

# Problems in Learning Mathematics: Comparison of Brunei Junior High School Students in Classes with and without Repeaters

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## Abstract

The study compared the mathematical problems encountered by Brunei students in first year (Form 1 with no repeaters) and second year (Form 2 with many repeaters) of lower secondary school. Participants consisted of 67 Form 1s and 46 Form 2s. Results from the Wide Range Achievement Test and the Woodcock-Johnson Psycho-Educational Battery indicated that the students had wide ranging difficulties in learning mathematics under the ongoing inclusive education and SPN21 curriculum reforms. 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 Woodcock-Johnson test 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 or grade was neither therapeutic nor advantageous unless factors that disable learning were identified and addressed.

**Keywords:** Mathematics, Learning difficulties, Assessment, Errors, Remediation

## 1. Introduction

Brunei Darussalam has adopted a 7:3:2:2 structure of education (Ministry of Education, 2004a). The first seven years consist of one year in a preschool and six years in a primary school. Preschools are usually annexed or attached to primary schools. Young children enter preschools at the age of five. The next three years after primary school constitute lower secondary school (equivalent to junior high school in other countries). Form 1 and Form 2 are equivalent to first and second year respectively in junior high school. These are followed by 2 years of senior secondary or high school leading to GCE "O" Level or IGCSE. Students spend a further two years in high school doing advanced pre-university studies (GCE "A" Level). Each phase (level or cycle) of education (except preschool) terminates with a national or public examination. Students who perform poorly in an academic year or grade are permitted to repeat the year or grade to ensure that nobody is left behind and that everyone progresses from one year / grade to another as well as from one level of education to the next (Ministry of Education, 2004b). The education statistics sometimes indicate the number of repeaters (Ministry of Education, 2004c). Mathematics is taught from preschool to the last two years of the school system.

Mathematics is a quantitative subject that fosters the development of cognitive abilities such as thinking (Shaffer, 2001). 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 Brunei Darussalam 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 Brunei 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 Brunei preschools have. For students in Brunei 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 of national education reforms such as inclusive education, in 1998 (Ministry of Education, 1997), the National Education System for the 21st Century known as SPN21 curriculum (Ministry of Education, 2007), and introduction of the education programme for gifted / talented students (Ministry of Education, 2008). 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 inclusive 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 SPN21 curriculum reforms might be quite challenging. To be successful, these curriculum changes might require a reform

of the school assessments (internal and external examinations) to force instructors to teach the new contents and skills. The development of the mathematics screening tests for lower and upper primary school students in Brunei (Yusop, Douglas, & Mak, 2001) has helped to identify additional problems students have in learning mathematics that early intervention strategies need to focus on and address. However mere identification of problems is, in itself, not enough. An equally important goal is to seek solutions to the identified problems since not all students' problems in mathematics can be prevented. Brunei studies based along this line of argument 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 (Yoong., Khalid., & Fung, 2001). 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; Knoff, 1985; Myles & Simpson, 1989). However one recent study (Mark, Mohidin, Koay, & Mundia, 2008) found that Brunei 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 Biological and environmental causes of problems in learning mathematics*

Learning difficulty (LD) is one of the four non traditional categories of disabilities. The others are emotional disorders (ED), emotional and behavioral disorders (EBD), and 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 caused by a variety of factors. 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 Brunei schools*

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 Brunei institutions of learning, the need to diagnose students' study skills is apparent from a variety of informal sources. For instance, the mushrooming of tutorial 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 in Brunei's two main English newspapers (The Borneo Bulletin and The Borneo Times). This too, suggests that some students are not achieving the desired results in popular and key subjects such as English, science, and mathematics. Also the increasing number of repeaters in various school grades seems to imply that some students may not be functioning adequately. In addition the setting up of the Special Education Unit (SEU) by the Ministry of Education (1997; 1998) to assist, among others, the learning disabled (LD) students appears to suggest that there are many students in the education system that might benefit from diagnosis and counseling in study skills. Furthermore the Department

of Examinations in the Ministry of Education recently reported a drop or decline in the annual statistical trend in the number of high or good grades at "Ordinary" and "Advanced" Level examinations in various school subjects including mathematics which may be due to many causal factors (Mohd, 2007). Furthermore the Department of Examinations in the 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. One of the school subjects in which Brunei students perform poorly in national or public 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 SPN21 curriculum reforms by the Ministry of Education (2008) and current changes in teacher education policy at the Sultan Hassanal Bolkiah Institute of Education (SHBIE) at the University of Brunei Darussalam (2009) are partly intended to introduce new ways of teaching, learning and studying to help the students to achieve higher but this may not be enough. To be successful, the curriculum reforms might need to be supplemented or complemented with the reform of school assessments particularly the public or national examinations to force instructors in schools to teach the new contents and skills. The new skills to be taught under SPN21 and the new MTeach teacher education programs at UBD 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 also no research done on the learning styles of Brunei 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). Pro-social teaching and learning methods are desired to increase interaction and minimize isolation (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.

