Title	Learning experiences of Singapore's low attainers in primary mathematics
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Source	*Symposium on "Mathematical Development, Learning and Intervention from Preschool to Secondary School", Singapore, 13 March 2014*
Organised by	Centre for Research in Pedagogy and Practice (CRPP), National Institute of Education (Singapore)

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SINGAPORE

Learning Experiences of Singapore's Low Attainers in Primary Mathematics

July 2011

An Institute of NANYANG TECHNOLOGICAL UNIVERSITY

Background

Background

- The term “low attainers” refers to pupils who attain very much less in mathematics when compared to their contemporaries (Haylock ,1991) in the mainstream primary school.

- Low attainment in mathematics has been found to be a result of not a single factor but the interplay of subject related difficulties, specific intellectual/ behavioural characteristics of the pupils and pedagogical shortcomings (Haylock, 1991).

- The research reported in this paper is part of a larger research study that explores the factors related to low attainment of primary pupils in Singapore (Kaur and Sudarshan, 2010)

Research Question

Research Question

- The research question that is addressed in this paper is one of the larger study's six research questions:

"What are the learning experiences of low attaining in mathematics pupils in primary schools?"

Review of Literature

Review of Literature

- According to Reusser (2000) there is sufficient evidence in research on mathematics learning and teaching that most observed failures and substandard performances are due to deficiencies in the teaching and learning environemtns rather than genetic factors.

- His perspective of an ‘effective teaching environment’ for low attainers centres around adaptivity and empathy in teaching.

- Direct structured instruction has also been found to be effective with students having difficulties in mathematics (Harris, Miller and Mercer, 1995; Jitendra and Hoff, 1996; Van Luit, 1994; Wilson, Majsterek and Simmons, 1996).

Review of Literature

- Cardelle-Elawar (1995) found that low achieving students showed metacognitive potential when stimulated by explicit individualized instructions.

- She recommends the following
  - Special consideration should be given to individual students' uniqueness, strengths and weaknesses
  - A supportive atmosphere in which errors and mistakes are considered a source of learning and not an occasion for punishment
  - More structure in the classroom
  - Great Deal of interaction between teacher and students

Review of Literature

- According to Watson (2001), low attainers are able to make shifts in their thinking from superficial features of mathematical tasks to forms of mathematical thoughts.

- She asserts that low attainment is not the result of an inability to think but the lack of structured work that promotes higher order thinking among the low attainers

- Zohar and Dori (2003) also found that low achieving students can gain from teaching and learning that are designed to foster higher-order thinking skills.

- They suggest that teachers should encourage students of all levels to engage in tasks that involve higher order thinking skills.

Methodology

Methodology - Subjects

- The subjects of the study are 346 year four pupils from nine primary schools in Singapore who qualified for participation.

- They were nominated by their respective schools, had parental consent for participation and took the mathematics benchmark tests of the study.

Methodology - Instruments

- Specific to the research question addressed in this paper, only instruments used to collect data from pupils and teachers on learning experiences of the pupils will be presented.

  - Pupils' Interviews
  - Lesson observations

Pupils' Interviews

- An idea adopted from child psychiatry about using pictures as stimulus for interviews (Angold, 1976).

			
Picture A Teacher-led whole class instruction	Picture B Group work (pupils working on tasks without manipulatives)	Picture C Individual working on tasks with manipulatives	Picture D Group work (pupils working on tasks with manipulatives)

Figure 1

Pupils' Interviews

- Pupils were interviewed in groups of 4 to 5 persons as they were rather reserved in their oral communication when they were in a one to one interview setting.

Pupils interviews

			
Picture A Teacher-led whole class instruction	Picture B Group work (pupils working on tasks without manipulatives)	Picture C Individual working on tasks with manipulatives	Picture D Group work (pupils working on tasks with manipulatives)

Figure 1

- Prompt 1: Which picture shows the way you mathematics teacher usually teaches you in class?
- Prompt 2: Which class do you want to be in? Why?
- Prompt 3: Which class don’t you want to be in? Why?

Lesson Observation

- Our lesson observations were guided by the following main analytical questions:
  - AQ1. What was the instructional sequence of the lesson like?
  - AQ2. Did the teacher tailor the instruction to meet the needs of different learners?
  - AQ3. What were the characteristics of mathematical tasks used in the lesson?
  - AQ4. Was the classroom learning environment a supportive one? If so, how did the teacher nurture such an environment?

Data and Findings

Interview data and findings

- ***Prompt 1: Which picture shows the way your Maths teacher usually teaches in class?***
  - 98% of the pupils interviewed said that their teachers always used whole class instruction for mathematics lessons (Picture A). 50% of the pupils interviewed also reported that sometimes they did group work during mathematics lessons (Picture B)

			
Picture A Teacher-led whole class instruction	Picture B Group work (pupils working on tasks without manipulatives)	Picture C Individual working on tasks with manipulatives	Picture D Group work (pupils working on tasks with manipulatives)

Interview data and findings

- Figure 2a shows the type of instruction the pupils desired and Figure 2b shows the type of instruction they disliked.

