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CAN WE IDENTIFY THE REASONS FOR A PUPIL'S LOW ATTAINMENT IN MATHEMATICS? ¹

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Abstract: Teachers attending an in-service course on underachievers in mathematics were assigned a school-based project, "Adopt-a-Child" case study. They had to decide whom they considered to be low attainers in mathematics. They had to observe and interview the child in school to draw up a profile identifying the reasons for the child's underachievement. Interviews with parents were also conducted. Teachers had to carry out remediation strategies to help these pupils overcome their difficulties. The teachers from different schools in Singapore selected thirteen primary six pupils and six primary two pupils for the case studies. The main objective of this project is to find the dominant reasons for the primary six pupils' difficulties in learning mathematics through the years of their education and to detect any trend of underachievement from the primary two case studies. The results of the case studies can be used to enhance in-service teacher training programme. The insightful information obtained could help teachers develop more effective approaches within school and classroom. Besides pupils' background, some of the dominant causes of low attainment could be due to the mathematics curricula, standardised assessment and teaching methods.

Introduction

Teaching students who do not do well in mathematics is the most demanding aspect of teaching the subject. At the same time, mathematics education from primary school onwards is moving towards more problem solving and higher order thinking skills that require a good foundation in basic mathematical concepts. It is a common notion that of all the subjects taught at school, mathematics provokes the strongest emotions of dislikes, anxiety and low self-concept in those students who do not seem to achieve some level of success in it. Mathematics is an important subject in the school curriculum and is compulsory up to secondary four in the Singapore education system. At the primary level, it is one of three subjects that pupils must master in order to progress through national examinations for promotion to the next level. It is the goal of education that every individual regardless of his or her status and origin should be given equal opportunity for education up to the highest level. As the nation moves towards a knowledge-based economy (KBE) where human capital is the source of growth, the potential of every member of the society must be realised. To prevent wastages, the learning of mathematics from young should not pose as an obstacle to a child's progress in school. It is undeniable that knowledge of mathematics at least up to secondary level is essential for students' educational advancement and unrestricted choice in job opportunities in the future.

It is not expected that everyone can or should become a mathematician, but mathematics will be necessary in most people's daily lives. In an education system like Singapore where teacher in a primary school may have to teach a large class of about 40 pupils of various abilities, slow achievers could well easily slip through the system until Primary Four or Primary Six. At these stages they sit for the national examinations and are then tracked according to their performance, normally to the lower-ability stream where contents and teaching pace will be adjusted accordingly.

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By then, it could be too late for these low attaining children to catch up with the lost years. This is also compounded by existing practices that teachers do not normally follow their pupils through the years. It is common for a child to go through six different teachers or more; by the time he or she leaves primary school. In view of such constraints in the school system, the strategy of "Adopt-a-Child" case study reported in this paper can be used for teachers to focus on particular children at risk in their classes, with the objective of designing a more responsive education to the needs of these children. This paper is based on case studies of low attaining pupils done by their class teachers who attempted to profile characteristics of low-attainers. In this respect they are personal views and do not claim to have all the answers as to the reasons for why some children are not successful in learning the subject.

Low-attainers in mathematics: Who are they?

Teachers and parents often felt exasperated when pupils just don't "catch on" to mathematics, where they systematically fails in the subject. They often wonder why is it that most pupils in the same class and taught by the same teacher are able to learn mathematics while some others are finding so much difficulty. Krutetskii (1977) firmly believed that completely incapable students in mathematics do not exist for normal healthy children. He stressed that when we talked about "slow learners", "low attainers" or "underachievers" in mathematics, we cannot discuss it to be an absence of any ability, but must be the lack of development of this ability. He cautioned against hasty conclusion about the incapacity of children in mathematics on the basis of the fact that they are not successful in this subject. He conceded that it is with the help of the teacher that the reasons for students' lack of success be clarified.

