

---

# MATHEMATICS TEACHERS AND THE VCE: BROADENING THE EDUCATIONAL LANDSCAPE

**Christine Brew**

La Trobe University  
<C.Brew@latrobe.edu.au>

**Gilah Leder**

La Trobe University  
<G.Leder@latrobe.edu.au>

**Glenn Rowley**

Monash University  
<glenn.rowley@education.monash.edu.au>

*The Victorian Certificate of Education (VCE) has been subject to ongoing modifications since its full introduction in 1992. These changes largely focused on reducing curriculum choice and the value of the school-based assessments. The recent government initiated Review has maintained this direction. We draw on the experiences of close to 500 senior mathematics teachers -interview and survey data - to consider the impact on them of the evolution of the VCE, particularly on their teaching practices at the junior secondary levels.*

## INTRODUCTION

Education is a large budget item and governments seek greater accountability for the increased economic outlays manifesting as greater government intervention in the outcomes of schooling (Horwood, 1998). In the early 1990s educational reform at both the National and State levels was aimed at meeting the requirements of a complex, rapidly changing and increasingly technologically dependent society (Hiebert *et al*, 1996). The Victorian Certificate of Education (VCE) is one example of this reform movement which aimed to change classroom practice through government intervention.

Prior to the introduction of the VCE in 1990 there were alternate forms of high school certificates. These had evolved to cater for the different types of students who wished to remain at school and complete some form of certificate. The VCE aimed to bring all of these courses and certificates together under the one umbrella while still catering for the diversity of student aspirations. The structure and requirements of the VCE anticipated modified classroom practices throughout all levels of secondary schooling through changes to both the standard curricula and the assessment tasks set. In its original format, the VCE provided a reduced emphasis on statewide examinations with equal weighting given to alternate and school-based assessment.

Opposition to this educational reform soon emerged, with considerable criticism of the assessment format from within the university sector. In one way the original VCE could be considered to have signalled an effort to disrupt the powerful influence of the university professoriate on the school curriculum. In science and mathematics in particular, students and teachers have traditionally been forced to cope with an academic curriculum primarily designed as a preparation for university studies (Horwood, 1998). As a consequence, the VCE was controversial, frequently capturing the attention of the press, which eventually led to two waves of major modifications in the curriculum and assessment format during the mid-1990s. These changes resulted in a much reduced and more hierarchical subject selection, and a return to a greater emphasis on examinations.

The terms of reference of the recent government Review of the VCE (1997) largely focused on finding ways to reduce students' workload and maximising authenticity of students' school-based assessment tasks. School assessed CATs have been replaced by school assessed coursework which are to be now completed as part of the regular teaching and learning program. The examinations remain unchanged and will be used to moderate schools' assessment of coursework to ensure comparability across the State. The outcomes of the

VCE Review appear to have continued the relentless direction towards a reduced emphasis on time spent engaging in alternate forms of assessment. The most significant components of the curriculum in mathematics, the problem solving and investigative tasks, have been eroded to a small shadow of their original status over the decade.

Historically, the successful implementation of educational innovations has been thwarted largely when teachers do not have a clear understanding of what is expected of them, and when they lacked the skills and knowledge required to perform their new role (Gross, 1971). When describing the tendency for educational reform to fail, Fullan (1982) argued this was due to a greater emphasis on policy-making at the expense of developing an understanding of how to work through a process of change. Whether this is the way to now view the current situation is open to debate. The final status of school-based assessment is yet to emerge fully. Evaluation of educational change is daunting because the process is complex and dependent on many interacting factors. Despite this, one of the crucial factors that affects the adoption and continuation of innovations is the quality of the relationship between policy-makers and local practitioners (Fullan & Stiegelbauer, 1991). Quality education is also time consuming and requires resources, up-to-date technology and qualified teachers.

The current situation in Victoria certainly reflects the influence of bureaucratic control and is consistent with treating the content as non-problematic with the focus on assessment and moderation (Horwood, 1998). While the use of external moderation procedures are designed to guarantee comparability across the State for school-based assessed coursework, the equitability of the assessment procedures have “the added effect of providing a means for constructing teaching in terms of quantifiable outcomes and external objectives” (Horwood, 1998, p.269). If greater equity was ever the real intention, moderation procedures might also take into account different assessment outcomes in terms of socio-economic status and gender. In mathematics, for example, research continues to highlight enormous gaps in assessment outcomes between students from different socio-economic circumstances (Teese, Davies, Charlton & Polesel, 1995). In terms of gender, the 1992 VCE mathematics assessment data demonstrate uniquely that boys do better overall than girls in examinations while girls tend to perform better than boys on the more intensive school-based assessment (Leder, Rowley & Brew, 1999). Subsequent modifications made to the VCE study design led to this situation becoming clouded. With statistical modelling to control for the tendency for girls to select themselves out of higher level mathematics, the clear gender pattern evident in the 1992 data remerged for 1994-1996 (Rowley, Brew & Leder, 1997). It is conceivable that the proposed scheme to use the examinations to moderate the school-based coursework may well exacerbate the advantage to males in the overall assessment.

