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Problems in Learning Mathematics: Comparison of Coral High School Students in Classes with and without Repeaters

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Abstract: ***This study considers the results of two tests and contrasts the difference in performance between two lower secondary school classes in Coral High School, Kilifi County, Kenya. It illustrates a difference in qualitative thinking between the two groups of students.The study compared the mathematical problems encountered by Coral high school students (kilifi county), in Form 1 (with no repeaters) and Form 2 (with many repeaters) of lower secondary school. Participants consisted of 67 Form 1s and 46 Form 2s. Results from Test I and Test II indicated that the students had wide ranging difficulties in learning mathematics under the The new 2-6-3-3-3 curriculum that has replaced the 32-year-old 8-4-4 system. Form 1 females significantly outperformed their male counterparts on both tests. A significant gender difference in performance among the Form 2s was obtained only on the Test II in favor of males. Overall, Form 1s significantly performed better than the Form 2s on both tests. Scores from Form 1s on the two tests correlated negatively and insignificantly whereas scores of Form 2s on the same instruments had a positive and significant relationship. Scores of the Form 1s and Form 2s on both tests were negatively related. Performance differences and error analyses of selected challenging items are discussed to inform and guide possible remedial interventions. Findings demonstrated that mere repetition of a class was neither therapeutic nor advantageous unless factors that disable learning were identified and addressed.***

Keywords: Mathematical problems, Learning difficulties, Error analysis, Remedial interventions

1. Introduction

Mathematics is the one of the most important subjects in our human life. Mathematics has been globally accepted as an important component of formal education from the ancient period to the present day. Mathematics is the body of knowledge in the area of science and technology. The subject mathematics is beautiful and interesting because of its owns symbols, language, terms, etc. In the world, each society has their own mathematical language, terms, symbols, counting system like Chinese, American, Japanese, Greek, Arabian etc. It is purported that students learn mathematics well only when they construct their own mathematical understanding and that this understanding requires them to examine, represent, transform, solve, apply, prove, and communicate. However, most of students perceive mathematics as a difficult subject and majority of students fail in the subject. Educationists as well as the nation of Kenya are facing the challenges with the problems of failure in Kenya Certificate of Primary Education (K.C.P.E) and Kenya certificate of secondary Education (K.C.S.E) examination in mathematics. This paper is an attempt to investigate the causes of difficulties in learning mathematics.

Coral High School Mtwapa, Kilifi county, Kenya has adopted the new 2-6-3-3-3 structure of education. According to the new system (2-6-3-3-3), primary education will be split into two categories, which is Pre-primary and Primary education, taking two and six years respectively.

Students will then advance to Junior Secondary School a stage that would take them three years before joining the Senior Secondary level.

At the senior level, they would spend another three years focusing on their areas of specialization depending on their abilities and interests. For instance, if one prefers Science subjects of the Arts, at this stage is when he/she has the privilege to choose.

After the senior secondary stage, students would go ahead to either enroll at vocational training centres or pursue university education.

The 2-6-3-3-3 model places emphasis on formative years of learning where learners will spend a total of eight years - 2 in pre-primary and six in primary.

Subjects to be taught in lower primary are Kiswahili, English, literacy, and mother tongue as well as science, social studies and agricultural activities.

Upper primary will include Kiswahili, English, Mathematics, Home Science, Agriculture, Science and Technology, Creative Arts (art, craft and music), Moral and Life Skills and Physical and Health Education.

Others are social studies (citizenship, geography and history) with an option of a foreign language (French, German, Chinese and Arabic).

Junior Secondary (grades 7, 8 and 9) and Senior Secondary Education (grades 10,11 and 12) will each take three years.

This model comprised 7 years of primary education, 4 years of lower secondary, 2 years of upper secondary (form 5-6) and 3 years for a university course.