Research to find possible causes of poor performance in mathematics have led to identification of categories of children been labeled with terms such as "slow learners", "low attainers", "and underachievers". Denvir, Stolz and Brown (1982) prefer to use the term "low-attainer" to describe the observable poor performance of the pupil, without implying a cause. They are concerned primarily with those pupils outside special schools who fall, for whatever reason, into the bottom 20 per cent of mathematical attainment in their age group in national assessment. Haylock (1991) would include these pupils in his category of "underachievers", sharing Krutetskii's optimism that they have the potential, given the right encouragement and appropriate curriculum, actually to achieve very much more than they are achieving at present. The label "slow learners" used to be an "in" word with very few people admitting to understanding what it means. This label seems to imply a pupil in an ordinary class, who is slower to learn than his peers because of some learning disabilities, whatever that may mean.

For the purpose of discussion in this paper, the term "low-attainers" and "underachievers" in mathematics will be used interchangeably to describe pupils in the primary schools who consistently failed in the subject. Their teachers through individual case studies hope to locate possible causes of their poor performance.

The Method: "Adopt-a-Child" case studies

Teachers attending an in-service course on underachievers in mathematics were assigned a school-based project, "Adopt-a-Child" case study. They had to decide whom they considered to be low-attainers in mathematics. They had to observe and interview the child in class to draw up a profile identifying the reasons for the child's underachievement. Interviews with parents were also conducted. The teachers had to carry out remediation strategies to help the low-attainers overcome their difficulties. The main objective of this project is to find the dominant reasons for the pupils'

difficulties in learning mathematics through the years of their education and to detect any trend of underachievement from the early years.

The teachers in this study selected primary school pupils who have failed frequently in mathematics based on results of the children's past years' continual assessments, semestral examinations and class tests. At the same time they selected them because they believed these children are underachievers. As they defined it "underachievers" are children with average or above average ability who are performing lower than that expected of their potential. The assignment for the teachers was for each of them to identify one pupil to study. In all, fourteen Primary Six (P6), four Primary Four (P4) and six Primary Two (P2) pupils were adopted.

It is a common situation in Singapore primary schools where teachers have to teach classes of between 30 – 40 children with a range of abilities. Teachers experience great difficulty in finding the time to focus on the low attaining pupils who normally need more individual attention from the teacher. Much of the time teachers would consider the problem of low attainment merely in terms of intellectual deficiencies using diagnostic tests to find out what errors and misconceptions the pupils have in learning the topics that are being taught. Very often the low-attainers display so much gaps in their learning that teachers do not know where to begin to help them. In most schools, the teachers do not follow their pupils as they move on to the next level. So many a times, the teachers felt that they inherited the problem of low-attainers from the teachers before them. There is insufficient time for teachers to fully know the cognitive and affective aspects of their pupils even though they may have them for one year. There is often a lack of teacher's time to reflect on underachievers' learning problems and plan suitable work for them especially when there are several of them with different levels of non-understanding, in addition to teaching the majority of the average pupils in the class.

In this "Adopt-a-Child" assignment, the teachers need only to focus on one child at a time over a period of about ten weeks. Locating the reasons of low attainment will increase the teacher's awareness of the pupil's difficulties. Base on these findings, the teacher would have to plan and implement approaches and content suitable for remediation with the child. To carry out this assignment, the teachers followed these procedures:

- Identify an "underachiever" in mathematics in his or her class;
- Access relevant information about the child [from school records such as report books or profiles; medical records; register for attendance; any correspondence with parents];
- Observe the pupil, talking with him or her and noting behaviour;
- Carry out diagnostic testing,
- If necessary, talk to parents or guardians

Descriptions of some primary underachievers in mathematics

Summaries of descriptions of seven underachievers from the 24 case studies by teachers are provided here to illustrate the variety of underachieving pupils with a diversity of characteristics:

Jacqueline-P2: from a middle-income family. Both parents away working in Thailand and she gets to see them only during her holidays. Live with grandparents and aunts with two younger brothers. Apathetic and listless in class. Attention span is short and easily distracted. Shows little interest in activities unless they are hands-on, enjoys going to the computer lab. Less emotionally stable and becomes easily upset. Weak in languages; scored 42 marks for her first math test and 41 marks for her recent one. Weak in addition and subtraction with renaming, no concept of place-value and

regrouping in tens. For word problems she worked on the numbers before she understood the problem. Attends remedial classes for all three subjects and stays back after school on Mondays to Thursday. Wakes up at 5 a.m. and leaves the house at 6 a.m to catch the school bus. When asked to write a short essay about herself, this is what she wrote:

About Me

“ I like to eat becake. I am 7 years olds. I like to read fairy tal soriy Book. I like to draw frog. I must stay bBack form Moday to Thursday. And Friday. Monday I stay Back for computer lap. Thurday I satay Back for Math. Wendersday I sttay Back for chinese. Thursday I stay Back for Engling. Went I go home I will do home work. Sometimes I sleep on me book.”

Betty-P2: mixes well and cooperates well in-group activities; helps the girl who sits next to her (a Learning Support pupil). Proficient in English, active participant during English lessons; but extremely quiet during Maths lessons. Has difficulty in subtraction sums involving zeros and those that require renaming twice. Tends to make copying errors and computation mistakes; at times may forget to do her Maths Homework. Can be creative forming patterns with manipulatives and give correct answer to the task. Does not feel at ease in a maths class; complained of headaches and stomachaches; most of the time does not understand what her friends are discussing in class; revealed that she cannot count and think at the same time if the problem sums contain big numbers. Spend more than an hour doing maths at home; has private tuition once a week; mother is a teacher and coaches her in maths; piles child with after school assignments from assessment books; scolds her if she does not know her work.

Jalyne-P4: both parents are teachers. Has a pair of three-year old twin sisters and six-year old brother. “*Mummy is forever so busy....*” Much of the time left in the care of Filipino maid who left her much alone, having to take care of the other children. Mother is aware of child's underachievement but leaves it to the private tutor to deal with the problem. The tutor always makes Jalyn do many sets of test papers of other schools, as well as all sorts of assessment papers. Mother is afraid to interfere and offend the tutor. Jalyne can internalise one-quarter of what is taught in class. Short attention span and short memory. With guidance can do simple mechanical sums like multiplication and division but has problem with story sums. The answers that she wrote in her daily work and test papers were always so extreme, something that did not even appear in the question. For example to add two fractions, her answer can be as big as a 3-digit whole number! Managed to pass her Chinese and English but failed badly in mathematics with only 23 marks. She does not enjoy anybody's companionship, likes to be alone in a corner. Very unpopular with her classmates, shouted at a classmate who tried to help her pack, scolded the girl for messing up her things. Cried very often whenever she felt hungry. On days when she was not well, she wept bitterly and had to rush to the telephone booth to call her mother. She enjoys computer work and is extremely alert when the class goes to the lab.

Nell-P4: quiet and passive; likes to watch her friends playing; always tired and sleepy; her eyes start to tear when she is asked to answer a question in class; takes pride in her work; able to absorb ideas if she is given one-to-one coaching. Failed maths since P2; has a fear of mathematics and does not spend much time on it; all right with straightforward calculations but not problem sums and model drawing. Proficient in mother tongue, Malay. Absent from school at least once a week; lack home support with schoolwork.

Muhd Faizal-P6: rather talkative and attention seeking from teacher; helpful and willing to share; co-operate with team mates in project work; is capable of being a leader; enjoys talking to teacher and tries his best to please his teachers; speaks reasonably well and able to follow instructions but

not able to read well as he cannot recognise words. Never passed his English and Mathematics SA papers since Primary One. Was emotionally disturbed when parents divorced, lost interest in school and played truant. He is now more stable and attentive in class. When he passed his Maths CA1 paper recently he was full of joy.

Ernie-P6: average intelligence; enjoys outdoor activities: netball, rollerblading, swimming & cycling. Academic results showed a gradual decline from P3 onwards; failing maths all the way to P6, while achieving marginal passes in English & Science; dislikes maths; fearful of fractions and problem sums; likes English because easy to understand. Parents divorced; no home supervision; spent much of her time playing around her neighbourhood or watching TV. Is asthmatic, used to absent once a fortnightly.