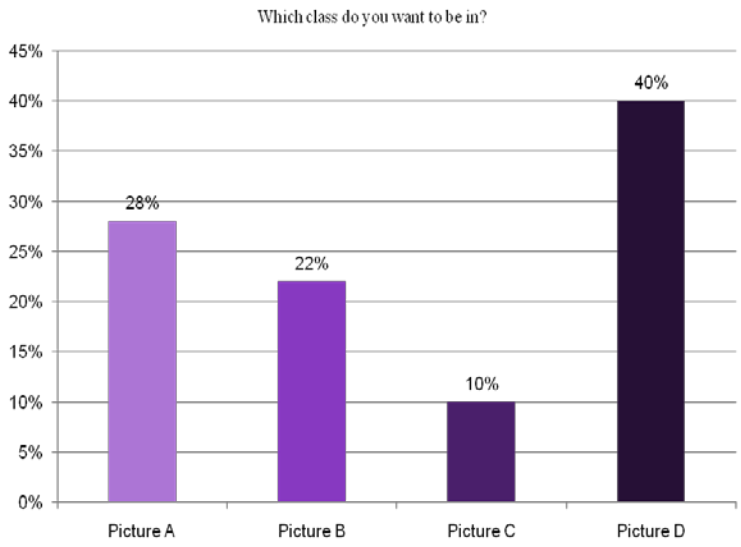

Figure 2a. Responses to prompt 2

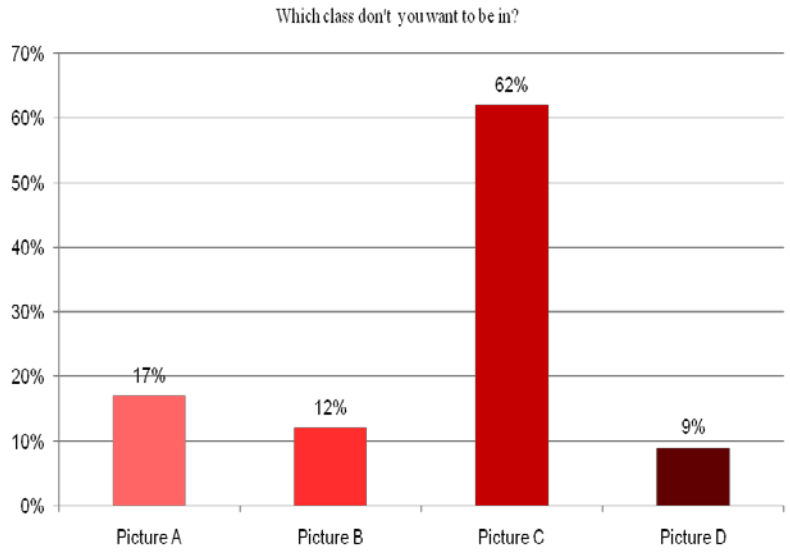

Figure 2b. Responses to prompt 3

Interview data and findings

- Table 1 shows representative samples of all the reasons given by the pupils with regards to the type of instruction they desired.

Sample responses for preference for Picture D – Group work (pupils working on tasks with manipulatives)
S038: "Discuss with a group, tell each other the answer and find out which is the correct answer". S057: "When we do the activity, we can feel that maths is fun". S105: "More fun to work with a group and can discuss with friends if I am not sure". S234: "I feel happy when I can do things to help me understand and improve". S537: "We can see how things happen and touch things".

Table 1. Sample of pupils' responses to the "Why" of "Which class do you want to be in?"

- From Table 1 above, it is apparent that pupils found a) interacting with peers a fun and good way to learn; and b) the "hands on" experience gratifying and meaningful in learning.

Interview data and findings

- Table 2 shows representative samples of all the reasons given by the pupils for not wanting to be in the classroom setting as shown in Picture C.

Sample responses for non-preference Picture C – Individual working on tasks with manipulatives
S074: “Work alone may not know how to do and then do the wrong thing”. S084: “It is boring and lonely when doing by ourselves”. S197: “If alone cannot study well, cannot ask anybody about the activity”. S453: “Scared if I don’t understand what teacher wants”. S528: “Don’t want to do things alone. With other people we can do better”.

Table 2. Sample of pupils’ responses to the “Why” of “Which class don’t you want to be in?”

- From the pupils’ responses, we can infer that pupils a)lacked the confidence to attempt tasks with out support of peers and teachers; and b)felt bored and lonely working by themselves.