Mathematics is a quantitative subject that fosters the development of cognitive abilities such as thinking (Shaffer, 2002). Reasoning skills are important for success in mathematics and other subjects students study in schools. Mathematics, particularly, is a base for all scientific and technological studies. Additionally, mathematics has high relevance and practical applications to many real-life situations and problems. It is therefore a key and compulsory subject in many school systems. In Coral Mtwapa primary and secondary schools, mathematics is a core subject. Important as it may be, the study of mathematics has however unfortunately been not easy for many students. Like elsewhere in the world, students in Coral schools have a wide range of problems with mathematics. Mathematics is one of the school subjects in which many students often perform poorly. Wong, Omar, and Mak (2004) noted a variety of mathematics problems that young students in Coral preschools have. For students in Coral primary and secondary schools the problems have been observed to be due to lack of proper understanding of mathematical language and misinterpretation of mathematical concepts (Anit & Suffolk, 2001; Chin & Clements, 2001; Vaiyatvutjamai & Clements, 2004). Students' problems in learning mathematics may increase with implementation the new curriculum where Learners will be evaluated through Continuous Assessment Tests (CATs) on the skills acquired as opposed to cramming for exams as has been the case.

Though designed to improve access to education for all (EFA) and raise the quality of education, these reforms are likely to pose problems to both teaching and learning. For example the instructors' methods of teaching and assessing mathematics in schools may also need to be reformed. In addition, the teaching and evaluation of integrated mathematical skills to students with learning difficulties in inclusive schools under the present 2:6:3:3:3 curriculum reforms might be quite challenging. To be successful, these curriculum changes might require

i) A reform of the school assessments (internal and external examinations) to force instructors to teach the new contents and skills.
ii) To identify additional problems students have in learning mathematics that early intervention strategies need to focus on and address
iii) To seek solutions to the identified problems since not all students' problems in mathematics can be prevented.

Based along these lines of argument Coral teachers have emphasized the importance of using suitable methods to teach mathematics to students especially the slow learners (Ahmad, 2001; Veloo & Diah, 2004). It is further believed that some instructional techniques might improve students' attitudes towards mathematics (Rajagopal & Bakar, 2004). Furthermore it appears there is also a need to address the many and varied concerns of mathematics teachers in the country . Unless teachers' professional development training needs are addressed sufficiently, students' problems in learning mathematics are likely to persist. Previous research from elsewhere showed that regular school teachers were, in general, opposed to having disabled learners in their classrooms (Jones et al., 1978; Jamieson, 1984; Knof, 1985; Myles & Simpson, 1989). However one recent study (Mark, Mohidin, Koay, & Mundia, 2008) found that primary school teachers were positive to the idea of including LD mathematics students in their classrooms and were also willing to assist them.

1.1 Causes of problems in learning mathematics

Biological and environmental

1) Learning difficulty (LD) is one of the categories of disabilities.
2) Emotional disorders (ED),
3) Emotional and behavioral disorders (EBD) and
4) Those at-risk (AR) of developing dysfunctional behaviors.

LD is the largest disability and category of special and inclusive education (Geary, 1999) followed by EBD. Previous research indicates that the incidence of LD has been on the increase since 1976 (Garnett, 1998). Both LD and EBD have a wide range of subtypes . The source of causes for LD may be the environment (e.g. unsatisfactory and harmful teaching, poor and inadequate learning resources, depressed interest or complete lack of interest in learning, deficiencies in intrinsic and extrinsic motivation, unsupportive and un-conducive home environment, high anxiety, attrition or poor school attendance, and so on). The students may have low self efficacy and selective attention difficulties (Gross Tsur, Manor, & Shalev, 1996). Sometimes the causes are biological (e.g. damage to the brain through injury, toxins, disease, or interference by cancerous tumors and blood clots which might impair various executive functions such as memory, cognition, language, vision, hearing, and motor ability. The many manifestations of LD can, however, be put into two main groups relating either to literacy (dyslexia) or numeracy (dyscalculia). The two conditions have linguistic connections such that students with dyslexia who have difficulty with mathematics are sometimes misdiagnosed as having dyscalculia because of the inability to use alphanumeric symbols and retain them in memory (Wright, 1996; Bull & Johnson, 1997; Geary, 2001).