Vigneswaran-P6: an average pupil in most subjects except maths; speaks well and enjoys reading; he is an AV monitor; enjoys computer lessons and help classmates with technical problems; been failing maths since P2; he panic during maths test and cannot even remember the simplest concepts taught. It is difficult for him to concentrate on math in class because he is distracted by his concerns about failure. He tries to “hide” himself by putting his head down when teacher asks questions. When he was called upon to answer, he shook his head and mumbled to himself, as if to say “hard luck”. He is overweight and was first perceived to be lazy or stupid; never did his homework and claimed he misplaced them. Teacher believes these misbehaviours are a cover-up for his lack of confidence and anxiety about failure.

Possible Causes of Low Attainment from the Case-Studies

The above descriptions illustrate that the underachievers are not a homogenous group. There is diversity of characteristics of this sample of 24 low-attainers that might explain why the pupils are not successful in mathematics. Twenty four reports written by the teachers on the case studies were analysed to look for some significant common causes among these P2, P4 and P6 pupils. Statements of possible causes relating to pupils’ specific behaviours, attitudes, mathematics deficiencies and home backgrounds were identified and counted for frequency of occurrence. Table 1 summaries the possible causes of low attainment of the P2, P4 and P6 pupils.

Table 1: Frequency of possible causes of low attainment among P2, P4 and P6 pupils

Possible causes of low attainment in mathematics	Number of P6 pupils [%]	Number of P4 pupils [%]	Number of P2 pupils [%]	Total
Has been failing maths since P1/P2	8 [57%]	3[75%]	6[100%]	70%
Has been failing maths since P3/P4	6 [43%]	1[25%]	-	-
Weak in English Language	7 [50%]	1[25%]	2[33%]	42%
Poor Number Concepts/sense	4 [28%]	2 [50%]	1[17%]	-
Subtraction with renaming	-	-	4[67%]	-
Fractions	8 [57%]	4 [100%]	-	-
Problem Sums/Story Sums	14[100%]	4 [100%]	3 [50%]	-
Show high level of math anxiety	9 [64%]	1 [25%]	4 [67%]	58%
Low self-esteem and confidence	4 [28%]	1 [25%]	-	-
Dependent on teacher most of the time	6 [43%]	1 [25%]	3 [50%]	42%
Passive/ easily bored/not interested	5 [36%]	2 [50%]	2 [33%]	38%
Hyperactive	0	0	2 [33%]	-
Tired/sleepy/dreamy	2 [14%]	1[25%]	1 [17%]	17%
Short attention span/easily distracted	6[43%]	2[50%]	4 [67%]	50%
Forgetful/poor memory	2 [14%]	2 [50%]	1 [17%]	21%
Untidy hand-writing/messy work	4 [28%]	2 [50%]	0	25%
Emotional problem relating to home	4 [28%]	-	-	-
Lack home support/supervision	8 [57%]	1 [25%]	0	37.5%
Excessive parental pressure/tuition	3 [21%]	3 [75%]	2 [33%]	33%
Frequently absent	4 [28%]	1 [25%]	0	21%
Do not hand in work/homework	4 [28%]	1 [25%]	1[17%]	25%

Cumulative Mathematics Failures through the years

From the school records of these underachievers, more than half of the P6 underachieving pupils had failed mathematics since primary one or two, whereas the others had done relatively well until P3 or P4. All the P6 pupils are in the EM3 stream, which is supposedly paced according to their ability. Three out of the four P4 pupils had also failed mathematics since year one or two and all the P2 pupils failed the year before. This trend points to the conclusion that if the foundation stage in mathematics (P1 to P4) are not developed then it very difficult for these pupils to catch up and achieve any success even though they have been tracked after the P4 streaming examination to the lower ability stream. This stream at P5/P6 levels was created in the education system in response to the needs of these pupils at slower learning pace with reduced depth and more revision of the earlier years' work.

