

A study of school mathematics curriculum enacted by teachers in Singapore secondary schools

The “Enactment Project” is a Programmatic Research Project funded by the Ministry of Education, Singapore, and administered through the Office of Educational Research, National Institute of Education, Nanyang Technological University. The project began in 2016 and its aim is to study the enactment of the Singapore mathematics curriculum across the whole spectrum of secondary schools within the jurisdiction. Under this overarching goal, there are two supporting studies: Study 1 examines the classroom enactment by teachers in relation to the curriculum framework as organised in the Pentagon (Skills, Concepts, Attitudes, Processes, Metacognition, with Problem Solving at its centre); Study 2 focuses on the enactment as seen through the instructional materials designed by the teachers.

Chair/Discussant: Berinderjeet Kaur

Paper 1: Toh Tin Lam, Berinderjeet Kaur, Tay Eng Guan, Lee Ngan Hoe, & Leong Yew Hoong *A study of school mathematics curriculum enacted by teachers in Singapore secondary schools.*

This paper provides an overview of the study, which covers the background, the organisation into two supporting studies, the methodology, and the phases of the project.

Paper 2: Berinderjeet Kaur, Lee Ngan Hoe, Ng Kit Ee Dawn, Yeo Boon Woon Joseph, Yeo Kai Kow Joseph, & Liyana Safii *Instructional Strategies Adopted by Experienced Secondary Teachers when Enacting the Singapore School Mathematics Curriculum.*

This paper presents preliminary findings of Study 1. In particular, it examines the instructional strategies adopted by teachers in the first phase of the project – where thirty competent teachers were selected for close study, which included video-recording of a suite of lessons and post-lesson interviews.

Paper 3: Leong Yew Hoong, Cheng Lu Pien, & Toh Wei Yeng Karen *Chronologically-grounded survey.*

This paper describes a methodological contribution by Study 2. From Phase 1 of the project, we obtained some characteristics of design utilised by competent teachers. To study the extent in which these characteristics capture the design work of teachers across Singapore secondary schools, we developed an instrument: Chronologically-grounded survey.

Paper 4: Tong Cherng Luen, Tay Eng Guan, Berinderjeet Kaur, Quek Khiok Seng, & Toh Tin Lam *Singapore Secondary Mathematics Pedagogy: The DSR DNA.*

This paper reports findings from a statistical analysis of a survey on 689 teachers in the second phase of the project. In particular, it analyses data from 32 items in one component of the survey regarding teacher moves in the classroom.

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This paper provides an overview of a programmatic research project, the Enactment Project, at the National Institute of Education in Singapore. The project studies the enactment of school mathematics by competent experienced teachers in secondary schools and also how widespread practices of these competent experienced teachers are in the classrooms of mathematics teachers in general. It elaborates the two studies and two phases of the project.

The Enactment Project

Background

The main goal of this programmatic research project, the Enactment Project, is to examine how experienced secondary school teachers implement the designated curriculum prescribed by the Ministry of Education in the 2013 revision of curriculum. This research is timely as it will be carried out in 2016-18, three to four years after the revised curricula for mathematics has been introduced. The findings will be pertinent for subsequent revision of the curricula.

It is a special focus project of system studies in pedagogical and educational outcomes. It focuses on understanding what goes on and what works in Singapore's classrooms – more specifically, the instructional core (City, Elmore, Fiarman & Teitel, 2009). The instructional core comprises

“the teacher and the student in the presence of content ... it is the relationship between the teacher, the student, and the content – not the qualities of any one of them by themselves – that determines the nature of instructional practice, [even though] each ... has its own particular role and resources to bring to the instructional process” (City et al., 2009, pp. 22-23).

The project is about the interactions between secondary school mathematics teachers and their students, as it is these interactions that fundamentally determine the *nature* of the actual mathematics learning and teaching that take place in the classroom. It also examines the content through the instructional materials used – their preparation, use in classroom and as homework. Such studies are crucial for the Ministry of Education (MOE) in Singapore and schools to gain a better understanding of what works in the instructional core in their classrooms and schools. This is critical for the development of their education system.

Past large scale studies (Hogan et al., 2013a, 2013b, 2013c) of mathematics teaching and learning in Singapore secondary classrooms, involving random samples, suggest that:

- i) Teachers focus more on procedural knowledge than conceptual knowledge and only engage students in domain-specific knowledge practice in about a third of the instructional time of a typical lesson. Procedural learning support is evident as teachers often help students with “how to do steps”.
- ii) Students are engaged in doing performative tasks (77.3%) more than knowledge building tasks (22.7%). A performative task mainly entails the use of lower order thinking skills such as recall, comprehension and application of knowledge while a knowledge building task calls for higher order thinking skills such as synthesis, evaluation and creation of knowledge.
- iii) The dominant performative orientation of pedagogical practice in Singapore (Hogan et al., 2013c, p. 100) may explain Singapore’s stellar performance in international studies.

While the above findings provide some insights about the widespread orientation of secondary school mathematics classroom teaching and learning in Singapore, they do not inform us about what our competent experienced teachers do when compared to the broad base of teachers studied. Furthermore, it is also not possible to infer how the “performative orientation” has contributed to Singapore students’ performance in PISA studies.

Conceptual framework

Conceptualization of the curriculum enactment process is shaped by the visual model, shown in Figure 1, created by Remillard & Heck (2014). Kaur (2014) noted that this model was rigorous for researching the enactment of school mathematics curriculum in Singapore.