Analysis of lessons observed

- Each lesson was observed by at least two researchers.
- Following the observation, a reflection of the lesson was guided by the analytical questions that provided the theoretical lens for analysis.
  - AQ1. What was the instructional sequence of the lesson like?
  - AQ2. Did the teacher tailor the instruction to meet the needs of different learners?
  - AQ3. What were the characteristics of mathematical tasks used in the lesson?
  - AQ4. Was the classroom learning environment a supportive one? If so, how did the teacher nurture such an environment?
- The main aspects of 3 of the lessons observed that the researchers concurred on are presented in Table 3a – 3d

Analysis of lessons observed

AQ1. What was the instructional sequence of the lesson like?	
Teacher C (School 3) Topic: Time [duration] N = 11	• Introductory phase – review of past lesson and use of real life contexts to arouse pupils' interest. • Main phase – development of concept and application of knowledge (adequate examples worked on the board with inputs from pupils) • Consolidation phase – pupils worked individually on new tasks, while teacher provided between desk instructions and feedback on completed tasks.
Teacher F (School 5) Topic: [Tessellations] N = 19	• Introductory phase – mentioned that lesson was on a new topic – tessellations. • Main phase – demonstration of concept of tessellation via examples and non-examples. Pupils worked in groups with unit shapes to make tessellated patterns and teacher encouraged peer evaluation. • Consolidation phase – pupils worked in pairs and again were given unit shape to make tessellated patterns.
Teacher I (School 8) Topic: [Symmetry] N = 38	• Introductory phase – mentioned that the past lesson completed the topic time and stated the goal of the present topic. • Main phase – demonstration of concept using manipulatives such as video-clips and cut-outs of the alphabet by the teacher followed by "hands on" work by pupils in groups – identifying the lines of symmetry of the alphabet. • Consolidation phase- pupils worked individually on similar tasks without assistance from teachers or peers.

Table 3a

**N represents the number of pupils in the class.*

Analysis of lessons observed

AQ2. Did the teacher tailor instruction to meet the needs of different learners?	
Teacher C (School 3) Topic: Time [duration] N = 11	No apparent attempt.
Teacher F (School 5) Topic: [Tessellations] N = 19	No apparent attempt.
Teacher I (School 8) Topic: [Symmetry] N = 38	No apparent attempt.

Table 3b

**N represents the number of pupils in the class.*

Analysis of lessons observed

AQ3. What were the characteristics of mathematical tasks used in the lesson?	
Teacher C (School 3) Topic: Time [duration] N = 11	Routine and repetitive
Teacher F (School 5) Topic: [Tessellations] N = 19	Routine and repetitive
Teacher I (School 8) Topic: [Symmetry] N = 38	Routine and repetitive

Table 3c

**N represents the number of pupils in the class.*

Analysis of lessons observed

AQ4. Was the classroom learning environment a supportive one? If so, how did the teacher nurture such an environment?	
Teacher C (School 3) Topic: Time [duration] N = 11	Supportive. Teacher encouraged pupils to ask questions, welcomed mistakes and praised the pupils who completed the given work and gave them a new worksheet to work on.
Teacher F (School 5) Topic: [Tessellations] N = 19	Supportive. Teacher encouraged pupils to comment on their peers answers and praised them for their attempts.
Teacher I (School 8) Topic: [Symmetry] N = 38	Supportive. Teacher encouraged pupils to talk to peers about their work, welcomed mistakes and praised the pupils for completing the group work on time.

Table 3d

**N represents the number of pupils in the class.*

Discussion and Concluding Remarks

Discussion and concluding remarks

Discussion	Concluding Remarks
• From the pupils' survey and interview data, there is a mismatch between how the teachers teach these pupils and how these pupils would like to be taught in mathematics lessons.	•This may explain the low attainers as according Reusser (2000) most observed failures are due to deficiencies in the teaching and learning environment rather than genetic factors.
•The three lessons observed depicted teacher-led whole class instruction which had some commonalities.	•The first two phases of all the three lessons were similar to that of Kroesbergen and Van Luit (2002) ie pupils' attention gained and teacher demonstrated how a particular task can be solved. However, in the third phase it is not evident that pupils had sufficient understanding of the tasks before they were given more tasks to practice independently..

Discussion and concluding remarks

Discussion	Concluding Remarks
•The tasks given to the pupils were routine and repetitive and did not seem to engage pupils in higher order thinking.	•Watson (2001) and Zohar and Dori (2003) have found that low attaining pupils are capable of making shifts in their thinking and improving in their mathematics attainment when challenged with higher order thinking tasks in a structured environment
•The learning environments were conducive, teachers were welcoming of mistakes, praising pupils for good effort, encouraging pupils to ask questions and engage in peer evaluation. The main focus was on the use of correct procedures to solve mathematical tasks.	•Errors made by pupils were not used as springboards for reflection. Also questions asked by pupils were not exploited to engage the class in critical thinking. Cardelle-Elawar (1995) found that low achieving pupils benefitted from metacognitive training. Hence it may be said that although the learning environment did have the potential to stimulate the metacognitve potential of the pupils it was not harnessed.

Questions and Answers

Thank You