

Grade12 Mathematics Teachers' Views on Curriculum Reform in New South Wales

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This paper reports on teachers' perceptions of major curriculum reform in New South Wales at the Higher School Certificate. Quantitative and qualitative data are presented. Measures of teacher self-efficacy and stress related to the innovation, as well as general perceptions of the implementation are reported. Mathematics teachers' views of the curriculum reform are also compared with those of other subject teachers.

The research reported in this paper was part of a larger study of a major curriculum reform in New South Wales. In particular, the parent study investigated the different sources of stress induced by the reforms, ramifications for teacher motivation and the success of the curriculum innovations. This paper focuses on some of the main issues reported by mathematics teachers and how perceptions of mathematics teachers compared with those of other subject teachers.

Background

The credential awarded for the final two years (11 and 12) of schooling in New South Wales is known as the Higher School Certificate (HSC). Following a substantial review of the HSC (McGaw, 1997) teachers began presenting the revised HSC curriculum to the first Year 11 cohort in February 2000. In November 2001, this cohort completed external examinations based on the new curriculum. This marked the most substantial and significant set of curriculum changes to secondary education in NSW for several decades. Arguably, the changes introduced in 2000 were highly significant, not only for the students, but also for their teachers. In most subjects, the new HSC meant major changes to what was to be taught and how students were to be assessed. Supporters argued that the changes significantly improved the quality of education in grades 11 and 12 and 'raised standards'. Prior to 2000, many subject areas offered a range of courses specifically designed for differing abilities. However, a major impetus of the reforms was to reduce the number of courses offered within subject areas. Of relevance here, two mathematics non-calculus courses (Mathematics in Practice & Mathematics in Society) previously designed for less mathematically able students were replaced by a single new course *General Mathematics*. This course included new topics on financial mathematics, statistics and mathematical modelling, with a greater emphasis on computer applications, especially spreadsheets (see NSW Board of Studies, 2000). This paper reports on the views of teachers of General Mathematics.

Theoretical Framework for the Study

A theoretical framework incorporating teacher stress, coping, and self-efficacy was developed to guide the larger study from which the data reported here were derived. Due to space restrictions only self-efficacy aspects are described here. Bandura's (1997) social cognitive theory (SCT) provides an extensive framework for understanding human motivation in varying contexts, including work environments (Bandura, 1997; Wood and

Bandura, 1996). Self-efficacy is a key construct in SCT. “Perceived self-efficacy is concerned with judgments of personal capability” (Bandura, 1997, p. 11). A key aspect of the self-efficacy construct is that it is highly specific. So, for example, a teacher may feel highly efficacious for teaching one mathematical domain, yet have low self-efficacy for teaching another; low self-efficacy for one form of lesson delivery, for example, practical work, and high self-efficacy for, say, presentation of theory. In studies involving motivational variables, self-efficacy has consistently been found to be the best predictor of achievement, and to be quite highly correlated with past achievement (Bandura, 1997; Bong and Clark, 1999). Bandura (1997) identified four constructs in SCT as primary sources of self-efficacy beliefs: past mastery experiences, vicarious experiences, social persuasion and physiological states. It was predicted that for the substantial HSC curriculum reform each of these four constructs would be relevant to some degree.

The likely impact of major curriculum changes on teachers' self-efficacy is further emphasised by research into teacher effectiveness. A study of HSC teachers by Ayres, Dinham and Sawyer (2000, 2004) found that effective HSC teachers shared a number of characteristics. Effective teachers had expert knowledge of the syllabus and the HSC exam. They were highly experienced and had built up vast resource bases around the HSC. Many belonged to strong departmental teams, members of which provided their own professional development. The mandated changes to the curriculum could be expected to alter the relevance of the existing subject knowledge base of teachers, reduce relevance of established resources and interfere with the overall effectiveness of teaching teams. All of which are related to sources of self-efficacy as outlined above.

Focus Group Data

The first stage of this study was completed in September 2001 and used focus groups to collect information on the main issues connected to the syllabus changes (see Ayres, McCormick & Beechey, 2002). Teachers expressed both positive and negative views about the new curriculum. However, in terms of the implementation, they expressed an overwhelming view that there was insufficient time to properly implement the new syllabuses, workloads had increased significantly, and too few resources were made available to properly support the transitional period. A strong view expressed by mathematics teachers in particular was that the new general mathematics syllabus was too difficult for many students. It was commonly stated that lower achieving students, those from a Non-English Speaking Background, and those with weak literacy skills, had not been catered for by the new syllabus. A further concern expressed by mathematics teachers was the requirement for teachers to use more computer technology, such as spreadsheets and other computer applications, which was seen as a new skill, for which greater training should have been provided.

