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 Wooi 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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Chronologically-grounded survey

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This is a common experience among education researchers: we notice a surprising instructional move enacted by a teacher. After deeper reflection, we ask, "How many other teachers in Singapore do this?" In this paper, we describe an instrument we designed that is part of the resource needed to answer such questions.

In this paper, we focus on the challenge of constructing survey items for the purpose of eliciting teachers' commitment to particular instructional practices. This enterprise encounters these theoretical hurdles: How do we strengthen the match between the meaning the crafter imbues into the item and the meaning that teachers draw from the item? How do we strengthen the match between the issues-of-focus that are of interest to the crafter of the items and the issues-of-focus that are of interest to teachers? How do we strengthen the match between the teacher's commitment to the survey items and his/her commitment in actual practice? Historically, each of these questions corresponds roughly to the respective problems of construct validity, research-practice link, and the gap between avowed belief and actual practice. We will return to these after the next section.

Background

The study reported here is part of a bigger research enterprise known as the Enactment Project. The aim of the project is to find out how the mathematics curriculum is enacted in Singapore secondary schools. We proceeded in two phases. Phase 1: we conducted in-depth analyses of classroom instructional practices adopted by thirty exemplary teachers. We derived common characteristics across some of these teachers. Our findings in this phase are reported elsewhere (e.g., Leong, Cheng, Toh, Kaur, & Toh, in press; Leong, Kaur, Lee, & Toh, in press) and will not be repeated here. Phase 2: we sought to examine the extent of these characteristics across more secondary schools in Singapore. We targeted 600 teachers from a wide range of schools. In terms of realistic methodology, it is not feasible to proceed using the same research instruments and frames – that is, video-recording of representative lessons with teacher- and student-interviews interspersed within these recorded lessons – at this larger scale. As such, we drew the data in this second phase from teachers' response to an online questionnaire. The survey items from this questionnaire drew from the characteristics we derived in Phase One. This challenging 'transference' from characteristics-of-practice in Phase One to characteristics-to-survey in Phase Two is the subject of our investigation in this paper.

We limit the scope to characteristics with respect to teachers' design of instructional materials. By instructional materials (IM), we mean materials that teachers bring into the classroom for instructional purposes, and in a form that is classroom-ready for students' access in the learning of mathematics.

The survey items

The purpose of the survey items is to determine the extent to which Singapore secondary mathematics teachers utilise certain moves in designing their IMs. How do we translate these moves we extracted from the earlier teachers into survey items in such a way that other teachers who read the items can resonate with its contextual meanings when responding to the questionnaire? Chronologically-grounded survey (CGS) is an attempt at addressing this question.

The CGS carried these features: (i) it was based on the actual IM used by teachers in Phase One; (ii) it presents (in the first section of the questionnaire) a broad sweep of how the IM was used by showing chronological snippets of the IM; (iii) the items (in the second section of the questionnaire) zoom-in to specific moves used by the teacher in each snippet to elicit response. Figure 1 gives an extract of one such online screen-page in the second section of the questionnaire.

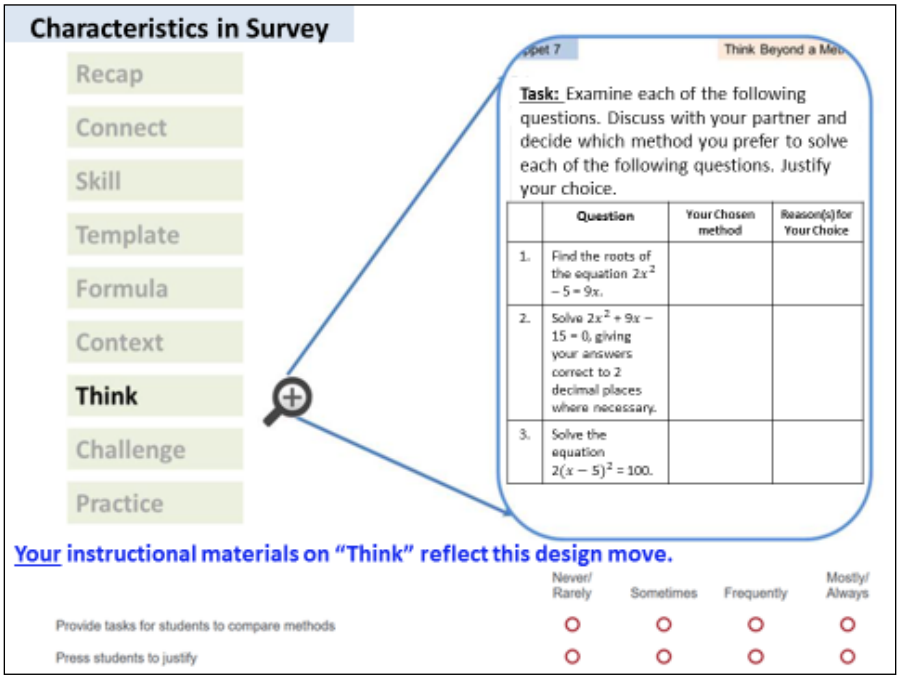

Figure 1. Extract of one page of the online CGS

Figure 1 provides a concrete illustration of the three features: (i) the diagram at the top-right is an extract from a teacher's IM; (ii) the left column retains the chronological categories that were covered in the first section of the questionnaire; and (iii) the response items at the bottom describe the zoomed-in design moves relevant to this particular part of the teacher's IM.