Individuals display a mathematics learning disability (LD) when their performance on standardized calculation tests or on numerical reasoning tasks is significantly depressed and comparatively low, given their age, education and intellectual reasoning ability (Heward, 1996; Kaufman & Lichtenberger, 1999; Sattler, 2001; Munro, 2003). However standardized assessments need to be supplemented by continuous educational assessments (Somerset, 1987; Taylor, 2003) as well as informal or authentic assessments to continuously monitor and confirm the learner's progress (Engelbrecht et al., 1993). The discrepantly low performance due to cerebral trauma is called acquired dyscalculia (AD) while mathematical learning difficulties with similar features but without evidence of cerebral aberration are referred to as developmental dyscalculia,

DD (Kosc, 1974; Hughes, Kolstad & Briggs, 1994; Munro, 2003). Developmental abnormalities in both cerebral hemispheres can lead to many AD complications (O'Hare, Brown & Aitken, 1991). According to Munro (2003) the right hemispheric dysfunction leads to difficulties in understanding the properties of quantities, spatial learning problems (for example, understanding and using place value) and using arithmetic knowledge to solve real life problems while the left hemispheric dysfunction leads to difficulty in comprehending the abstract meanings of numbers, sequencing numerically and mathematics operations. DD is the broadest category of dyscalculia.

1.2 Suspected causes of poor math achievement in Coral school

Studying (in all subjects) after school is as important as classroom teaching and learning. Previous research indicates that students who don't study efficiently do not usually perform well on tests of academic achievement (Putwain, 2009; Sander, 2009; Sanders, Sander, & Mercer, 2009). Despite lack of research on students' study strategies in Coral schools, the need to diagnose students' study skills is apparent from a variety of informal sources. For instance, the mushrooming of private schools in the country to help weak students provides indirect evidence that some students might not be performing optimally. Advertisements for examination coaching services by private instructors regularly appear from time to time. This too, suggests that some students are not achieving the desired results in popular and key subjects such as English, Kiswahili, science, and mathematics. Also the increasing number of repeaters in various grades seems to imply that some students may not be functioning adequately. In a troubling trend, performance in Mathematics and sciences in the Kenya Certificate of Secondary Education (KSCE) examination has been declining for the last few years, a *Nation Newsplex* review of national examination data reveals. (see table below)

Table 1: Candidates' Performance in Mathematics Alt B for the years 2013-2017

Year	Paper	Candidature	Maximum Score	Mean Score	Standard Deviation
2013	1	1104	100	9.89	12.98
	2		100	7.44	9.94
	Overall		**200**	17.29	21.96
2014	1	1293	100	13.71	12.68
	2		100	11.16.	13.28
	Overall		**200**	24.76	24.71
2015	1	1387	100	9.35	11.76
	2		100	7.26	12.53
	Overall		**200**	16.58	22.72
2016	1	1611	100	9.37	11.28
	2		100	8.02	10.60
	Overall		**200**	17.18	20.67
2017	1	1486	100	7.07	8.58
	2		100	13.39	13.56
	Overall		**200**	20.20	20.26

A baseline study by the Centre for Mathematics, Science and Technology Education in Africa (Cemastea), a government agency, shows that teachers routinely advise students they consider weak not to take up science courses, when they should be encouraging them instead.

Furthermore Ministry of Education recently reported a drop or decline in annual statistical trend in the number of "A" grades at "O Level" examinations in various school subjects which may be due to many causal factors including problems in teaching, learning and studying. For example only 1% of KCSE candidates scored an A or A-grade in 2016

Source: Kenya National Examination Council

One of the school subjects in which Coral students perform poorly in national examinations is mathematics. The use of unsatisfactory and harmful study strategies is one of the many suspected causes of this low achievement in mathematics. The implementation of the ongoing 2:6:3:3:3 curriculum reforms by the Ministry of Education are partly intended to introduce new ways of teaching, learning and studying to help the students to achieve higher .Experts are of the view that it will enable learners to develop beyond academics and also focus on how best they can use their specific talents to make a living. To be successful, the curriculum reforms might need to be supplemented or complemented with the reform of school assessments particularly the national examinations to force instructors in schools to teach the new contents and skills. The new skills to be taught under 2:6:3:3: should preferably include effective study strategies to assist students to improve their understanding, mastery, internalization, and retention of the learned knowledge and skills. There is no research done on the learning styles of Coral students in mathematics.