It is the role of this paper to broaden the educational landscape by presenting the views of mathematics teachers on these broader issues with respect to the VCE. It is hoped that this paper will serve as an historical marker from which to consider the impact of the latest round of VCE modifications. It is our perception that the voices of the secondary school teachers have been largely absent in public discussion and in the policy directives that have been instigated. In this paper we present evidence that indicates there is a high level of support among mathematics teachers for alternate assessment at the VCE level. There is a widespread perception that it encourages the development of different mathematical skills in students, in particular, to be able to apply their mathematical knowledge rather than just follow rules and procedures, and that it also encourages more innovative teaching practice in the junior levels.

## **THE STUDY**

### **The Sample**

In Oct-Dec 1996, interviews with 40 mathematics coordinators from across all school sectors and regions were conducted to explore the impact of the evolution of the VCE on schools, teachers, and teaching practice (Brew, Rowley & Leder, 1997). These interviews formed a pilot study that led to the development of a survey to explore the views of a representative sample of teachers across the State. Issues that emerged in the interviews structured the survey into a range of themes and a selection of these are drawn upon here to report the findings.

In April 1997, surveys were mailed to 250 randomly-chosen secondary schools within the three school sectors. For each of the sectors, 100 State schools were approached, 50 Catholic and 50 Non-Catholic Independent schools (hereafter referred to as Independent). Close to 500 VCE mathematics teachers responded from 162 schools (83 State, 44 Catholic and 35 Independent). The school response rate was 65%. A more detailed summary of the survey findings is reported by Brew, Rowley and Leder (1998).

### **Format of the Survey**

The survey contained 140 items. Teachers were asked to identify whether their school had obtained funding under the disbanded Disadvantaged Schools Program [DSP](pre 1993) or the Victorian Equity Program (1994). And to provide biographical data to allow comparisons between teachers' views and experiences by gender, years of teaching, qualifications and studies taught. A standard Likert five-point scale was adopted for most items with teachers being asked to indicate their strength of feeling from "strongly agree" to "strongly disagree." A "yes/no" response was requested in some cases; further comments in others.

## **RESULTS**

### **The Impact of the VCE upon Junior Level Mathematics**

One aim of the VCE was to encourage innovative teaching practice across all levels of secondary schooling through a diversified assessment program at the highest level. Seventy-five percent of teachers said that they had modified their mathematics teaching at both senior and junior levels since the inception of the VCE. Support for the major innovations with their greater emphasis on problem solving and project based studies was high (83%) across all school sectors and regions. These innovations were reported by 68% of teachers to have led to an enhanced focus on mathematical communication and justification of work. Just on half of the teachers also wished they could include more project work and problem solving in their junior classes but the time required for marking prevented them from doing so. From the interviews with the coordinators it also emerged that it was more difficult to be innovative at the higher levels due to the severe time limits and high stakes nature of the assessment. Despite the restrictions, junior level teaching provided the greatest opportunity to be inventive and flexible in their teaching practice. The following quotes from provide examples of this perspective:

There is a lot less chalk and talk than there was, especially in the junior levels. A lot more activity based learning. (At) VCE level, there is still a lot of chalk and talk as you have to get through the course.

Problem solving ... was the best innovation which filtered its way down the school so we now have specific problem solving exercises from Year 7 up. (The VCE) certainly has changed teachers' attitudes to the importance of problem solving and projects. At the top end it hasn't worked as well where you have a four week project. That is too demanding.

Female teachers were also more likely to say they had modified their junior mathematics teaching practice than were male teachers (females: 87%; males 71%). This is consistent with the notion that the VCE had to some extent feminised the curriculum through the introduction of assessment that required greater language skills. Such skills were more likely to be possessed by girls than by boys and hence provided a greater opportunity for girls generally to participate in mathematics.

