STUDENT PERSPECTIVE ON EFFECTIVE MATHEMATICS PEDAGOGY: STIMULATED RECALL APPROACH
Students’ and Teachers’ Perspectives of Good Mathematics Lessons

Berinderjeet Kaur

THIS STUDY OF MATHEMATICS PEDAGOGY examined the practices of three competent Secondary 2 mathematics teachers and their classrooms. This research brief presents the findings and analysis of part of the data from the study that is related to good mathematics lessons. It examines the instructional approaches of these three teachers. It also examines their students’ perceptions of the lessons they taught as well as the characteristics of good mathematics lessons. The findings of teacher practice and student perception are juxtaposed to elicit characteristics of good mathematics teaching in Singapore’s Secondary 2 classrooms.

INTRODUCTION
This is the first study in Singapore that has attempted to document at the micro-level teaching and learning activities in the classrooms of three competent Secondary 2 (Grade 8) mathematics teachers. These teachers, deemed to have the required ability and knowledge, were recognized for their teaching excellence in their respective schools. They were experienced and senior members of the school who often mentored the junior teachers and were looked upon by the leadership of their schools as “good teachers”.

This study is also part of the Learner’s Perspective Study (LPS) coordinated by Professor David Clarke at the University of

KEY IMPLICATIONS

• Mathematics lessons must be driven by instructional cycles with specific instructional objectives, with every subsequent cycle incrementally building on the knowledge of the previous cycle.

• Examples must be carefully selected so that they vary in complexity from low to high and engage students in constructing their knowledge.

• Teachers must reinforce their students’ understanding of knowledge expounded during whole-class demonstration through detailed review of student work.
Melbourne (Clarke, Keitel, & Shimizu, 2006). The data collected as part of this study is very extensive. This research brief presents the findings and analysis of part of the data from the study that is related to good mathematics lessons in Singapore.

Palmer, Stough, Burdenski and Gonzales (2005) found in their study that the following categories were often used by researchers to identify teacher expertise: years of experience, social recognition, professional or social group membership, and performance-based criteria.

In this study, the characteristics of good mathematics teaching are explored from two perspectives. The first perspective is that of the teachers. Characteristics of good mathematics teaching are established by examining the instructional approaches of three competent Secondary 2 mathematics teachers. The second perspective is that of the students. Perceptions of students about their teacher’s lessons and the desired characteristics of good mathematics lessons are examined. “Good” in this context means the “desired qualities” from the perspective of the students.

Finally, a juxtaposition of teacher practice and student perception helps illuminate the characteristics of “good mathematics teaching” in Singapore’s Secondary 2 classrooms.

**METHODOLOGY**

The study adopted the research design set out in the LPS (Clarke, 2006). A total of three mathematics teachers, recognized for their locally defined “teaching competence”, participated in the study in 2005.

Two research questions guided the analysis of data reported in this research brief:

1. What are some characteristic features of the instructional approaches of the three competent Secondary 2 mathematics teachers?
2. What are some desired characteristics of good mathematics teaching from the perspective of the students?

Video-recordings of 13 consecutive lessons (3 during the familiarization stage and 10 as part of the study) for each teacher were collected using three cameras. The Teacher camera captured the teacher’s actions and talk during the lesson. The Student camera focused on two students, known as the “focus group”, and captured their actions and talk during the lesson. Each group of students was only videotaped once. The Whole-Class camera captured the whole class in action.

After every lesson, the two students in the focus group for the day were interviewed separately. The interviews were conducted immediately after school each day, and the split-screen video-recording of the day’s lesson was used as a stimulus for the student interview. The teachers were interviewed four times: once each week for 3 weeks and once more at the end of their participation in the study. The interviews were based on a lesson the teacher had taught during the week, and the video-recording of the lesson was used as a stimulus for the teacher interview.

At the end of the study, the students took the International Benchmarking Test (IBT) as required by the LPS and also completed a questionnaire designed by the research team in Singapore. The maximum score for the test was 50.

The three classes taught by these teachers were Secondary 2 Express classes offering the GCE O-level Mathematics course for their national examination, to be taken at the end of Secondary 4. Teacher 1 (T1) taught a class of 37 students. The Primary School Leaving Examination (PSLE) aggregate scores of her students were in the range of 245–267, with mean score = 250 and median score = 249. Their mean IBT score was 42.8 (85.6%).

Teacher 2 (T2) taught a class of 40 students. The PSLE scores of her students ranged from 253–265, with mean score = 253 and median score = 252. Their mean IBT score was 41.9 (83.8%). Teacher 3 (T3) taught a class of 40 students. The PSLE scores of his students ranged from 188–253, with mean score = 207 and median score = 206. Their mean IBT score was 38.3 (76.6%).

It is apparent that both T1 and T2 taught students who were high achievers, while T3 taught students who were of average ability.

