

An Exploratory Study on Low Attainers in Primary Mathematics

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THIS STUDY EXPLORED the characteristics and learning experiences of low attainers in primary mathematics. Six research questions related to processes and practices were used by schools to identify, organize, motivate and address the diverse learning needs of low attainers as well as the characteristics of low attainers related to school, home and their learning experiences. The findings of the study show that the School Readiness Test and school-based semestral examinations were mainly used to identify low attainers in mathematics. The schools and teachers appeared to use a variety of approaches to address the diverse learning needs of these pupils and motivate them in their learning. The pupils found school mathematics word problems challenging. Generally, these pupils were not attentive in class and were easily distracted. These pupils also lacked support with their work outside of school. There also appeared to be a mismatch between pupils' desired form of classroom instruction and teachers' mode of instruction.

INTRODUCTION

The impetus of this study has been the intense concern of school leaders about the growing proportion of low attainers in primary mathematics. It appears that this concern has arisen from national and/or international mathematics studies. Ginsburg, Cooke, Leinward, Noell and Pollock (2005) found in their secondary analysis of the Trends in International Mathematics and Science Study (TIMSS) 2003 data for the US that pupils who were failing at Grade 4 subsequently continued to fail at Grade 8. Table 1 shows the TIMSS 2007 mathematics mean score by the percentiles of the participants from the top four performing countries for Grade 4 mathematics.

KEY IMPLICATIONS

- School support is important for teachers to implement teaching strategies to meet the needs of low attainers in mixed-ability classes.
- Teachers need to provide pupils with a voice as to how they learn best and implement those practices.
- Professional development is essential in providing teachers of low attainers with the necessary knowledge and skills to work well with such pupils.

From the table, it is apparent that Grade 4 pupils from Singapore were underachieving in mathematics compared to their peers from Hong Kong and Chinese Taipei when comparing their mean scores up to the 5th, 10th, 15th and 20th percentiles. Such findings from international studies and also national examinations have prompted researchers and policymakers in Singapore to explore the needs of and provisions for low attainers in primary schools.

Table 1. TIMSS 2007 Grade 4 mathematics mean scores.

Country	Rank	Mean scores of pupils up to the <i>n</i> th percentiles				
		<i>n</i>	5th	10th	15th	20th
Hong Kong	1	462	488	503	514	524
Singapore	2	408	440	461	477	490
Chinese Taipei	3	427	453	469	481	490
Japan	4	404	432	449	463	474

So far, only a few studies done in Singapore provide findings that may relate to low attainers in primary mathematics. Loo and Fong (1996) found that both mathematical and psychological factors correlated with mathematics achievement, while Ng (2003) found that variables related to socio-economic status were also correlated. Foong (1999) found that low attainers were diverse in their needs; Lim (1999) found that they preferred formally designed learning environments; and Lee (1999) noted that academic achievement scores related positively with subject-related self-esteem. Leong (1999), in her study on parental involvement and effects on the academic performance of pupils, found that there was no conclusive evidence to suggest that the higher the degree of parental involvement, the better the academic performance of the pupil. Though these studies provide glimpses of the characteristics of low

attainers, none of them have investigated the content knowledge of pupils, their learning experiences, and how schools organize, motivate and inspire them.

Failure in mathematics due to factors that may be controlled for would be unjust for the pupils. Therefore, this study hopes to shed light on the needs of low attainers in primary mathematics and help them realize their potential.

RESEARCH DESIGN

This study fits the overall research framework of NIE and, in particular, supports research leading to intervention programmes and levelling up strategies for low-achieving pupils. It also complements the “Sustained Support for Math” project carried out by the Mathematics Unit of the Curriculum Planning and Development Division at the Ministry of Education in 20 primary schools from 2009. The long-term impact of this research will certainly be “every child achieving his or her potential in math at the primary school”.

Nine government schools from across Singapore voluntarily participated in the study. The schools identified the pupils for the study, based on the school’s criteria of low attainers. The parents of the pupils were asked for their consent regarding their child’s participation in the study. Table 2 shows the number of participating pupils, school leaders and teachers.