1.3 Remediation of math learning difficulties

Students with special needs, like normal peers, ought to learn mathematics painlessly without much anxiety, stress, and tension in their minds. To achieve this, teachers must first demystify the subjects by the way they approach them. They need to use teaching methods that are capable of creating and maintaining students' interest and intrinsic motivation in the subjects. In terms of teaching, the use of language that is suitable to the level of the learners is highly recommended (Kalisk, 1979). Teaching methods should also involve students to learn things practically through activities or manipulations done preferably collaboratively (Dodd, 1992). In some cases, team teaching is necessary if a regular teacher needs help from a specialist. More training in special education is highly desirable to increase the teacher's knowledge, skills and confidence in handling disabled students. To reduce anxiety and fear of failing, teaching methods should emphasize mastery and competence in acquisition of knowledge and skills (Martinez, 1987). As far as possible, all students should be given an opportunity to experience success. The literature on instructional strategies in special education is abundant (for example see Thornton et al. 1983; Walker, 1996). It is, however, important to remember that each teaching technique has its own strengths and weaknesses and there are several other factors that need to be taken into consideration for teaching to be effective with special needs students.

Characteristics of Students with learning difficulties in Mathematics

Students who struggle with mathematics learning regardless of their motivation, past instruction, and mathematical knowledge prior to starting school:

- Demonstrate slow or inaccurate recall of basic arithmetic facts;
- Answer problems impulsively, without inhibition;
- Have difficulty representing mathematical concepts mentally;
- Have poorly developed number sense; and
- Have difficulty keeping information in their working memory.

1.4 Objectives of the Study

Given the many problems students have in learning mathematics in Coral schools, the purpose of the present study was to address the following research problems using the TEST I and Test II to:

1) Determine gender differences in performance on the two tests.
2) Determine differences in performance by educational level.
3) Assess the relationship in performance on the two tests by class and test.
4) Identify the most challenging items for Form 1 students on the two tests.
5) Identify the most problematic items for Form 2 students on the two tests.
6) Describe the common errors made by all the research participants on selected items of the two mathematics tests.

2. Method

The study used the survey research method in probing the aims of the investigation. The rationale for using this approach in this study was based on three main reasons. First, the study was merely exploratory and intended to find out the performance of junior secondary school students on the selected items for the two standardized tests. Second, to administer the survey instruments to as many students as possible in the selected classes as participants in the study. Third, the overall goal of the research was to identify students' problems in doing mathematics that could be a basis for further diagnostic and intervention studies.

2.1 Sample

Two classes were selected for participation in the study. All the students in the selected classes constituted the sample for the study. This way the study involved a total of 70 Form 1 students (45 males and 25 females) and 48 Form 2 students (10 males and 38 females). The students in the two Form 1 and two Form 2 classes at each school were administered the same two mathematics tests . The total number of Form 1 students who wrote the two tests at the school fluctuated during the two instrument administrations (67 on TEST I with 45 males and 22 females; and 76 on TEST II comprising 51 males and 25 females). The total number of Form 2 students who took the two tests was the same (46) but this constant number differed on gender composition during the two instrument administrations (8 males versus 38 females on TEST I and 10 males plus 36 females during Test II). The pooled sample of Form 1 and Form 2 students ranged in age from 14 to 18 with a mean of 16.9 and a standard deviation of 4.2. In general the Form 1s were younger (Mean = 15.7) than the Form 2s (Mean = 17.1). The differences in the number of students taking the tests were due to the unexplained absence from school of some students on the days the instruments were administered.