Survey Development

The data from the focus group sessions were used in combination with established motivational instruments to develop a survey questionnaire. The first section of the questionnaire measured self-efficacy. Each item was scored using an 11-point scale ranging from 0% (no confidence) to 100% (complete confidence). The second section measured personal views of the implementation of the new HSC. Responses were scored on a Likert-type scale ranging from 1-strongly agree, to 5-strongly disagree. The third section,

measured stress with responses scored on a Likert-type scale ranging from 1-No Stress, to 5-Extreme Stress. At the end of the survey form, space was provided for teachers to comment further.

Method

Participants and Procedure

Surveys were sent to the home of teachers of one randomly chosen government secondary school in each of the 40 public school districts in the state of New South Wales (NSW), coinciding with Grade 12 students sitting their final HSC examinations. Consequently, teachers received the surveys after they had finished teaching the new courses for the first time. Information on the teachers was obtained through the NSW Teachers Federation. A total of 400 complete surveys were returned indicating a response rate of 25-33% of estimated Grade 12 teachers at the 40 schools. The sample consisted of teachers from over 30 separate teaching areas, including 32 teachers of General Mathematics.

Results

Exploratory and confirmatory factor analysis identified 13 factors (for more detail see McCormick, Ayres & Beechey, 2006). Inspection of means revealed for nine factors, notable differences between responses of mathematics and other teachers (see Table 1). As a consequence of these observable differences, these nine factors were included in a MANOVA. Three factors were related to *self-efficacy*, five to *personal views* and one to *stress* (see Table 1). All factors had a Cronbach reliability alpha value of at least 0.80. The remaining four factors are not discussed here on account of space restrictions. Because of the huge difference in sample size between the two groups (N=32 and N= 368), five different sub-samples of N=32 from the All Other Teachers group were selected at random. Five separate MANOVAs were then completed which compared the 32 mathematics teachers with the same number of randomly assigned other teachers over the nine factors. The overall F-statistic for each MANOVA was significant with the following p values: MANOVA-1 (p=0.02), MANOVA-2 (p=0.002), MANOV-3 (p=0.006), MANOVA-4 (p=0.006), and MANOVA-5 (p=0.002). Clearly mathematics teachers had different perceptions about the curriculum changes compared with other teachers. To identify individual factor differences simple effects tests were conducted, accepting only p values of less than 0.01 in order to control for Type1 error. As a consequence, significant differences were found on four factors (4, 5, 8 and 9).

For Factor 4, Mathematics teachers found past resources less useful than their colleagues. Mathematics teachers reported that many former lesson plans, activities and assessment tasks were no longer appropriate for the new curriculum. In particular, the preparation of new assessments was seen as an important issue, as the following quote illustrates:

Assessment criteria to be met makes a task twice as long to prepare.

One teacher was even critical of colleagues for failing to follow the new requirements:

Lack of willingness of an experienced staff to investigate alternate options of assessment rather than just re-using what they already have.

Table 1:

Means and standard deviations (in brackets) of each factor for Mathematics Teachers and All Other Teachers

Factors	Mathematics Teachers	All Other Teachers
1 Self efficacy: Teaching the new syllabus	0.68 (0.20)	0.73 (0.18)
2 Self efficacy: Incorporating technology into teaching	0.56 (0.26)	0.66 (0.26)
3 Self-efficacy: Teaching lower ability students	0.35 (0.25)	0.41 (0.25)
4 Personal views: Usefulness of past resources	3.70 (0.73)	3.31 (0.84)**
5 Personal views: Perceptions of positive change	3.58 (0.64)	3.16 (0.69)**
6 Personal views: Understanding the new syllabus requirements	2.54 (0.78)	2.27 (0.86)
7 Personal views: Support received from government and curriculum organisations	4.14 (0.94)	3.83 (0.92)
8 Personal views: Support received from local in-services and networking	3.66 (0.92)	3.23 (0.97)**
9 Stress: Caused by students	4.04 (0.99)	3.16 (1.17)**

** p < 0.01

The significant difference for factor 5 indicated that mathematics teachers were less positive about HSC changes than their colleagues. Mathematics teachers reported that their enjoyment in teaching had been reduced. One teacher even reported going on stress leave because of the new demands-

Took stress leave this year of 10 weeks, due mainly to expectations of new course and extra demands by employer.

A strong antipathy towards the *outcomes* approach was also present and expressed by some mathematics teachers:

These new courses and the outcome based assessments aim to increase teachers' workload and have no positive effect on student' learning. I prefer the old course and the old system of assessment

However, the strongest issue revealed by the qualitative data was that the new course was no longer suitable for many students. The following responses were typical:

Teaching in a low socio-economic area the lower ability students had extreme difficulty understanding the concepts. Too much reading involved in the questions — they already have poor literacy skills, therefore interpretation of what to do was a major problem. Add to that the course is very boring to these kids. It is too difficult for lower ability students.