### *1.4 Objectives of the study*

Given the many problems students have in learning mathematics in Brunei schools, the purpose of the present study was to address the following research problems using the WRAT3 and WJPEB tests:

- (1) Determine gender differences in performance on two math tests.
- (2) Determine differences in performance on two math tests by educational level.
- (3) Assess the relationship in performance on the two math tests by class and test.
- (4) Identify the most challenging items for Form 1 students on the two math 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 schools and classes (out of many in the whole country) 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 schools were selected randomly for participation in the study. At each of these selected schools two Form 1 (1st year in junior high school) classes and two Form 2 (2nd year in junior high school) classes were chosen randomly for purposes of the study. All the students in the selected classes constituted the sample for the study. In this way the study involved a total of 76 Form 1 students (51 males and 25 females) and 46 Form 2 students (10 males and 36 females). The students in the two Form 1 and two Form 2 classes at each school were administered the same two mathematics tests (WRAT3

and WJPEB). The total number of Form 1 students who wrote the two tests at the two schools fluctuated during the two instrument administrations (67 on WRAT3 with 45 males and 22 females; and 76 on WJPEB comprising 51 males and 25 females). The total number of Form 2 students who took the two tests at the two schools was the same (46) but this constant number differed on gender composition during the two instrument administrations (8 males versus 38 females on WRAT3 test and 10 males plus 36 females during WJPEB test). The pooled sample of Form 1 and Form 2 students ranged in age from 11 to 15 with a mean of 13.9 and a standard deviation of 4.2. In general the Form 1s were younger (Mean = 12.7) than the Form 2s (Mean = 14.1). 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 one hour each (30 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 items adopted from the Blue Arithmetic version of Wilkinson's (1993) Wide Range Achievement Test, Third revised edition (WRAT3). This test is now in its fourth edition which the researcher did not have access to. However the main change in WRAT4 is only the inclusion of a new measure of sentence comprehension. The Blue Arithmetic test in WRAT3 has 40 items but only the first 35 items (Items 1-35) were administered to the sample. The last 5 items (Items 36-40) were excluded as the researcher considered them to be too difficult, inappropriate, and beyond the comprehension and ability levels of the young early adolescent students. The second test administered comprised of items adopted from the calculation subtest of the Woodcock and Johnson Psycho-Educational Battery, WJPEB (Part Two: Tests of Achievement, Woodcock & Johnson, 1977). The WJPEB test has 42 items arranged in age and grade appropriateness (suitable for administering to people from early childhood to adulthood stages). Again not all items were administered to participants in this study but only the first 34 items (Items 1-34). The researcher left out the remaining 8 items (Items 35-42) because they required very advanced mathematical skills and background knowledge which lower secondary school students in Brunei did not have.

WRAT3 had the highest alpha reliability with Form 2 students (.704) while its reliability with the Form 1s was .678. The reliability of WJPEB with the Form 2s was adequate (.686) but inadequate with the Form 1s (.180). The validity of the items on the two tests (WRAT3 and WJPEB) for use in this study was judged and determined by three Bruneian teachers (one male and two females) who were both highly qualified (BEd and BSc Ed mathematics majors) and experienced (9-13 years) in teaching mathematics at the junior 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 analyses and ratings indicated that the two tests covered most of the math contents taught in Brunei junior high schools and therefore the test instruments had adequate content validity for purposes of using them in this study. Both WRAT3 and WJPEB were used for the first time in Brunei Darussalam.