In addition to the two tests described above, the study included a qualitative dimension. During administration of the two tests, the researcher carefully observed informally how the students interacted with peers, the instructor, and learning materials in mathematics lessons. These were double lessons lasting 80 minutes each (40 minutes per lesson). The researcher noted down instances of peculiar behavior that occurred and compared the behaviors across the classes that participated in the study.

2.2 Instruments

The study used two test instruments and an informal observation to obtain the required data. Each of the two tests had two sections. Part A had only three demographical items that requested participants to indicate their gender, age and class. The second section (Part B) of each instrument asked the respondents to solve mathematical problems in the space provided for each item. The first test that was administered consisted of 35 questions adopted from the K.C.P.E examination. The second test administered comprised of items adopted from Form I text book. Test II had 34 questions that required mathematical skills and background knowledge acquired in lower secondary.

TEST I had the highest alpha reliability with Form 2 students (.704) while its reliability with the Form 1s was .678. The reliability of TEST II with the Form 2s was adequate (.686) but inadequate with the Form 1s (.180). The validity of the items on the two tests (TEST I and TEST II) for use in this study was judged and determined by three Coral teachers (one male and two females) who were both highly qualified (B.Ed. and B.Sc. mathematics majors) and experienced (9-13 years) in teaching mathematics at the lower high school level (Form 1 and Form 2). The teachers were requested to compare / match the contents of the two tests and the contents of the mathematics curriculum or syllabus for Form 1 and Form 2 students. Their content analysis and ratings indicated that the two tests covered most of the math content taught in Coral high schools and the therefore the test instruments had adequate content validity for purposes of using them in this study. Both TEST I and TEST II were used for the first time in Coral High School Mtwapa.

2.3 Procedure

Before commencing the research, permission to conduct the study was formally obtained from relevant school authority. In addition, research participants were verbally briefed by the researcher (via their teachers) on the ethical requirements and rules for their involvement in the study. This was done prior to administering each of the two tests. The discussion centered on the issues of voluntary participation, privacy, anonymity, confidentiality, protection from both physical and psychological harm, and informed consent. The tests were administered by their teachers in the students' usual mathematics classroom environments to maximize ecological validity and reduce possible cautious and defensive responding. Observations during tests administrations showed that respondents needed about one hour to complete each test.

2.4 Data analysis

The random data were analyzed by descriptive and inferential statistical procedures. The descriptive statistics included frequencies, percentages, mean, and standard deviation. Pearson's correlation and the T-test for independent groups were the inferential techniques employed in data analysis. The test item statistics used included the computation of item facility values and item discrimination indices. The calculation errors made by students on selected test items were analyzed qualitatively by literally describing them per item.

3. Results

The findings of the study are presented below per the objectives of the research outlined above.

3.1 Findings from the informal observations

The researcher noted many qualitative differences in the way Form1 and Form 2 students behaved during mathematics lessons. According to mathematics teachers' answers to the researchers' probes on observations, most of the repeaters were males. The repeaters tended to have behavioral problems from the way they conducted themselves in class. Three of these repeaters probably had moderate to severe attention deficit hyperactive disorder (ADHD). Two of these three problematic students were included in the same class and this made it difficult for teachers to pay adequate individual attention on them. The three students with conduct disorders were restless, frequently moved around the class, and occasionally went outside the class to the toilet for long periods of time. Most of the students identified as noisy, playful, and naughty in Form 2 were repeaters. One of them looked over-aged in the class. Overall the repeaters did not appear to have adequate interest and motivation to learn. For example most of them did not do their homework assigned to them a day or more before the class for no good reasons and did not participate actively in class by for example answering oral questions directed to them. They had limited interactions with the teacher and peers during lessons. Most of them sat near or at the back of the class to escape the teachers' immediate attention. In general these students lacked concentration and seemed to have poor attitudes to schooling. Some of them did not benefit from group work during class because of focusing on inappropriate behaviors. In comparison, students in Form 1 classes did not show most of these negative behaviors.