The model shows that as teachers draw on the designated curriculum (which in the case of the project is the Mathematics Syllabus for Secondary Schools (Ministry of Education, 2012)) along with other resources (particularly instructional materials) to design instruction they create what we would refer to as “teacher-intended” curriculum in the context of the project. It includes the interpretation and decisions teachers make to envision and plan instruction. Remillard and Heck (2014) noted that this form of curriculum is difficult to document as part of it exists in the most detailed form in the teacher’s mind. Nevertheless, detailed teacher plans and post lesson video stimulated interviews with the teachers may offer an opportunity to capture the teacher-intended curriculum and its enactment succinctly.

The two studies

The two studies of this project are:

- i) Study 1: Pedagogies adopted by competent experienced mathematics teachers when enacting the curriculum
- ii) Study 2: Competent experienced secondary school mathematics teachers’ use of instructional materials for the enactment of the curriculum

Each study is guided by a string of detailed research questions which are detailed in Kaur et al., (2018). Both studies draw on the same data set and are being carried out concurrently.

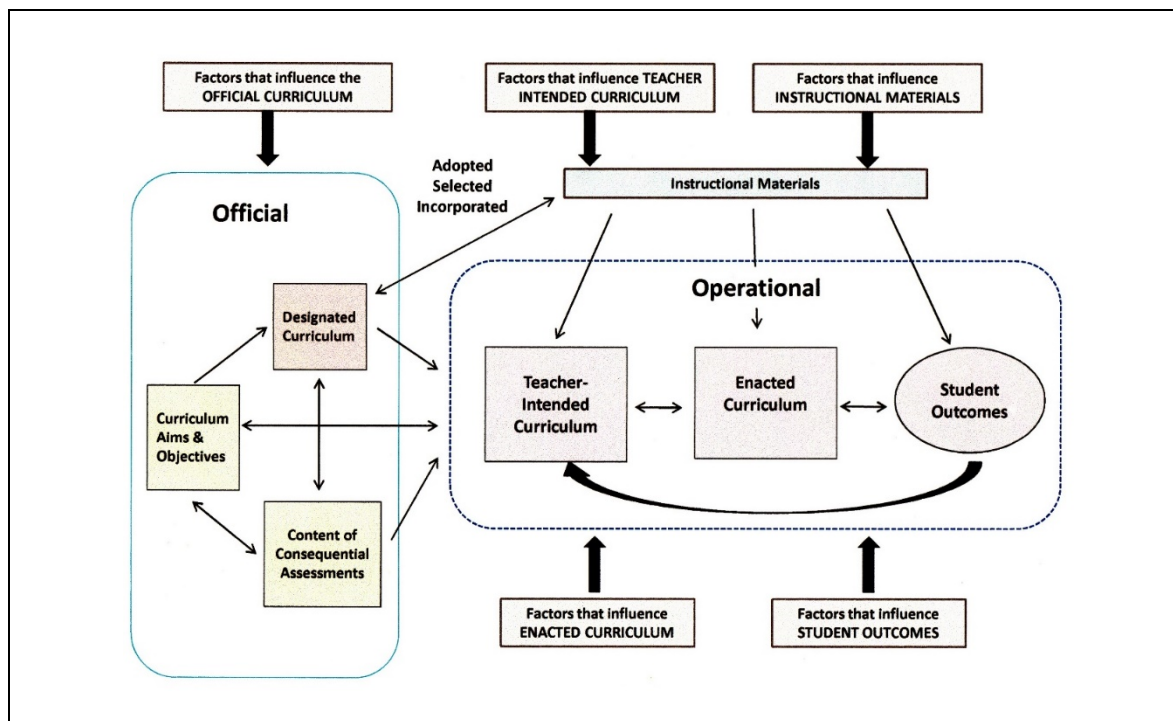


Figure1: Model of the curriculum enactment process (Remillard & Heck, 2014, p. 709)

The two phases

The project has two phases, the first and second. The first phase is the video segment and the second one is the survey segment. The survey segment is dependent on the findings of the video segment. The video segment documents the pedagogy of competent experienced secondary mathematics teachers while the survey segment aids in establishing how uniform the pedagogy of these competent experienced teachers is in the mathematics classrooms of Singapore schools. The video segment of the study is adopting the complementary accounts methodology developed by Clarke (1998 & 2001), a methodology which is widely used in the study of classrooms across many countries in the world as part of the Learner's Perspective Study (Clarke, Keitel & Shimizu, 2006). This methodology recognizes that only by seeing classroom situations from the perspectives of all participants (teachers and students) can we come to an understanding of the motivations and meanings that underlie their participation. It also facilitates practice-oriented analysis of learning. For the survey, the project is adopting a self-report questionnaire to collect data on teachers' enactment of their "teacher-intended" curriculum.

Thirty competent experienced teachers (10 Express course of study, 4 Integrated Programme, 8 Normal (Academic) course of study and 8 Normal (Technical) course of study) and approximately 600 (in each class about 20 students, who volunteered to be the focus students were interviewed) students in their classrooms participated in the video segment of the project. In the context of the project, a competent experienced teacher is one who has taught the same course of study for a minimum of 5 years, is recognized by the school / cluster as a competent experienced teacher who has developed an effective approach of teaching mathematics. These teachers were nominated by their respective school leaders and the research team followed up on the nominations and interviewed the teachers. A strict requirement for participation in the study was that the teacher had to teach the way she / he

did all the time, i.e., no special preparation was expected.

For the survey segment of the project, 690 secondary school mathematics teachers, purposefully sampled and representative of the profile of mathematics teachers in Singapore secondary schools, participated in the project.

Data and findings

The following three papers in this symposium provide some results from phases 1 and 2 of the project.

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