

Teachers' Concerns About The Revised Mathematics Curriculum

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Abstract

The revised 1990 mathematics syllabus for the New Mathematics Curriculum is being implemented progressively in Singapore schools since 1991. It is a transition period for teachers adapting to any new changes in the curriculum. The purpose of this study is to identify the stages of concern and the types of constraints faced by primary and secondary school teachers that are brought about by changes in the mathematics curriculum. The results show that most of the teachers were aware of the new curriculum and many were already teaching it, however, the initial stages of concern regarding needs for more knowledge and understanding of the rationale for new topics and personal needs like new skills to cope with these changes were found to be most intense and urgent. As such, their open-ended statements of concerns reflected that they felt strongly the constraints of time which was related to the increase in load of the content, lack of knowledge on new topics and teaching skills to help their pupils especially those whom they believe were not ready due to slow cognitive and language development. The results of this survey have implications for improvement in training teachers for the new syllabus.

Introduction

The revised primary and lower secondary mathematics curricula for Singapore schools in the 1990's present a vision for the teaching and learning in mathematics that reflects recent development in mathematics education around the world. Much of this vision is presented in terms of **change** (Mathematics Newsletter, 1990). Change from an emphasis on rote memorisation of facts and procedures to meaningful understanding of concepts and problem solving; change from a dependence on paper and pencil, manipulative computations and skills to mental calculations and thinking strategies; change from teaching by telling to meaningful teaching through activities, group work and communication in mathematics; and lastly change from paper and pencil testing for the sole purpose of assigning grades to alternative assessment methods. It is important to recognise that the key figures responsible for changing the ways in which mathematics is taught and learned in the classroom are the teachers. How mathematics curricula change is

implemented depends in turn on teachers' images of the mathematics they are teaching (Thompson, Philipp, Thompson and Boyd, 1994). If teachers' image of mathematics is a body of facts and rules, the tendency is for teachers to adopt a calculational approach. Whereas if teachers' image of mathematics is that of a process of thinking and reasoning then a conceptual orientation will be manifested in their teaching.

Support in the form of re-education through in-service briefing sessions and provision of appropriate instructional materials are essential for practising mathematics teachers in Singapore who have to teach in the conceptual way as prescribed in the new syllabus. However, it is important to recognise that at the heart of the process of implementation are the teachers who along with knowledge have feelings, beliefs, and values that must be addressed if change is to occur. In an extensive review of research literature on staff professional development, Clarke (1994) extracted ten important principles that can be used to guide the planning and implementation of staff development programmes. Top on the list of the ten principles is the issue of teachers' concern and interest during innovation adoption in the curriculum. For curricula reform to achieve significant change in classroom practice, change facilitators such as curriculum developers and administrators need to address issues of concern and constraints, identified by the teachers themselves in terms of changes to content, pedagogy and assessment of the revised mathematics syllabus. In diagnosing teacher needs and constraints during implementation of innovation, staff developers and trainers can use these concern data to tailor more relevant and adaptive in-service programmes to facilitate teachers in the process of change.

In Singapore the revised syllabus for the New Mathematics Curriculum is being implemented progressively in schools since 1991. According to the Ministry of Education schedule for implementation, by 1996 all primary mathematics teachers and by 1993, all lower secondary teachers would have been involved in teaching the new syllabus. It is a transition period for teachers adapting to the changes in the curriculum. In an investigation on teachers' concern during adoption of a new science curriculum, Hall and Loucks (1978) recognised that change is a highly personal experience, it is a process and not an event. Teachers involved in change go through stages in their perceptions and feelings about the innovation, as well as in their skill and sophistication in using the innovation. There is a progression of concerns from self (do I know the content?) to task (how do I explain this concept?) to impact (are my pupils learning something worthwhile?) among teachers involved in an on-going adoption of the new curricula.

In the Singapore context, the change in the mathematics curriculum is something that teachers have to adopt as agents of educational policies. This change is not experienced passively by teachers. They have certain perceptions, feelings, motivations, frustrations and satisfaction in the change process. Hence the objectives of the present study are:

- i. to assess the stages of concern among samples of Singapore primary and secondary school teachers during their adoption of the new mathematics syllabus;
- ii. to identify the constraints faced by these teachers in using new curriculum materials with their pupils;
- iii. to recommend training programmes to resolve issues of concerns and constraints identified by teachers.