Both qualitative and quantitative data were collected for the study. Four main methods were used to collect data. They were paper-and-pencil tests, surveys, interviews and observation. Data were collected from school leaders, heads of Mathematics

Table 2. Pupil, school leaders and teacher participants in the study.

School code	School location	No. of pupils nominated	No. of pupils with parental consent	No. of pupils taking all benchmark tests	No. of pupils interviewed	No. of school leaders	No. of teachers
01	East	37	24	21	23	1	1
02	East	69	51	41	48	1	4
03	East	43	32	30	29	1	1
04	East	33	24	18	22	1	1
05	East	78	56	52	55	1	4
06	West	52	35	32	31	1	4
07	North	74	12	54	11	1	3
08	West	55	50	48	45	1	2
09	West	119	91	94	82	1	4
Total		560	375*	390*	346	9	23

*This number is larger than the “bona fide” participants of the study as in Schools 7 and 9, the teachers administered the benchmark tests to a larger group of pupils in their respective schools.

departments, Mathematics teachers, pupils and their parents. In accordance with the ethics requirements of the study, consent was sought from all participants.

KEY FINDINGS

The study was guided by six research questions (RQs). The questions and key findings are as follows.

RQ1: What were the practices and processes used by schools to identify and organize low-attainer groups?

Most schools (7 out of 9 schools) used the School Readiness Test to identify the low-attainer groups for Primary 1 pupils. School-based entry/diagnostics tests conducted during Primary 1 orientation and teachers' feedback on pupils were also used to identify these pupils in some of the schools. All nine schools used the previous year's semestral assessment results to identify the low-attainer groups from Primary 2 to 5.

The nine schools used banding based on either the pupils' overall performance or their performance in core subjects (e.g., English and Mathematics) during year-end semestral assessment to organize them for learning. Only the pupils identified at Primary 1 and 2 were placed in the Learning Support Programme and/or Learning Support for Mathematics.

RQ2: How do schools and teachers motivate and inspire low attainers in Primary Mathematics to learn?

All nine schools used one or more of the following to motivate their pupils:

- modified teaching packages to teach them in small groups;
- activity-based approach using pictures, games, songs and manipulatives; and
- information and communications technology incorporated during lessons.

Recognizing pupils' achievement through school-based awards and rewards were also seen to motivate these pupils. The teachers used words of encouragement, and extrinsic rewards like stickers and sweets. The teachers observed that games and quizzes helped their pupils remain motivated.

RQ3: How do schools and teachers address the diverse learning needs of low attainers in primary Mathematics?

These schools addressed the diverse learning needs of low attainers by engaging additional teaching staff (e.g., allied educators and adjunct

teachers) and providing remedial/supplementary lessons. The teachers identified class size, time constraints, the nature of the Mathematics syllabus, and mode of assessment as limitations. Some of their recommendations included teacher training in teaching low-attaining pupils, enrichment programmes for low-attaining pupils, and more time to be allocated for core subjects.

RQ4: How did the low-attaining pupils perform in Mathematics tests that tested mastery of Primary 3 Mathematics content knowledge and skills?

The mean and standard deviation of the scores for each of the eight benchmark tests are shown in Table 3. Pupils seemed to perform relatively well in whole number operations but consistently poorly in both word problem tests.

Table 3. Eight benchmark tests.

Test	Max. score possible	Mean	Standard deviation
Whole numbers (concept)	30	17.10	4.49
Whole numbers (operations)	29	22.10	3.98
Whole numbers (word problems)	9	3.52	2.45
Fractions	29	13.71	6.98
Measurement	21	10.14	3.69
Measurement (word problems)	8	3.20	2.05
Geometry	10	6.34	2.16
Data analysis	10	6.37	2.55

RQ5: What were the characteristics of low-attaining mathematics pupils related to school (behaviour during class, absenteeism, interactions with peers), home (support, resources) and self?

The majority of the low attainers (70%) were sometimes, seldom or never paying attention during lessons. Very few pupils (15%) sought help from the teachers when in doubt. As they were not attentive and few sought help from their teachers, less than half of the pupils (39.6%) were able to submit classwork on time.