**FINDINGS**

*The Teachers’ Perspective*

The instructional approaches used by the three competent teachers T1, T2 and T3 studied were mainly whole-class demonstration, seatwork, whole-
class review of student work, or combinations of these three as their discourse patterns. Their highly structured instructional models were a composite of instructional cycles, at times similar in format and repetitive. These sequential cycles were incremental in nature, with mathematical knowledge being built up from one cycle to the next. Each cycle focused on a single instructional objective or part of an objective, and the teachers tended to use mainly examples from the textbooks and mistakes made by the students as their teaching tools in the development of students’ mathematical understanding.

During whole-class demonstration, all three teachers played an active role in expounding mathematical concepts and problem-solving skills mainly through the use of examples. The examples had been carefully selected and systematically varied from low to high levels of complexity. The most common interaction pattern in the three classrooms was the initiation-response-feedback (IRF) discourse format (Sinclair & Coulthard, 1992). The teacher asked a question, the students responded, and then the teacher gave feedback.

The main form of student activity in all three classrooms was seatwork, individual or group or both. Seatwork almost always followed whole-class demonstration or whole-class review of written work. During seatwork, all three teachers actively monitored their students’ understanding by moving from student to student. They guided those with difficulties and selected student work for subsequent whole-class review and discussion. Whole-class review of student work comprised review of both in-class work as well as homework. This segment appeared to be the crucible for reinforcing student understanding of knowledge expounded during whole-class demonstration.

Though it appeared to be teacher-centred, the main source of content for the discourse was students’ work—incorrect solutions, good presentation of solutions, and multiple solutions to a problem. The emphasis of the discourse was learning from mistakes and the conceptual knowledge that guided the process of arriving at the solution.

Despite the seemingly teacher-centred approach that characterized all three teachers’ instructional approaches, there were strong indications, particularly from the review segments, that the students’ thinking was frequently taken into consideration during lessons and foregrounded in the discourse, albeit through the teacher.

Needless to say, there were also differences in the instructional approaches of the teachers. However, it is not the intention in this brief to explore the differences in the three classrooms.

**The Students’ Perspective**

Part of the interview of the “focus group” students was stimulated by the following two prompts:

1. Would you describe that lesson as a good one for you?
2. What has to happen for you to feel that a lesson was a “good” lesson?

A total of 59 students were interviewed: 19 from the class of T1, 20 from the class of T2, and 20 from the class of T3. Their responses to the above two prompts were analysed to establish the students’ perspectives of good mathematics teaching.

Analysis of the interview data specific to the prompt *Would you describe that lesson as a good one for you?* showed that 94%, 85% and 84% of the students of T1, T2 and T3 respectively felt the lesson was a good one for them. It may be inferred from these high percentages that generally the lessons of the three teachers were deemed as good by their students.

Analysis of the interview data specific to the prompt *What has to happen for you to feel that a lesson was a “good” lesson?* shed light on students’ perceptions of desired characteristics of good mathematics lessons. According to the students, a good lesson was one where the teacher did one or more of the following:

- explained clearly the concepts and steps of procedures;
- made complex knowledge easily assimilated through demonstrations, use of manipulatives, and real-life examples;
- reviewed past knowledge;
- introduced new knowledge;
- used student work/group presentations to give feedback to individuals or the whole class;
- gave clear instructions related to mathematical activities for in-class and after-class work;
- provided interesting activities for students to work on individually or in small groups; and
- provided sufficient practice tasks for preparation towards examinations.
Teachers’ and Students’ Perspectives: A Juxtaposition

By juxtaposing the findings of the teachers’ instructional approaches and interview data from the students, it is hypothesized that good mathematics teaching in the three Secondary 2 classrooms comprised three main segments: whole-class demonstration (exposition), seatwork, and review and feedback. Some of the actions that characterized good teaching in each of the segments are listed below.

Whole-class demonstration
The teacher:
• explained clearly the concepts and steps of procedures;
• made complex knowledge easily assimilated through demonstrations, use of manipulatives and real-life examples; and
• introduced new knowledge.

Seatwork/after-class assignments
The teacher:
• gave clear instructions related to mathematical activities for in-class and after-class work;
• provided interesting activities for students to work on individually or in small groups; and
• provided sufficient practice tasks for preparation towards examinations.

Review and feedback
The teacher:
• reviewed past knowledge; and
• used student work/group presentations to give feedback to individuals or the whole class.

IMPLICATIONS
The findings reported in this brief have implications for both practice and teacher training.

For Practice
The practices of competent mathematics teachers are worth emulating. Mathematics teachers may, in particular, note the value of using students’ in-class work or homework to strengthen mathematical understanding. Taking into consideration their students’ perspectives of good teaching will strengthen the teaching-learning nexus in mathematics classrooms.

For Teacher Training
Findings from this study are useful in the preparation of mathematics teachers. The value of finding out student perceptions, the use of student-generated material, and monitoring of student work-in-progress will all contribute to enhanced programme effectiveness.

REFERENCES

ABOUT THE AUTHOR

Berinderjeet KAUR is with the Mathematics and Mathematics Education Academic Group at the National Institute of Education, Nanyang Technological University, Singapore. She is also Head of the Centre for International Comparative Studies at NIE.

Contact Dr Kaur at berinderjeet.kaur@nie.edu.sg for more information about the project.

>> More information about NIE’s research centres and publications can be found at www.nie.edu.sg