Lack Understanding in Basic Concepts, Skills and Problem Sums

Through diagnostic tests, four out of the fourteen P6 underachievers and two out of the four P4 underachievers have not mastered basic number concepts; they have poor number sense with large numbers. Four out of six of the P2 underachievers had difficulties with the subtraction algorithm where renaming is required. Fraction operations escaped more than half the P6 underachievers and all of the P4 underachievers. However, identifying basic concepts of fractions was not difficult with these pupils. All the P6 and P4 pupils expressed dislike for problem sums or word problems; they had difficulty understanding the questions. Although they were taught the technique of drawing "model" to interpret and solve such problems, they were unsuccessful in transforming the word problem into a diagrammatic model to show relationships such as "twice as many"; "three times as

many”; “two more than” etc. For P2 underachievers, half of them have difficulty with simple word problems of the four operations. However the difficulty with word problems among these pupils of the different levels cannot be directly linked to the lack of proficiency in the English language. Only half of the P6 pupils, one out of four P4 pupils and two out of six of the P2 pupils were weak in English language.

Lack Interest and Concentration

Observation of these underachievers, showed some of them as passive learners who are easily bored and generally not interested. Five P6, two P4 and two P2 pupils were observed to have these traits. Easily identifiable ones are those who are always tired, looking sleepy or dreamy most of the time and there were four of them. Four P2 underachievers were found to have short attention span and are easily distracted. Six P6 pupils also display this trait. Forgetfulness and poor memory were used to describe some of the underachievers. Some of them have untidy handwriting and were messy in their work or do not hand in their homework. Four pupils were absent from school frequently. Pupils who played truant might often feel that they were not learning anything useful or interesting in mathematics. It is mandatory in the school system that underachievers identified have to stay back after school for remedial lessons. And if these lessons were conducted as repeated lessons without a different approach to meet the needs of these pupils, then tiredness and boredom very easily set in. This is evident in the case of Jacqueline, who in her short essay wrote about herself being occupied by remedial lessons every day after school and being so tired that she often fell asleep on her books while doing homework; and this is confirmed by her teacher’s observation of her listlessness in class.

Mathematics Anxiety and Home Influence

Many of the P6 underachievers were apparently afflicted with mathematics anxiety through the years of cumulative failures. The teachers observed that some of them lack confidence and had low self-esteem. In all there are ten pupils who were always seeking teacher’s attention and assurance in their work. Unfortunately this affliction started as early as P2 in which four of the early learners were anxious while in maths class. Pupils also brought with them emotional problems from home. Three of the P4 underachievers came from broken where parents were divorced which affected them emotionally. Eight P6 underachievers were reported lacking home support and supervision in their schoolwork while none of the younger children at P2 were neglected after schools. Most of the children had both parents working with little time left to spend with them after work. Ten out of the 24 pupils came from middle-income families. On the other hand there were children who had very concerned parents over their underachievement. These parents might have added extra pressure and anxiety to the children by engaging private tutors if they thought they had no time or no knowledge to help their child. Parents who experience difficulty in mathematics might have passed on their anxiety to their children, especially when they stressed the importance of the subject and the marks pupils should score in order not to be tracked to the lower stream after P4. Tuitions are often sessions of more assessment worksheets without helping children to understand the mathematics that they might have missed in school. The pressure to perform in school and at home without meeting success can be a deterrent to learning more mathematics for these children. Eight pupils faced such situation at home and very evidently at the P4 streaming stage, three out of the four low attainer had tuition at home in addition to coaching from parents.

Discussion: Factors of low attainment in mathematics

Many studies on pupils’ low attainment in mathematics focused only on diagnosis of children’s errors and misconceptions which are inadequate to address the question on why some pupils do

poorly in mathematics. Haylock (1991) suggests using an *ecological model* to analyse the problem that may describe the relationship between the child and the whole learning environment in order to get more useful insights to the factors associated with low attainment in mathematics. He considered three significant factors to the problem: 1) the nature of school mathematics, 2) the specific characteristics of low-attainers and 3) the way mathematics is often taught. He believes that a pupil's low attainment in mathematics is the result of a complex interplay between components of these three factors. The causes attributed to low attainers as identified by the teachers in this study shall be discussed in the light of this ecological model.