3.2 Gender differences in performance on the tests

Form 1 females scored significantly higher than their male counterparts on both TEST Iand TEST II as observed in Table 2 (which addresses the first two objectives of the study) but this trend was reversed among the Form 2s. However Form 2 males only scored significantly higher than females on the Test II.

Table 2: Differences in Performance by Class, type of Test and Gender

Class	Test	Gender	n	M	SD	t	df	P (2-tailed)
Form 1	TEST I	M	49	30.1	4.3	-2.7	69	.027*
		F	27	26.9	3.3			
Form 1	TEST II	M	56	28.3	2.1	-2.5	74	.019*
		F	29	29.1	1.8			
Form 2	TEST I	M	13	25.6	1.9	1.9	47	0.076
		F	44	24.7	3.6			
Form 2	TEST II	M	17	26.9	2.7	3.1	48	.006**
		F	45	24.2	2.9			

* $p < .05$, ** $p < .01$

3.3 Relationship in performance by class and tests

Form 1 students' scores from TEST I and Test II correlated negatively and insignificantly (Table 3). On the contrary it can be observed from the same table that Form 2 students' scores from the same tests had a positive and statistically significant association. Form 1 and Form 2 students' scores from TEST I and Test IIs were related negatively and insignificantly. The inverse relationships are presented in Table 3. Both correlations were based on 48 paired observations only (the size of the Form 2 subsample that was smaller than the Form 1 sub-sample).

Table 3: Relationship in Performance by Class and Test

Classes	Tests	n	Pearson r
Form 1	TEST IVs. TEST II	70	-0.094
Form 2	TEST IVs. TEST II	48	.451**
Form 1 Vs. Form 2	TEST I	48	-0.275
Form 1 Vs. Form 2	TEST II	48	-0.456

** $p < .01$

3.4 The most challenging items for Form 1 students

Form 1 students experienced fewer problems on test items than the Form 2s. Table 4 shows only items whose facility and discrimination values were both below the .60 level. These were difficult items that perhaps measured mathematics knowledge and skills beyond those assessed by all other items. An alternative explanation or reason for this finding might be that teaching did not possibly cover these items adequately. Four items met this criteria on TEST I(three on Test II) with regard to the Form 1s. Apart from Item 26 (on TEST I) the rest tended to be the last few items on both tests. The nature of each item is described in Table 5.

Table 4: The most Challenging Items for Form 1 Students

Test	Item	Item description	Facility [proportion correct]	Discrimination (corrected item total r)
Test I	26	Dividing two proper fractions	.19	.26
	33	Adding two equations by elimination	.03	.28
	34	Computing a percentage	.36	.36
	35	Converting a decimal to a fraction in its lowest terms	.49	.29
Test II	32	Solving a simple linear equation with one unknown	.13	.02
	33	Solving simultaneous equations by elimination	.27	.27
	34	Calculating ratios	.19	.19

3.5 The most problematic items for Form 2 students

Form 2 students had more problems with items on both tests than the Form 1s. Seven (7) items on TEST I (9 on TEST II) had facility and discrimination indices that were both below .50 as shown in Table 2. These items were in the third and fourth quartiles of the two tests. The type of each item is explained in Table 5.

Table 5: The most Problematic Items for Form 2 Students+

Test	Item	Item description	Facility [proportion correct]	Discrimination (corrected item total r)
Test I	17	Dividing two proper fractions with regrouping	.18	.06
	20	Dividing a number of three digits by a number of two digits	.40	.29
	22	Subtracting a mixed number from one whole number	.12	.31
	25	Adding two equations by elimination	.00	.00
	26	Computing a percentage	.03	.02
	27	Converting a decimal to a fraction in its lowest terms	.07	.26
Test II	16	Adding a proper fraction with an improper fraction	.29	.29
	17	Multiplying a 2-digit decimal number by a 1 digit decimal	.11	.07
	20	Solving a simple equation to find the unknown	.14	.11
	22	Dividing two proper fractions with different denominators	.34	.26
	25	Solving a simple linear equation	.18	.28
	26	Dividing a mixed number by another mixed number	.07	.18
	27	Solving a simple equation to find the unknown	.00	.00
	28	Adding two simultaneous equations by elimination	.12	.29
	29	Calculating ratios	.26	.23