The attempt to introduce and broaden innovative practice in the junior level teaching was not without its problems. The rationalisation process that was sweeping through State schools in the mid 1990s, epitomised by reduced budgets and staffing, would appear to be a major factor, not just a backlash against top down change (Fullan & Stiegelbauer, 1991).

The VCE has changed mathematics right through down probably as far as year 8. There was certainly an enormous change two years ago. I think a lot of that has gone by the board now because people have cut back a lot of the project work because of the time features. I know I was doing a lot more project work three years ago compared to now.

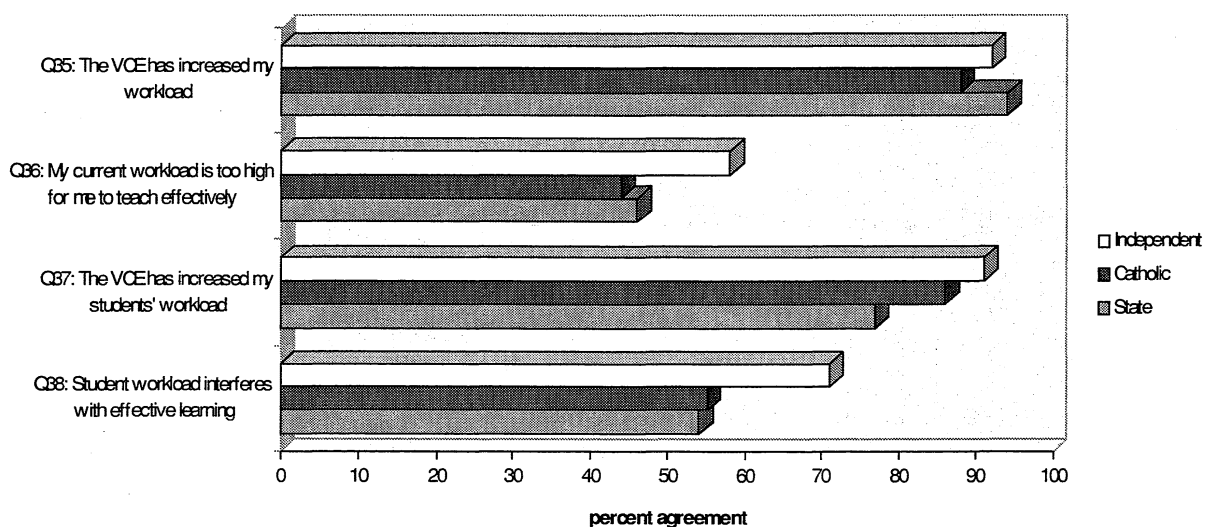
One big problem is the VCE is enormously time consuming to do it correctly, (because of) the workload, a lot of people are paying lip service. ... realistically, if you do a Year 10 class and do the projects correctly, you have created 10 hours of work. To put in 10 hours at one class and then you have to do similar things at Year 7, 8 and 9, you are looking at a phenomenal work load, you can't run a high quality program and cut the guts out of it which is what is happening.

### High Workloads

A huge increase in teacher workload was a major factor associated with the introduction of the VCE that emerged from both the interviews and survey findings. Nearly one in every two teachers reported that it was interfering with effective teaching (Figure 1) and this was more evident in Independent schools where the pressure is more likely to be higher on teachers to maximise their students' academic achievements.

What the teachers were effectively saying was that the introduction of problem solving and project work was very time consuming, both in the classroom and in the assessment of generated student work. It was increasingly becoming impossible for State school teachers

Figure 1  
Teachers' Views on the VCE Workload by School Sector



to maintain the momentum and commitment to an innovative curriculum right across all levels during a rationalisation process and casualisation of the workforce.

We have eighteen staff here involved in maths, and I would estimate that there are five who are full time maths. Considering we have 930 students, I would have hoped for more. There are six teachers that have got one class and that doesn't represent the building of strength.

One of the major problems is that the government has now brought in this rule about absorbing your own excess. We were in a position of having seven teachers in excess ... and this has caused us to be pulling in a number of people from other faculties ... with little maths experience to take junior classes. I have always had a rule at the school you put your most experienced people with the year 7s and the VCE. ... But when you are in a situation where you have someone who is the careers teacher and who has taught junior maths ten years ago, you are forced into putting that person in year 7 or 8, not in the middle school.

Roberts (1994) also noted a related problem. Despite teachers in Years 7-10 attempting to introduce more VCE-like exercises into their courses, they were frequently not well qualified in mathematics and therefore evaluation and analysis, the two key areas that allow students to obtain higher grades, were not generally a focus.