Method

Subjects

The subjects were 173 teachers from 21 primary schools and 116 mathematics teachers from 20 secondary schools. These schools were well spread out in locations and types such as government and government-aided in Singapore. About 51% of the primary school teachers and 27% of the secondary school teachers in these samples had over 20 years of teaching experience; while 18% and 25% of the primary and secondary school teachers respectively had 5 years or less of teaching experience. About a quarter of the primary and secondary school teachers did not receive any form of training or briefing from the Ministry of Education on the New Mathematics Curriculum while 61% and 72% of the primary and secondary school teachers respectively had attended some in-service briefings or workshops. Only 15% of the primary and 19% of the secondary school teachers in this study were not yet involved in teaching the new mathematics syllabus. Data on teachers' concerns and constraints with regard to the new mathematics curriculum for this study were collected from these teachers using the Stages of Concern (SoC) questionnaire and an open-ended statement response to a question. Participation was voluntary and confidentiality was assured.

Stages of Concern (SoC)

Research has identified seven stages of concern for the typical adult user of an innovation. These stages are closely linked to personal beliefs about instructional practice and student learning:

Stage 0 - AWARENESS: *"I am not concerned about any change."*

At this stage, teachers are not really concerned about making changes in their approach to instruction.

Stage 1 - INFORMATIONAL: *"I would like to know more."*

Teachers have a general awareness and interest in learning more details. They are interested in substantive aspects of the new curriculum in a selfless manner such as general characteristics, effects and requirements for use.

Stage 2 - PERSONAL: *"How will using these ideas affect me?"*

Teachers are more committed to the innovations and more interested in being involved. They are uncertain about the change in their roles and their ability to meet those demands.

Stage 3 - MANAGEMENT: *"I am overwhelmed. How do I organise?"*

The teachers' attention is now focused on the processes and tasks of implementing the new curriculum; how best to use both the information and resources that have been provided. Issues related to organising, managing, and time are utmost in their minds.

Stage 4 - CONSEQUENCE: *"How is the innovation affecting my students?"*

Teachers begin to focus on the impact the change is having on their students; in particular to the relevance of the new curriculum for students' learning and evaluation and how to enhance students' performance.

Stage 5 - COLLABORATION: *"I'm concerned about sharing ideas for change."*

Teachers are eager to coordinate and cooperate with others on how best to generate change through the new curriculum.

Stage 6 - **REFOCUSING**: *"I am confident that I can improve on ideas learned."*

At this last stage, teachers explore more universal benefits from the new curriculum, including the possibilities of major changes or replacement with a better alternative to the proposed change.

Hall, George and Rutherford (1979) developed a reliable and valid questionnaire for assessing users' stages of concern. This questionnaire was used for the present study. It consists of 35 items, each of which has a Likert scale [not true of me (0) to very true of me (7)] on which respondents indicate their present degree of concern about the topic described in the item. The raw scale score for each stage of concern is computed based on five items and converted to a score on a percentile scale using the conversion chart from Hall, George and Rutherford (1979, p. 27, Figure III.4.).