3.6 Common errors made by all students on the tests

The common errors made by Form 1 and Form 2 students on selected items from the two tests were content analyzed. Content descriptions of the errors are presented per test and per item in Table 6. Diagnostic interviews based on these error analyses were not performed. The error descriptions were determined by going through the students' written / worked answers or solutions to mathematics test items.

Table 6: Error Analyses of Common Mistakes made by all Research Participants on Selected Items

Test	Item	Problems encountered/experienced
Test I	17	Carelessness by regarding ÷ as + sign. Inverting the wrong fraction before solving
	20	Inability to convert whole numbers into improper fractions with same denominator
	22	Unable to change mixed numbers to improper fractions with same denominators. Failure to get common denominator using the LCM. Adding either numbers or denominators only
	25	Division and multiplication errors. Need to use calculators properly for speed and accuracy.
	26	Lack of understanding and skill in using multiplication by 10, 100, and 1000 to move the decimal point to the right by 1, 2 and 3 places respectively to convert a decimal into a whole number into a fraction (as second step)
Test II	17	Place value problems. Omitting or disregarding the decimal point on the final answer
	20	solving simple algebraic equations by transferring known terms to one side
	22	Don't know how to solve the equation [e.g. 3+2(9) = ?]. First added and multiplied. Inability to do BODMAS, BEDMAS and PEDMAS
	25	Failure to invert second fraction when converting division to multiplication
	26	None use of multiplication to eliminate one of the two terms. Failure to add the remaining terms and quantities to simplify the equation
	27	Unawareness that ratio (:) means divide (÷). Calculation errors

4. Discussion

Both genders and groups of students (Form 1s and Form 2s) had problems with mathematics in this study (see Tables 2-5). In addition, both genders and groups also made a number of common errors on selected items (Table 3). The findings from this case study appear to have educational implications for both the local and international community using informal observations, TEST I, and TEST II as screening tools to identify students' problems in mathematics. The main implications are presented and discussed below under two relevant themes.

4.1 Practical implications drawn from informal observations

Although students in both grades performed reasonably well on the two tests, two observations can be made from Table 2. First, Form 1s scored much higher on both tests than Form 2s. This might be partly due to the fact that the Form 2 group consisted of many over-aged and mathematically weak students who were repeating the class. Most of these repeaters were observed to have challenging behaviors. Due to lack of adequate counseling or psychotherapy resources in schools, the repeaters' behavioral problems persisted and continued affecting their school performance or achievement adversely. The three most difficult students needed to be seated in front and middle of the class for teachers to keep an eye on them or sit near the door so that their frequent movement to go outside does not interrupt the whole class. Preferably only one difficult student was supposed to be integrated in each class with a high student-teacher ratio for teachers to easily control and manage the classroom behaviors effectively. Literature on previous research has shown that regular teachers were less interested in students with behavioral and mental health problems (Williams & Algozzine, 1979; Vandivier & Vandivier, 1981). Because of their familiarity with learning materials, repeaters could easily be bored and frustrated in class if the instructors' teaching methods and learning materials were not varied, interesting, and stimulating. The need to diversify teaching strategies and learning resources was more apparent now in Coral with the implementation of the new curriculum. As pointed out above by Hunt and Goetz (1997) the involvement of parents in the control and tutoring of students with special needs (such as the repeaters and problem students in this study) was considered as an essential aspect of the overall intervention plan to help students with math learning difficulties.