We think that CGS has the potential of addressing the challenges we raised in the introductory section of this paper: (a) [Construct validity]. The use of authentic IM and the chronological arrangement strengthens the teacher's closeness of interpretation to the intended meaning of the items. Singapore teachers are known to organise their instructional plans and routines along temporal lines. Compared to 'contextless' survey items, it is easier for teachers in the CGS environment to experientially connect to the chronological flow and contents of the IM, thus more readily respond to the items with a degree of mental resonance (or dissonance); (b) [research-practice link]. We did not craft the items based on some imaginary or purely theoretical starting point. Rather, as explained in the preceding section, we drew from the actual IMs used by the teachers, and based on careful analyses, derived

the characteristics of design that are "grounded" in practice. This rigorous process strengthens the closeness-to-practice within the research setup; (c) [belief-practice gap]. When teachers commit to, say, "frequently" to a response item, they are indicating an avowed belief towards the stated design move. It is acknowledged that there can be a significant gap between this avowed belief and actual design moves. With the items being "chronologically-grounded", there is a higher likelihood that teachers would not merely read these items in abstraction; rather, they would project mental imageries of how these sections of the IM square (or not) with their lived professional experiences.

From the data

Internally, we discuss at length the tension between heightening teacher's sense of resonance with the prompts and the accentuation of the social desirability bias. The line of thought is: higher contextual relevance provided by the CGS items may increase the former but also the latter – as teachers envisages more clearly the instructional utility described in the items, wouldn't they also tend to rate highly on these items as they are then seen to depict socially desirable professional traits? If this is so, then the net effect may not be a strengthening of construct validity, as claimed earlier.

As an initial exploration to this tension, and due to space limitations, the investigation we report here is solely based on responses to one snippet – the page as shown in Figure 1. This was selected for two reasons: (1) Since the label for this page is "Think", and with the Singapore education authority's continual emphasis on "thinking schools" over the last two decades, this is likely to be the subject for the greatest social desirability bias effect; (2) Based on qualitative responses in the survey, the snippet as shown in Figure 1 has the highest count in terms of explicit references of positive comments. 42 out of 302 teachers indicated that they liked this page. [302, not 600, because teachers were channeled into different survey tracks according to their teaching experiences]. Again, the logic is: since this is the most-liked page, it is most likely the subject of the social desirability bias.

We looked at the responses of the two items listed under this page (see Figure 1): Item A – Your instructional materials on "Think" reflect this design move [as in, you] provide tasks for students to compare methods; Item B - Your instructional materials on "Think" reflect this design move [as in, you] press students to justify. We assigned the scores of 1, 2, 3, 4, to the responses of "Never/Rarely", "Sometimes", "Frequently", "Mostly/Always" respectively. The summary of means is given in Table 1.

Table 1
Summary of means

Item	All 302	42 who likes
A	2.40	2.26
B	2.47	2.29
All	2.91	2.94

The means show that, for all the 302 respondents, the claim for regular-use of the features flagged in this snippet in their own design of IMs is not strong. In other words, there is no evidence in support of the social desirability bias from the responses to items in this snippet. Moreover, we make a stronger case using this logic: if there were social desirability bias, it would have been more pronounced among the 42 who had explicitly stated that they endorsed this snippet; instead, their means were lower than the overall means of the respective items.

At least, there is no evidence here of such a bias that would threaten construct validity.

An interesting finding – we think a direct consequence of the close resonance that CGS affords to teachers (that is, the research-practice link) – is that, out of the 42 who indicated they liked the page, eight made explicit statements about how they have learnt from this particular piece of IM. Language such as "I want to adopt …", "I will like to try …", "I am intrigued by …" were used. We extract this particular response because it captured the admirable honesty necessary for professional growth that we advocate: "Regretfully, I don't encourage or provide students [with opportunities] to explore alternative methods, let alone compare them. I need to work on this …". If this honesty can be shown to be pervasive across the sample (an effort beyond the scope of this paper), it will support CGS's facility in closing the belief-practice gap.

That IMs can be "educative" (Davis & Krajcik, 2005) – in the sense that teachers can learn professionally when using them – is not surprising; that the CGS can be a platform to facilitate this educative encounter is encouraging. This can open up new ways of conceptualising professional development programmes – perhaps, integrate a teacher survey component using CGS into in-service courses?

Discussion

CGS is in the early stages of instrumentalisation, and the ideas purported here are exploratory. But we think CGS can potentially contribute to the development of surveys that are practice-near without compromising the aims and rigours of research. We are not aware of teacher survey instruments of this nature that are currently administered at scale. Research on "what teachers really do in the classroom" can be broadly classed as: (1) case studies based on analysis of actual classroom observations or videos. Due to logistical resources demanded, realistically, only a few cases can be studied this way. This challenges any claims of representativeness of the findings to the wider jurisdiction; (2) survey designs that targets large sample size for representativeness. This overcomes the logistical constraints but usually compromises the "resonance" with ground experiences. The results of the research are generally 'distant' and irreconcilable with "what teachers actually do in the classroom. CGS is a bridge between these two traditional paradigms of research: we began with case studies to derive the characteristics, and use them to craft survey items that are "chronologically-grounded".

References

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