### **Teachers' Qualifications**

The large majority of mathematics coordinators (86%) did, however, indicate they had enough qualified mathematics teachers for the VCE. A breakdown down by years of teaching senior mathematics found that nearly 80% of teachers with more than 20 years experience had studied three years of university mathematics while fewer than 60% of the teachers with less than five years experience had done so. The figures also revealed that a few schools have always been using unqualified mathematics teachers to fill shortfalls, but there was also a trend to suggest that the shortfall is growing.

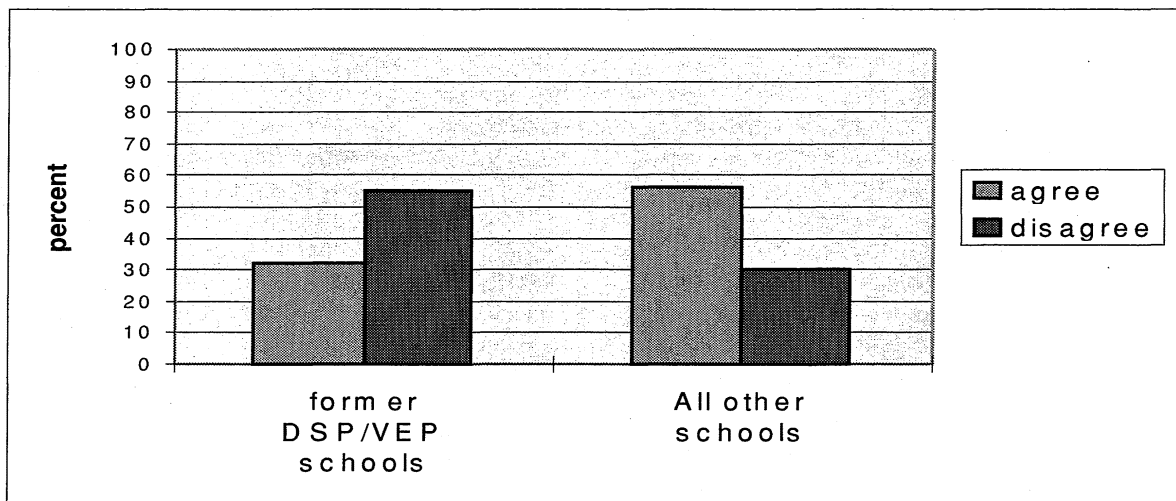
### **Restrictions on Innovative Teaching Practice**

While the VCE was aimed at encouraging innovative practice, schools that had developed their own initiatives for catering for students individually felt thwarted in their efforts.

(We have not changed the way we teach) at VCE, we have changed the way the we teach from 7 to 10, but VCE is getting in the way. ... We adopted a system where everybody does their own thing at their own speed all continuously assessed ... each one of them is a case management system. (So) we would like to teach individually and VCE as well, but because of the administration ... it might prove difficult. For example, suppose I have a student in Year 8 who is ready for VCE and is quite capable of teaching themselves the whole lot and they still have to hand in their projects and they can teach themselves all the theory very quickly. I don't see why it should take them 12 months. I don't know what is wrong with 3 months. ... So I think that ties you down to teaching in old fashioned ways.

There was further evidence that the VCE was experienced as restrictive for teachers rather than providing a means toward being more creative with course structure. This was evident after the second round of modifications in 1994 when three hierarchical mathematical studies replaced the existing six study choices that incorporated broad choice through a cluster system. While there was widespread support for the three study structure (83%), there was not a similar level of support for the associated reduction in study choice (61%). While the content and flexibility of both Mathematical Methods and Specialist Mathematics were perceived as appropriate for their intended clientele (84% and 89% respectively), Further Mathematics, the mathematics perceived as the least academic, was the least likely to be experienced as meeting the needs of the students (63%). This outcome is consistent with only half of teachers (51%) expressing the view that the VCE curriculum was allowing them to cater well for the lower ability mathematics students compared to 90% for the middle and higher achievers. This situation was even more evident for teachers at former DSP/VEP schools (Figure 2).

*Figure 2*  
*The VCE Structure Allows our School to Cater Well for the Lower Ability Mathematics Students*



### Gender and Assessment

The views of teachers on any bias in the assessment format by gender was consistent with the statistical evidence. More teachers agreed that the school-based assessment provided a better opportunity for girls to succeed compared to boys (38% vs 27%) and more teachers agreed that the examinations provided a better opportunity for boys to succeed compared to girls (44% vs 12%). That many teachers were undecided may well reflect the now clouded situation because of the greater tendency for girls compared to boys to self-select out of mathematics altogether and out of higher level mathematics in particular.