4.2 Teaching implications gleaned from students' performance on tests

An inspection of the mean scores in Table 2 indicated that the two tests were almost equivalent in difficulty and that the mean scores for Form 2s were depressed by the repeaters' low scores. Though fewer in number, Form 1 females had better mathematical skills than their male counterparts. The girls' high confidence and self-esteem in coeducation classes and in previously male-regarded subjects needs to be encouraged and supported by both teachers and parents to break gender stereotypes.

Form 1s performed better on TEST I than on TEST II but the difference was small and the negative correlation was low and insignificant (Table 3). This was because TEST II had more difficult items towards the end than TEST I. In addition, some of the problems were relatively new to Form 1s than to Form 2s This might also be interpreted to mean that the two tests were not a duplicate of each other and that they required slightly different mathematical skills. On the other hand, Form 2 students who scored high on TEST I also scored high on TEST II and vice versa, resulting in a low but significant positive correlation (see Table 3). Overall, the correlations presented in Table 5indicated that the Form 1s had better or stronger mathematical skills than the Form 2s, some of whom were repeaters. This finding suggests that mere repetition of a class or grade was neither therapeutic nor advantageous unless the root causes of poor performance in a student were identified and addressed through counseling and remedial teaching to break the vicious circle of repeated failure.

Tables 4 and 5 show the items that had low facility values (difficult indicators) and low discrimination indices (construct validity coefficients) on the two tests (TEST Iand TEST II). These are the items that are not properly understood by Form 1 and Form 2 students in Coral (and perhaps in other counties as well) and to which remedial teaching efforts should be directed. In general, Form 2s had more difficulties with mathematics than the Form 1s. The Form 2s and males in this study needed more intervention in mathematics (both psychological and educational) than the Form 1s and females. However, some of the deficiencies in mathematical skills were common to both genders and groups of students (see Table 6). The difficult items identified through error analyses in this study could be administered again to similar students and then use observational, think aloud, and diagnostic interview techniques to gain additional insights into the nature and extent of the students' difficulties in mathematics (to determine why, how, when, and where the errors occur). Group remedial sessions or classes could then be conducted separately for Form 1 and Form 2 students who need assistance. Group therapy would be preferable in this instance for two principal reasons. First, the large number of students who might need assistance in each group may warrant mass interventions. Second, the procedure would enable students with special needs to share and experience mathematical problems as a group with a view to teach them the strategies of learning from each other. However, individual counseling and intervention would also be necessary for a few students with high support needs in mathematics and who might not benefit from group sessions. The nature of the errors listed in Table 6 suggest that the students largely operated at a concrete level. To be beneficial, remedial teaching should emphasize the use of task analysis strategies and visual aids or other tangible materials to facilitate the students' cognitive manipulations during hands-on-experience sessions (Martinez, 1987; Heward, 1996; Hunt & Goetz, 1997).

The students' performance on the tests also suggested that Coral teachers need further training in teaching mathematics. It is hoped that the new curriculum will address teachers' needs and concerns for further training so thay they can help students to acquire effective study strategies. Recent research on examination performance has repeatedly indicated that students who use poor study strategies do not perform well on examinations (Putwain, 2009; Sanders et al., 2009; Sander, 2009). Teachers will also need further training on the use of informal assessments to complement or supplement formal evaluations (Engelbrecht et al., 1993).

5. Conclusion

The study addressed six research objectives and identified items on the TEST I and Test IIs that were most challenging or problematic to the respondents in Coral high schools.

1) More emphasis and attention need to be directed to these types of items during diagnostic and remedial teaching to prevent the onset of problems in mathematics students.
2) The error analyses conducted on selected difficult items were illuminative and insightful about the kinds of interventions (both psychological and educational) that need to be carried out with lower secondary school students individually and in groups.
3) According to the findings, schools need to have adequate counseling and psychotherapy resources to help students with personal and academic problems such as high support needs in mathematics.

Many currently serving Coral teachers may need various forms of in-service training to update and upgrade their subject knowledge and teaching skills to the level demanded by the new, 2:6:3:3:3 curriculum.

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