Nature of School Mathematics

School mathematics is characterised by abstract content that does not resemble other school subjects. Mathematics deals with abstract concepts and relationships between these abstractions. From primary one onwards, the symbols and language of mathematics are used to represent abstractions and their relationships. For example, the mathematical statement of " $7-4 = 3$ " is a relationship between the abstractions 7, 4 and 3, and itself represents many ideas, such as "taking away" one set of 4 things from a set of 7 things; it can also mean the difference in numbers between two sets of things or to represent the concept of "more than" and "less than". Unlike addition, this relationship in subtraction is non commutative, a teacher may tell P2 pupils that "you cannot take 7 from 4" but later on in the upper grades the students are told they can "4 minus 7 to get -3". Such characteristic of mathematics, using the same symbol to represent different meanings and the unstable "truth" of certain relationship can be confusing for many pupils. In this study, it was found that the P2 low-attainers had no difficulty with subtraction as a "take-away" concept but the operation of its numbers in an algorithm that required regrouping and place-value concepts proved to be a challenge. The learning of school mathematics is also marked by a variety of activities such as early number concept formation through modeling with concrete objects, mastery of computational and measurement skills, mental calculation, spatial thinking and problem solving.

In a traditional classroom, mathematics learning is usually a highly procedural activity. Teachers often transmit patterns of activity to students by presenting mathematical problems whose solutions involve these patterns. This could be due to a feature unique to mathematics that is the logical organisation of its contents. It involves a hierarchical structure where learning has to proceed as such. To reach any particular branch, it is necessary to go a long way along the whole mathematical tree. For instance it is impossible to learn percentages and their calculations without understanding of part-whole concepts and mastering decimal fraction conversions, that need mastering the arithmetic of fractions, and fractions with knowledge of the multiplication table, and so on. This also adds to a significant feature of school mathematics: to be successful in it pupils need to concentrate on their task that requires care and accuracy. Pupils need self-disciplined and perseverance to do mathematics. Low-attainers with poor memory and attention span have difficulty in mentally shifting from one response to another according to different requirements in the learning task. If one arithmetic process e.g. addition is concentrated on for any length of time, the transfer to another process say subtraction is difficult for the child. Often children have no problem adding or subtracting simple like fractions but have great difficulty with operating with unlike fractions and mixed numbers together.

Cumulative failure can occur to a child who does not get it right on the first step as he moves on in school mathematics. Unlike other subjects where answers to questions can be open-ended, in mathematics it often demands "right" or "wrong" answers. For those who know and provide the correct answer in the mathematics classroom, it may be a pleasant and motivating experience. But for those who do not know the answers most of the time, the repeated disapproval from teachers, and the red crosses filling their workbook make mathematics learning a source of frustration and

discomfort that leads to negative attitudes towards it. The low-attainers in this study, as early as primary two, exhibited signs of mathematics anxiety. For the lower primary pupils anxiety could be aroused from the pressure of completing worksheets and tests with no understanding and for the upper primary pupils the impending failures could lead to anxiety or resignation with misbehaviours like not handing in work or even truancy.

Solving word problems requires a higher level of thinking on the part of the primary pupils who are at the same time trying to master an everyday language such as the English language. A child might very well be able to read and understand each of the individual words in a word problem, but putting them together can become a complex task. In Singapore schools, English language is the medium of instruction for mathematics and all other subjects except mother-tongue languages. For example, a word problem like “Melina has some sweets, her teacher gives her two more sweets and now she has seven. How many sweets has she at first?” A child must be able to abstract the relationships in this statement and model it with the appropriate mathematical statement. Mathematics has a complex language pattern peculiar to itself and does not come easily to many children. Children with limited range of language structure and vocabulary in their everyday lives will find solving word problems in mathematics extremely difficult. Almost all of the low attainers in this study expressed dislike for and failure in solving word problem. Even though a child may have no particular language problem, his mental schema must become geared and adapted to the special language of mathematics. It is a language that is symbolic and coded with its own peculiar shortcuts and abbreviations. The characteristics of the low attainers in the study also support this observation, as about half of the pupils were actually quite strong in their oral and written English Language.

