmic Procedures' is the most dominant error category. In division this category contributed 34.8% of total error.

(3) There exists a subtraction error dubbed (by the investigator) 'the diagonal subtraction bug.' This bug occurs generally where the number of digits in the minuend exceed the number in the subtrahend by at least 1 and where the left most digit of the minuend is greater in primary value than the leftmost digit of the subtrahend. This error accounted for 37% of algorithmic procedure errors in subtraction.

(4) The students do not solve problems because they cannot translate data expressed in English words into quantitative mathematical data and symbolism, and also because they are weak on computational skills. The facility rate in problem solving based on correct selection of data and operation as well as on correct computation was a low 16%.

(5) There is a comprehensive lack of knowledge of and skill in place value. The incorrect response rate on some facets of the place value concept was as high as 72%.

(6) The teachers have not mastered some fundamental mathematical concepts and they tend to over-estimate the students facility on mathematical tasks. As a result of the two factors it is deduced that the teachers contribute to the students' non-mastery of mathematical concepts and computational skills.

The findings in the investigation are supportive of others on error diagnosis and analysis. They should prove instructive and helpful to teachers undertaking remediative tasks and intervention programmes in whole number arithmetic.

Institutions engaged in providing both pre-service and in-service training in mathematics education for teachers in the upper primary and lower secondary grades could well find that the findings have implications for the training programmes in the institutions.

It may be advanced that the procedures used in the study provide a powerful paradigm for error diagnosis and analysis on whole number operations and problem solving.