## 2.3 Procedure

Before commencing the research, permission to conduct the study was formally obtained from relevant school authorities as *loco parentis* (on behalf or in lieu of parents). In addition, research participants were verbally briefed by the researcher (via the research assistants) on the ethical requirements and rules for their involvement in the study. This was done prior to administering each of the two instruments. 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 research assistants in the students' usual math classroom environments to maximize ecological validity and reduce possible cautious and defensive responding. Since the two instruments were restricted psychological tests, participants were not allowed to possess a copy of each. For these same reasons the item contents were not revealed in this study. Both actions were taken to protect the validity and commercial value of the instruments. Observations during instrument administrations showed that respondents needed about one hour to complete each test. The study fully met the ethical requirements of the University of Brunei Darussalam (UBD) and the Helsinki Declaration on the use of human participants in research. In view of this the researcher was allowed and funded by UBD and the government of Brunei to present the findings of the study at the 2nd Pacific-Rim Education Conference held at Illinois State University, USA, in October 2008.

## 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 Form 1 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 WRAT3 and WJPEB as observed in Table 1 (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 WJPEB test.

< Insert Table 1 Here >

#### 3.3 Relationship in performance by class and tests

Form 1 students' scores from WRAT3 and WJPEB tests correlated negatively and insignificantly (Table 2). 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 WRAT3 and WJPEB tests were related negatively and insignificantly. The inverse relationships are presented in Table 2. Both correlations were based on 46 paired observations only (the size of the Form 2 subsample that was smaller than the Form 1 sub-sample).

< Insert Table 2 Here >

#### 3.4 The most challenging items for Form 1 students

Form 1 students experienced fewer problems on test items than the Form 2s. Table 3 shows only items whose facility and discrimination values were both below the .50 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 WRAT3 (three on WJPEB test) with regard to the Form 1s. Apart from Item 26 (on WRAT3) the rest tended to be the last few items on both tests. The nature of each item is described in Table 3.

< Insert Table 3 Here >

#### 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 WRAT3 (9 on WJPEB) had facility and discrimination indices that were both below .50 as shown in Table 4. These items were in the third and fourth quartiles of the two tests. The type of each item is explained in Table 4.

< Insert Table 4 Here >

#### 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 5. 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.

< Insert Table 5 Here >

#### 4. Discussion

Both genders and groups of students (Form 1s and Form 2s) had problems with mathematics in this study (see Tables 1- 4). In addition, both genders and groups also made a number of common errors on selected items (Table 5). The findings from this case study appear to have educational implications for both the local and international community using informal observations, WRAT3, and WJPEB 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 a close look at Table 1. 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. They also needed to be seated near a buddy who they could model as an example of a well behaved student. 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 Brunei with the implementation of the ongoing educational reforms discussed earlier (see Ministry of Education, 1997; 1998; 2007; 2008). 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 1 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 WRAT3 than on WJPEB but the difference was small and the negative correlation was low and insignificant (Table 2). This was because WJPEB had more difficult items towards the end than WRAT3. 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 WRAT3 also scored high on WJPEB and vice versa, resulting in a low but significant positive correlation (see Table 2). Overall, the correlations presented in Table 2 indicated 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 3 and 4 shows the items that had low facility values (difficult indicators) and low discrimination indices (construct validity coefficients) on the two tests (WRAT3 and WJPEB). These are the items that are not properly understood by Form 1 and Form 2 students in Brunei (and perhaps in other countries 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 5). 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 5 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 Brunei teachers (both pre-service and in-service) need further training in teaching mathematics. It is hoped that the ongoing changes in Brunei teacher education policy and programs at the University of Brunei Darussalam (2009) will address teachers' needs and concerns for further training. Among the key skills that the new teacher education programs should emphasize is training teachers the ways 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). Informal assessments such as portfolios and problem-based assessment (PBA) are essential in evaluating learners with special needs.

## 5. Conclusion

The study addressed six research objectives and identified items on the WRAT3 and WJPEB tests that were most challenging or problematic to the respondents in Brunei junior high schools. 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. 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. 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 Brunei teachers who are ineligible to take the MTeach course may need various forms of in-service training to update and upgrade their subject knowledge and teaching skills to the level demanded by the ongoing educational reforms (such as inclusive education, SPN21 curriculum, and education for the gifted). The present study could be replicated using both quantitative and qualitative measures as well as a large, random, national, and representative sample to gain results that can be generalized. In addition the next study should add a qualitative diagnostic interview component to probe how and why students commit the identified errors.