Personal characteristics of low-attainers

Haylock (1991) reported a study where teachers were asked to consider a list of statements, which referred to various factors often, associated with low attainers in mathematics. Among the 215 Year 6 school children surveyed, for those with score on a mathematical test in the bottom 20%, the teacher were asked to indicate whether, in their judgment, the statements describe the child. Some of the statements, together with the percentage of mathematical low-attaining pupils matching them are list below. The teachers in the present case studies also described their underachievers using some similar statements as these:

- low-attaining in mathematics from the first year in school [82%]
- low-attaining in most areas of the curriculum [79%]
- equally poor in all aspects of mathematics [74%]
- poorly developed reading skills [77%]
- poorly developed language skills [70%]
- show little commitment or interest in mathematics class [39%]
- show little commitment or interest in school in general [33%]
- immature relationships with other pupils [39%]
- has difficulty in relating to adults [33%]
- has emotional problems related to an exceptional home background [30%]
- displays behavioural problems, such as hyperactivity, in most lessons [26%]
- shows an abnormal level of anxiety towards most tasks in school [26%]
- shows an abnormal level of anxiety towards mathematics [26%]

- has been absent frequently in the last year [17%]
- seems excessively tired much of the time [14%]
- some physical factor such as deafness, poor eyesight etc. [18%]
- has suffered frequent changes of mathematics teachers or schools [5%]

Shortcomings in the Teaching of Mathematics

Although teachers in this study did not explicitly include teaching methods as a possible cause of low attainment in pupils, many had in their recommendations for remediation reflected on adopting different approaches to help the underachievers. Many had suggested the use of manipulatives and hands-on activities for the children who could not follow the teacher's whole class exposition of concepts as the more able pupils. There were suggestions for computer-based learning, smaller group teaching and co-operative learning for these pupils. Most of the teachers were made more aware of the unsuitable teaching methods that they had used for the whole class to the less motivated pupils. Many felt that the syllabus and recommended materials were not responsive to the needs of these pupils. At P4 when there is a common national streaming examination, teachers often tried to teach everything in the mathematics curriculum to the low-attainers within the same time frame as the rest of the class. Many underachievers' sense of failure at mathematics is a result of the failure to remember and master the different procedures step-by-step in order to carry out abstract computation as in a formal algorithm. Realistic and relevant targets should be set for underachievers to achieve a sense of success and attainment before they are rushed to finish the syllabus as everyone else.

The normal practice is usually with teachers tending to rigidly follow a syllabus and scheme of work for mathematics that are planned for the average and above-average pupils in mind. Regardless, the low-attainers in mixed-ability and unstreamed classes in the foundation stage (P1 to P4) are expected to go through the same scheme and be assessed by a common examination. Teachers may not exercise flexibility to let some of the children miss any of the exercises in the workbooks for they have been "told" by "certain authority" that every child should work through every exercise stipulated in the scheme of work. On top of that there is parental pressure to teach their child everything that other children are also learning. Hence there is a tendency to rush through the syllabus for the low-attainers who really need a lot more time than their able peers. The result of this can be a total fuzziness in the child's mind, particularly when the processes are taught by rote. By P3 many of the low-attainers have not mastered the addition and subtraction algorithm of two and three digits because the concepts of place-value and regrouping have not been fully understood. To them the whole exercise is a meaningless routine of manipulations paved with errors and half remembered rules.

Many teachers also use the adage: "practice makes perfect" to justify large quantities of drill-and-practice activities. Merely giving more practice on the same thing is often counterproductive for low-attaining pupils because it may result in encouraging rigid thinking and reinforcing errors. Staying back after school for remedial to do more of the same thing will not help these pupils. Practicing a skill incorrectly and then redoing an assignment is frustrating for everyone, especially when the practice is performed on a large number of problems. This could be a reason why many underachievers do not hand in or conveniently misplaced their homework, especially for those who had no one at home to help them. Also in a spiral curriculum, topics and concepts are covered in the same way that they were covered in the lower grades. Few new or interesting ways to use fractions and decimals are offered. Much of the tasks given to pupils are devoid of meaningful real-life context. Many are computational tasks like " $\frac{3}{4} + \frac{1}{2} + \frac{1}{4} = ?$ " or " $5.025 \div 5$ ".