Results And Discussion

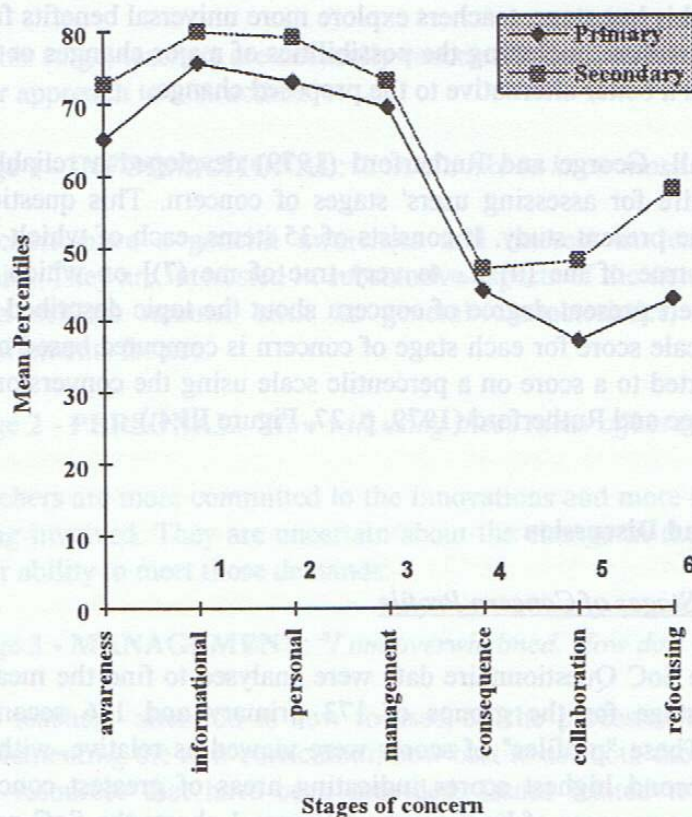
Teachers' Stages of Concern Profile

The SoC Questionnaire data were analysed to find the mean percentile of every stage for the groups of 173 primary and 116 secondary school teachers. These "profiles" of scores were viewed as relative, with the highest and the second highest scores indicating areas of greatest concern and the lower scores as areas of least concern. Figure 1 shows the SoC profiles of the primary and secondary school teachers with mean percentiles versus the stages of concern.

For both groups, the teachers' most intense concerns were on stages 1 and 2 (percentile means of 75.7 and 73.1 respectively for the primary level and percentile means of 80.0 and 79.2 respectively for the secondary level). This indicates that the teachers were most concerned at Stage 1, about having more general descriptive information on the new curriculum with respect to how the revised syllabus is better than the "old" and what resources are available and requirements to be met. This in turn is highly related to their next greater

concern at Stage 2 which is the personal implications of what and how the innovation would affect their classroom practices.

Figure 1 SoC Profiles of Primary and Secondary School Teachers



Coming close is the next stage of concern which is **management**, percentile means of 69.6 and 73.2 for the primary and secondary school teachers respectively. Teachers complained of having not enough time to complete teaching the syllabus, plan lessons, as well as incorporate new contents and approaches like mental calculations, problem solving and group work recommended in the new curriculum. The areas of least concern for the primary school teachers were on stage 5 (mean 37.2) and stage 6 (mean 42.9), whereas the secondary school teachers were on stage 4 (mean 47.1) and stage 5 (mean 48.1). Stage 5 is of least concern to the teachers which involves

collaborating with others. This is because the teachers as individuals were grappling with problems at the initial stages of concern at stages 1 and 2. While the primary school teachers were least concerned about refocusing for better alternatives to the new syllabus at stage 6 (mean percentile, 42.9) as they were still trying to come to grip with the compulsory curriculum packaged materials provided for them to use, the secondary school teachers displayed a higher concern, mean percentile, 58.1, in this area.

Constraints Faced By Teachers

Open-ended statements of concerns were solicited from the teachers by asking them for written responses to the question: **"When you are using the new maths syllabus (or any new maths curriculum packages), what specific aspects are you concerned about?"** Respondents were requested to be frank as confidentially was assured. From the overall tone and pattern of the open-ended responses of these teachers, these concern statements reflected the constraints that teachers encountered while implementing the revised curriculum. These constraints were coded and classified into six categories which were not exclusive but interrelated: (1) **Pupils' Readiness and Heavy Content** (2) **Pupils' Language Ability Constraint** (3) **Time Constraint** (4) **Lack of New Teaching Skills** (5) **Limitations of Resource Materials** (6) **Lack of Support System.**

About 63% of the primary school teachers and 59% of the secondary school teachers responded. 164 and 108 written statements of constraints from the primary and secondary school teachers respectively, were collected and the frequency of occurrences are shown in Table 1:

Table 1: Frequency of Constraints Faced By Teachers

Type of Constraints	Primary Teachers	Secondary Teachers
1. Pupils' Readiness	49 (30%)	12 ((11%)
2. Language Ability	12 (7%)	3 (3%)
3. Time	34 (21%)	29 (27%)
4. Teaching Skills	34 (21%)	32 (30%)
5. Resource Materials	19 (11%)	17 (15%)
6. Support System	16 (10%)	15 (14%)
Total	164 (100%)	108 (100%)