A majority of the pupils perceived that mathematics is important (88.9%) and useful to daily life (65%). Although the majority of the pupils (89.6%) believed that they could do better in mathematics, approximately half of them (54%) thought they were not good at it. Learning mathematics aroused a diverse range of emotions, including feelings of happiness, dislike, anger, confusion, stress, anxiety, and boredom.

Although about half of the pupils had parents with secondary (45.3%) and tertiary (8%) education, about one-third of the pupils (28.8%) reported that their parents did not check their mathematics work at home.

RQ6: What were the characteristics of low-attaining mathematics pupils related to their experiences of learning?

A majority of the pupils (82.7%) indicated that their teachers used teacher-led whole-class instruction to teach them during lessons. About half of the pupils (54.1%) reported that they did group activities and a high percentage of the pupils preferred to do activities (88.2%) and group work (80.5%).

All the 10 lessons observed by the researchers displayed teacher-led whole-class instruction that focused on dissemination of knowledge. During whole-class instruction, there were no apparent attempts made by the teachers to tailor instruction to meet the needs of learners with differing abilities. All lessons catered to the needs of the majority of the pupils, that is, those of average ability.

The tasks used by the teachers were routine and repetitive, and it was apparent that the teachers made no attempt to engage pupils in higher order thinking. A majority of the teachers asked their pupils closed questions such as “What is the next step?” and “What do I do next?” They tended to use correct responses from pupils to explain mathematical concepts, and did not attempt to use pupils’ misconceptions to create valuable opportunities to enhance pupil learning.

Few pupils asked their teachers questions to clarify their doubts during whole-class instruction. Instead, they only did so during group work and individual seatwork. It was observed that pupils lacked opportunities to clarify their thoughts and ideas with their peers.

IMPLICATIONS

For Policy

It is important for schools to support teachers in implementing innovative teaching strategies and alternative forms of assessment to meet the needs of low attainers in mixed-ability classes of usually 30–40 pupils. Consideration of class size and provision of teacher aides can help a teacher in conducting differentiated instruction that incorporate more hands-on, group activity-based lessons to develop conceptual understanding and communication in mathematics.

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For Practice

The study showed that there is a mismatch between how pupils think they best learn mathematics and how their teachers teach. The instructional method adopted by the teachers was mainly teacher demonstration, seatwork and review of pupil work. Teachers need to provide pupils with opportunities to talk and clarify their thinking as well as to motivate pupils to ask questions and freely share their thoughts with others. Therefore, a necessary next step would be to carry out teaching experiments and transform the classroom pedagogy for low attainers in primary mathematics such that optimal learning takes place for pupils.

For Teacher Professional Development

Teachers who teach low attainers need the necessary knowledge and skills to work well with such pupils. Providing teachers of low attainers with professional development may be an essential step forward.

REFERENCES

- Foong, P. Y. (1999). Can we identify the reasons for a pupil’s low attainment in mathematics. In S. P. Loo (Ed.), *Educational challenges in the new millennium* (pp. 648–660). Proceedings of the MERA-ERA Joint Conference, Malaysia.
- Ginsburg, A., Cooke, G., Leinward, S., Noell, J., & Pollock, E. (2005). *Reassessing U.S. international mathematics performance: New findings from the 2003 TIMSS and PISA*. Report prepared by the American Institute for Research for the U.S. Department of Education.
- Lee, L. (1999). *Self-esteem of pupils with learning difficulties* (Unpublished master’s thesis). National Institute of Education, Singapore.
- Leong, K. Y. E. (1999). *Parental involvement and its effects on academic performance of students* (Unpublished master’s thesis). National Institute of Education, Singapore.
- Lim, K. K. A. (1999). *A comparison between the learning styles of high-achieving and low-achieving pupils in a primary school* (Unpublished master’s thesis). National Institute of Education, Singapore.
- Loo, C. P., & Fong, H. K. (1996). Variables associated with mathematics achievement of primary five pupils in Singapore schools. *The Mathematics Educator*, 1(1), 1–16.
- Ng, T. J. (2003). *Possible factors relating to poor performance of underachievers in primary schools* (Unpublished master’s thesis). National Institute of Education, Singapore.