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Table 1. Differences in Performance by Class, type of Test and Gender

Class	Test	Gender	n	M	SD	t	df	P (2-tailed)
Form 1+	WRAT3	M	45	27.3	3.1	-2.3	65	.024*
		F	22	29.1	2.9			
Form 1	WJPEB	M	51	28.4	1.6	-2.4	74	.017*
		F	25	29.4	1.7			
Form 2+	WRAT3	M	8	23.6	1.5	1.7	44	.086
		F	38	21.3	3.7			
Form 2	WJPEB	M	10	25.6	2.7	2.9	44	.005**
		F	36	22.5	2.9			

+ Form 1 = 1st year in junior high school; Form 2 = 2nd year in junior high school

\*  $p < .05$

\*\*  $p < .01$

Table 2. Relationship in Performance by Class and Test

Classes	Tests	n	Pearson r
Form 1+	WRAT3 Vs. WJPEB	67	-.075
Form 2+	WRAT3 Vs. WJPEB	46	.422**
Form 1 Vs. Form 2	WRAT3	46	-.151
Form 1 Vs. Form 2	WJPEB	46	-.237

+ Form 1 = 1st year in junior high school; Form 2 = 2nd year in junior high school

\*\*  $p < .01$

Table 3. The most Challenging Items for Form 1 Students+

Test	Item	Item description	Facility (proportion correct)	Discrimination (corrected item-total r)
WRAT3	26	Dividing two proper fractions with different denominators.	.17	.24
	33	Adding two equations by elimination.	.02	.25
	34	Computing a percentage.	.32	.34
	35	Converting a decimal to a fraction in lowest terms.	.44	.28
WJPEB	32	Solving a simple equation to find the unknown.	.11	.01
	33	Adding two simultaneous equations by elimination.	.22	.26
	34	Calculating ratios.	.12	.18

+ Form 1 = 1st year in junior high school

Table 4. The most Problematic Items for Form 2 Students+

Test	Item	Item description	Facility (proportion correct)	Discrimination (corrected item-total r)
WRAT3	26	Dividing two proper fractions with regrouping.	.17	.05
	29	Dividing a number of three digits by a number of two digits.	.30	.34
	31	Subtracting a mixed number from one whole number.	.11	.35
	32	Subtracting one mixed number from another mixed number.	.11	.35
	33	Adding two equations by elimination.	.00	.00
	34	Computing a percentage.	.02	.01
	35	Converting a decimal to a fraction in lowest terms.	.06	.23
WJPEB	25	Adding a proper fraction with an improper fraction.	.34	.27
	27	Multiplying a 2-digit decimal number by a 1-digit decimal	.10	.08
	28	Solving a simple equation to find the unknown.	.13	.10
	29	Dividing two proper fractions with different denominators.	.32	.25
	30	Solving a simple linear equation.	.17	.29
	31	Dividing a mixed number by another mixed number.	.06	.19
	32	Solving a simple equation to find the unknown.	.00	.00
	33	Adding two simultaneous equations by elimination.	.11	.34
	34	Calculating ratios.	.23	.21

+ Form 2 = 2nd year in junior high school

Table 5. Error Analyses of Common Mistakes made by all Research Participants on Selected Items

Test	Item	Problems encountered / experienced
WRAT3	26	Carelessness by regarding + as + sign. Inverting the wrong fraction before solving.
	31	Inability to convert whole numbers into improper fractions with same denominator.
	32	Unable to change mixed numbers to improper fractions with same denominator. Failure to get common denominator using the LCM. Adding either numerators or denominators only.
	33	Not aware of using multiplication to eliminate one of the two unknown variables. No idea of how to add and simplify the solution. Use of guessing or trial and error method.
	34	Division and multiplication errors. Need to use calculators properly for speed and accuracy.
	35	Lack of understanding and skill in using multiplication by 10, 100 and 1,000 to move the decimal point to the right by 1, 2 and 3 places respectively to convert a decimal into a whole number (as first step). Unaware to use the multiplicand as a denominator to change the whole number into a fraction (as second step).
WJPEB	27	Place value problems. Omitting or disregarding the decimal point on the final answer.
	28	Memory lapses. Forgot how to solve simple algebraic equation by transferring known terms to one side.
	29	Don't know how to solve the equation [e.g. $3 + 2(9) = ?$ ]. First added and then multiplied. Inability to do BODMAS, BEDMAS and PEDMAS.
	30	Failure to invert second fraction when converting division to multiplication.
	33	None use of multiplication to eliminate one of the two unknown terms. Failure to add the remaining terms and quantities to simplify the equation.
	34	Unawareness that ratio (:) means divide (+). Calculation errors.