If word problems are given, they are often multiple-step problems where pupils are trained to recognise certain problem structures and apply some specific methods like drawing “models” and such. Teachers often display the finished product of the model solution without demonstrating the heuristics, trial and errors of the problem solving process with the pupils. The material is the same old drill, practice and routine problem solving, which foster apathy among students. Teachers tend to use fewer or none at all, concrete approaches to teaching mathematics in the upper primary than are used in teaching lower primary mathematics. According to Piaget’s classification of ages and learning stages, the average pupil in upper primary is still in the concrete to semi-concrete learning stage. Thus a mismatch of teaching methods and learning stages appears to occur more frequently at the upper primary levels that results in producing more underachievers. From this study, there is evidence of some low attaining pupils to have done relatively well in P1 and P2 mathematics but started to decline as they moved on to P3 and up.

Conclusion: Some Implications

The identification of the factors from these case studies will not give simple solution to the problem of pupil low attainment in mathematics but it will increase teacher’s awareness of the various reasons for pupil’s difficulties. It is also difficult to pinpoint a particular reason for individual pupil’s low attainment. However it is possible to identify, in general, those reasons that are frequently associated with underachievement among children in their early years of learning. This is especially essential if teachers have to teach large classes with mixed abilities. Using the findings in these case studies can help teachers to be more sensitive to the affective characteristics of the underachievers and the kind of home background they come. It will also enable them to design more responsive approaches and content for remediation with the underachievers. After-school remedial lessons although catered to a smaller number of pupils in need, must adopt different strategies and not be a repeat of the same lesson. The “ecological” profiles of the underachievers should be formally compiled and be accessible to the next teacher, when pupils transfer from one teacher to another. It is often the case in Singapore where a teacher seldom follows his or her pupils as they move on to the next level. Pupils can be disadvantaged if there are too many changes of teachers giving rise to lack of continuity to alert the next teacher on the pupil’s cognitive difficulties, affective characteristics as well as home background. At the same time, pupils’ strength and special talents should be passed on for further development. School records of pupils should extend to include such profiles besides the report cards of examination marks and grades for the various subjects a child have achieved for each level of his or her school years.

Having identified the reasons for low attainment in mathematics what teaching approaches would be appropriate in working with underachievers? The Singapore mathematics curriculum is based on a “Specific Instructional Objectives (SIO’s) and Assessment” model with a sequence of SIO’s to be attained by pupils and then assess the pupils’ current attainment against these objectives. In the course of pursuing the specific content objectives to be attained and assessed by national examinations for every pupil, teachers should not neglect the quality of mathematical learning experiences to achieve these SIO’s; other than through drilling pupils in routine procedures. There should also be an emphasis on the development of key patterns of mathematical language. The Concrete-Pictorial-Abstract approach must not be compromised with a show and tell approach for the teaching of early mathematical concepts to pupils in the foundation stage of the education system. This is especially essential for low attaining children who have short attention span and are far from formal thinking. They need to see meanings in the symbols that they were told to manipulate to get the answer. They need hands-on and purposeful activities in meaningful context for motivation. The numerous contrived multiple-step relational word problems that stumped most low-attainers in the upper primary should be reduced and be supplemented by real problems in meaningful context that pupils can relate to, such as earning money, travel, sport, shopping, and

television. Most importantly the factor of teachers' content and pedagogical knowledge can influence pupils' learning. It should not be assumed that all teachers are endowed with the necessary knowledge without going for further professional development such as in-service training.

The problems of the underachievers and mathematics in the primary schools, as presented in the case studies, would seem to be many and possible solutions may not be easy to find. There are many factors within our social structure that affect student performance. They cannot be treated in isolation and should be a part of a review of the whole curriculum. It is timely that the Ministry of Education is moving towards an "ability-driven" curriculum based on the belief that every child has some talent or ability. There is a need to systematically identify and develop both academic and non-academic talents and abilities. In mathematics education in the school, it is the desire of teachers that all their students enjoy the learning of mathematics and strive to develop in them mathematical ability in accordance with their potentials.

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