The introduction of General Maths to replace Maths in Practice and Maths in Society is criminal for the non-academic students. In 2002 we will have 8 students in Year 11 not understanding a Maths course — this is the first time in the 15 years I have been at this school that students will not be doing Maths at senior level. In a changing society where maths (particularly financial knowledge) is essential providing no senior maths for low ability students is disgraceful

Differences on Factor 8 indicated that mathematics teachers found in-services less useful than their colleagues, and that there had been limited opportunities to discuss the new syllabus with teachers from other schools or network with them. There was also a

significant difference for Factor 9 (Stress Caused by Students). Overall, mathematics teachers reported being more stressed by student classroom behaviours than their colleagues. One teacher made a strong link between the new course and discipline problems:

Not suitable for lower ability students. They cannot achieve meaningful results in this subject.
Brings about a sense of failure. This leads to discipline problems and the need to grade classes.

Surprisingly no significant differences were found for any of the three self-efficacy factors despite the mathematics teachers having lower means. Of considerable interest here are the differences between the three factors (see Table 1). Overall, teachers were fairly confident that they could teach the new syllabuses. However, the confidence level was slightly lower on the factor Incorporating Technology into Teaching. Although not overall significant, mathematics teachers recorded the least confidence from any subject area on two items comprising the factor: *Use Technology the Syllabus Suggests*, and *Incorporate the Use of Technology in my Teaching*. Qualitative data revealed that teachers were worried about access to technology and the lack of training as the following quotes indicate:

Lack of access to technology (especially Computing technology) to investigate problems
Give us technology / training / software and then we'll use it.

For the third factor, Teaching Lower Ability Students, teachers reported a significant drop in confidence levels to very low levels. For mathematics teachers, teaching students with lower levels of knowledge was a very important issue. However, it was also an equally important issue for many other subject teachers.

It should be noted that a number of individual items did not load on to any of the identified factors, however, they elicited some of the strongest responses. Generally all teachers identified a number of concerns about the new syllabuses. Many teachers clearly thought the implementation had been rushed. The majority of these teachers also reported that the changes had resulted in excessive extra work and made greater time demands on teachers. Teachers also felt that they had not been very well prepared in terms of professional development and resources. There was also a strong sense of political expediency and 'ulterior' motives expressed by several teachers:

The New HSC in General Mathematics has been cynically received as the DET's way of coping with the shortage of Maths teachers, viz make the course too difficult for less able pupils so they won't choose Maths, so less teachers needed.

The DET is staffed by bureaucrats- essentially totally irrelevant to classroom teachers. They, their leaders and the BOS are the servants of their political masters. Too often we have change for change sake and to suit a political rather than educational agenda

The new HSC was hurriedly implemented with little consideration given to students needs or teacher input for purely political purposes.

Conclusions

The curriculum reforms of the New South Wales HSC introduced in 2000 provided a rare opportunity to study educational change and the motivation of teachers. Whereas, there were some common views expressed by all subject teachers, there were also some significant differences expressed by mathematics teachers. In particular, mathematics teachers were less positive about the changes, found past resources and professional in-services less useful, had less opportunity to network, and were more stressed by student misbehaviour. Such differences could well affect the expertise of mathematics teachers, as well as their motivation.

The relationship between self-efficacy/confidence and curriculum reform has in recent times been identified as important (see Christou et al., 2002; Chissick, 2002). Overall, the teachers in this study reported relatively high levels of self-efficacy for new aspects of teaching related to the new curriculum and moderate levels of self-efficacy for using the requisite technology. Nevertheless, mathematics teachers reported the lowest self-efficacy levels on several items within the technology factor. This is an important finding because the new General Mathematics syllabus includes many reforms, involving technology, recommended and previously implemented by other states and countries. However, teachers reported that they had not been trained to use the necessary technology or that it was not readily available in some schools. Consequently, it can be concluded that such reforms will not necessarily be successful without adequate resourcing and training. In terms of the bigger picture of wide-scale curriculum reform, policy makers may need to pay more attention to the needs of individual subject areas, rather than a one-size-fits-all approach to implementation. In terms of teaching less able students, self-efficacy levels were relatively lower. One explanation is that these were the students for whom the changes were most major and the teachers had fewer opportunities for mastery experiences in teaching them. There is no doubt that the mathematics teachers in this study were very concerned about the needs of all students. This study clearly demonstrated that participating mathematics teachers believed that all students should study mathematics in grade 12 at an appropriate level of difficulty. Unfortunately, a major concern of many has now unfortunately materialised- in 2005 there were approximately 7,000 (12%) less students studying mathematics at the NSW HSC.

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