1. Pupils' Readiness and Heavy Content

30% of the primary school teachers felt that the pushing down of more content to the lower levels in the new primary mathematics syllabus was detrimental to slow learners. For examples, they were of the opinion that the learning of fractions starting at P1; and P2 addition and subtraction of number up to 1000 using mental strategies; and drawing of models to solve story sums, could be difficult for children who were developmentally not ready for such abstractions and sophistication. Many felt that there were too many new topics to be covered especially at P4 where children would not be able to assimilate the concepts meaningfully before teachers move on to complete the scheme of work for the streaming examinations. They felt that the new curriculum did not cater to the weaker pupils. Although this constraint was not as serious at the secondary level, 11% of the teachers also felt that some of the topics and problem solving approaches could be difficult for the weaker students. Examples of concerns:

"For children already having difficulty with the "old" syllabus, transferring the more difficult topics down e.g. adding unrelated fractions, multiples & factors, from P5 to P4, add greater pressure for them."

2. Pupils' Language Ability Constraint

12 teachers were of the opinion that the new curriculum package for pupils at the lower primary levels had too many written instructions and word problem sums which posed difficulties for pupils who have yet to develop a good grasp of the English language at that level. E.g.

"Pupils having to solve 2-step problems as early as in P2 and three or more steps in P3. Those with poor knowledge of the English language will never be able to understand the lengthy word problems."

3. Time Constraint

Both primary (21%) and secondary (27%) school teachers felt there was insufficient time to cover all the topics at each level and there were concerns about the quantity of workbook exercises and homework students had to do and teachers had to mark. In addition, due to the

shift in emphasis on problem solving in the new syllabus, curriculum materials developed by Curriculum Development Institute of Singapore (CDIS) for use in the primary and lower secondary levels contain more group activities and games in the teacher's guide for mathematical thinking, problem solving and investigation in the classroom. If teachers were to do these activities with the students, then they would be left with too little time to consolidate new concepts and skills in the syllabus. Examples of teachers' complaints were:

"The group activities and games suggested in the Teacher's Guide are interesting. The problem is that there is simply no time for such activities in class. As it is, all exercises in the workbook and Practice Exercises in the textbook have to be done as homework by the pupils."

"I feel that the Primary 4 syllabus is too heavy. The number of new topics is too many. There is too little time for the pupils to grasp concepts."

4. Lack of New Teaching Skills

Teachers were concerned about being able to put across new concepts for pupils to understand without being confused by too many methods suggested in the new curriculum package. 30% of the secondary school teachers felt inadequate in their teaching approaches on problem solving especially for non-routine problems as they saw no definite methods to it. Teachers were uneasy with the open-ended nature of problem solving. At the primary level, new topics like mental calculations proved to be a constraint where teachers were used to the old method of teaching pupils "count-on" algorithm instead of using various mental strategies.

"Mental calculation is difficult to impart to students who cannot produce results instantly - prefers long addition, subtraction or multiplication."

"When I am using the new maths syllabus, I am concerned about problem solving aspects and the various methods/ways to derive a solution and how to explain some of these methods."

5. Limitations of Resource Materials

The secondary school teachers expressed a lack of resource materials available for teaching problem solving apart from the standard textbooks that they had been using to cover the "O" level syllabus. As for the primary levels, comprehensive packages including pupil textbooks, workbooks, teacher's guides and resource materials were provided by CDIS for all schools. However teachers using them experienced limitations such as pupil workbooks should include activities for different ability pupils; pupil textbooks were not coordinated with the workbooks; too many repetitive sums; too many formats of a particular sum were given within an exercise which were confusing to children and teachers; too large numbers were used in certain exercises; too many workbooks per year; lack of charts and transparencies recommended in the teacher's guide; and other deficiencies.

6. Lack of Support System

Although teachers might have started teaching the new syllabus, many were still in doubt and in the dark about the purpose of its implementation as to *"how effective and practical this new syllabus is going to help our pupils by and large"*. A primary school teacher asked *"Is the new method going to help pupils learn better or is it going to confuse them further? Will the new method produce better results?"* Some felt the adaptation to the new curriculum should be gradual and assessment with respect to the P4 streaming examination, PSLE and "O" level should match the aims of the new curriculum. Teachers expressed frustration over lack of support from the school authority such as principal or head of department who demanded more of what's required in the new syllabus without understanding the constraints teachers had to face.

Conclusion And Implications

Although the new mathematics curriculum has been enforced in the primary and lower secondary schools since 1991, the results of this study show that the teachers in the sample involved in the progression of change were not enlightened on the "why", "what" and "how" of change. Most of the teachers were aware of the new curriculum and many were already teaching it, however,

the initial stages of concern regarding needs for more knowledge and understanding of the rationale for new "things" and personal needs like new skills to cope with these changes as they teach were found to be most intense and urgent. As such their open-ended statements of concerns reflected that they felt strongly the constraints of time which was related to the increase in load of the content, lack of knowledge on new topics and teaching skills to help their pupils especially those whom they believe were not ready due to slow cognitive and language development. The teachers felt very bounded by the syllabus and the stipulated requirements in terms of emphasis on problem solving and new methods of teaching certain topics, as well as quantity of pupil output like workbook and worksheets. These teachers also expressed a lack of support from change facilitators and school administrators in their understanding of the various problems encountered during the change. Teachers' concerns at the collaboration stage were assessed to be the least important in this study indicating that schools should foster more autonomy among teachers and provide opportunities for shared decision making on the best ways to handle teaching problems and how to adapt the new syllabus for the weaker students.

The results of this study reveal a variety of implications for the curriculum developers, staff developers and teacher trainers. In-service training programmes are more likely to achieve significant change in classroom practice if they are seen by teachers as being responsive to their needs. After-school or one-day regional workshops or a Saturday morning briefing for teachers on the new syllabus were judged to be insufficient. Training should be for those teachers on the two stages of concern: informational and personal. The teachers might be lacking a sophisticated view of mathematics as advocated in the new curriculum. If traditionally teachers see mathematics as a "step-by-step" process, then it is difficult for them to conceptualise the solution process to a problem including the generating of multiple solution methods. Both groups of teachers in this study had expressed confusion to the "too many methods" proposed in their instructional materials for teaching concepts and problem solving. Training programme is more effective when it involves theory, demonstration, practice and feedback. Such training programmes should emphasise goal-oriented outcomes such as teachers practising new skills, using problem solving strategies and adapting strategies and contents for learners of different abilities.

When teachers are told what to do, they do not think; they just respond. If the activity was not of their choice they do not find it personally meaningful and they are more likely to see theory, research and practice as fragmented and disconnected. Through reflecting on teaching practices, teachers develop

autonomy. Teachers should be given opportunities to share their views with others and to hear and debate the views of others. Teachers can and do learn many things on their own. Within school there should be collaborations of teachers through project activities focusing on how to incorporate changes proposed in the new curriculum. Teachers can under the leadership of the head of department, identify a particular problem or need, develop an action plan, acquire the knowledge or skills required to implement the plan, implement the plan and then assess the outcome. Teachers learn more effectively when they have a need to know and a problem closest to them to be solved. With enhanced knowledge it will influence their beliefs and change their instructional strategies and in turn the performance of their students.

References

- Clarke, D. (1994). Ten Key Principles from Research for the Professional Development of Mathematics Teachers. In D.B. Aichele & A.F. Coxford (eds.) **Professional Development for Teachers of Mathematics - 1994 Yearbook**. National Council of Teachers of Mathematics Inc. Reston, Virginia.
- Hall, G.E., George, A.A. & Rutherford. (1979). **Measuring Stages Of Concerns About The Innovation: A Manual For Use Of the SoC Questionnaire**. R & D Report No.3032, Centre for Teacher Education, University, Texas, Austin.
- Hall, G.E., & Loucks, S.F. (1978). Teacher Concerns as a basis for facilitating and personalising staff development. **Teachers College Records**, 80:1, 35-53.
- Thompson, A.G., Philipp, R.A., Thompson, P.W. & Boyd, B.A. (1994). Computational and Conceptual Orientation in Teaching Mathematics. In D.B. Aichele & A.F. Coxford (eds.) **Professional Development for Teachers of Mathematics -1994 Yearbook**. National Council of Teachers of Mathematics Inc. Reston, Virginia
- Mathematics Newsletter, (1990). **The Revised Primary And Lower Secondary Mathematics Syllabus**. Vol.1 No.3 December. Curriculum Planning Division. Singapore.