### The Relationship Between the Policy Makers and Teachers

The VCE Review has maintained the status of the General Achievement Test (GAT) in assisting the Victorian Board of Studies (VBOS) to moderate school assessment. In the submission we made to the Review we highlighted that while the large majority of teachers were confident in following the marking criteria set by VBOS they had far less confidence in the moderation process, particularly the use of the GAT scores (Table 1).

*Table 1*  
*Teachers' opinions about Verification and Authentication Procedures*

Survey statement	% agreeing	% disagreeing
I am confident of my ability to assess CAT 1 in accordance with VBOS marking criteria	83	8
I have confidence that if any students' work is recalled it will be marked fairly by VBOS in their review process	36	32
The use of the GAT scores to support the review of school results is appropriate	16	56

### CONCLUSIONS

Providing for the diversity of student aspirations, the requirements of tertiary institutions, the economic needs of the State, and a fair and equitable education system for all, is clearly a daunting balancing act. The VCE in its original format clearly stands as a genuine attempt to meet all of these needs. The subsequent modifications made to it in response to powerful

political forces have made an accurate assessment of its impact more difficult. It would appear that the recent outcomes of the VCE Review have continued to undermine some of the major innovations. The high stakes nature of the assessment has clearly inhibited the achievement of the aims documented above, and it is perhaps likely that some of the pre-VCE mathematics courses may well have catered better for the diversity of student aspirations, particularly those who did not wish to pursue a purely academic stream.

What does remain crucial to the on-going educational outcomes of students is the quality of the relationship between the policy-makers and the local practitioners. There would appear to be strong evidence of a low level of trust between VBOS and teachers. While shifting to an even greater emphasis on centrally set examinations is one way to reduce the conflict that teachers may feel in their dual role as educators and assessors, the longer term implications for quality education remains clouded. If there is a relationship between mathematics examinations and reliance on rules and procedures, this is clearly maladaptive for meeting the requirements of a complex, rapidly changing and egalitarian society and for meeting the requirements of education institutions which prepare students for such a world.

### REFERENCES

- Brew, C., Rowley, G., & Leder, G. (1998) Mathematics teachers and their experience of the VCE: The Teachers' Voice. *Vinculum*, 35(3), pp 12-15.
- Brew, C., Rowley, G., & Leder, G. (1997) Teachers' perceptions of VCE mathematics: A response to "teething problems?" In H. Forgasz, A. Jones, G. Leder, J. Lynch, K. Maguire, & C. Pearn (eds). *Mathematics: Making connections*. Brunswick: Mathematical Association of Victoria.
- Fullan, M. (1982) The meaning of educational change. Teachers College Press, Columbia University: New York.
- Fullan, M. & Stiegelbauer, S. (1991) *The new meaning of educational change*. (2nd edn). The Ontario Institute for Studies in Education. New York: Columbia University Press.
- Gross, N. (1971) Implementing Organisational Innovations: A sociological analysis of planned Educational Change. Basic Books: New York
- Hiebert, J., Carpenter, T.P., Fennema, E., Fuson, K., Human, P., Murray, H., Olivier, A., & Wearne, D. (1996) Problem solving as a basis for reform in curriculum and instruction: The case of mathematics. *Educational Researcher* May: 12-21.
- Horwood, J. (1998) Towards an explanation of curriculum control. In C. Kanes, M. Goos, E. Warren (Eds.), *Teaching Mathematics in New Times. Conference Proceedings, Volume 1 MERGA 21*, pp. 263-270.
- Leder, G., Brew, C., Rowley, G. (1999) Gender differences in mathematics achievement here today and gone tomorrow? In G. Kaiser, E. Luna & I. Huntley (Eds), *International comparisons in Mathematics Education. Studies in Mathematics Education Series 11*, pp. 213-224. London: Falmer Press.
- Roberts, N. (1994) Implementing VCE Mathematics. *The Australian Mathematics Teacher* 50(3): 38-39.
- Rowley, G., Brew, C. & Leder, G. (1997) The impact of self-selection on patterns of gender differences in mathematics achievement. *Paper presented at the annual conference of the Australian Association for Research in Education*, Brisbane.
- Teese, R., Davies, M., Charlton, M., & Polesel, J. (1995) *Who wins at school?* Melbourne: Department of Education Policy and Management, The University of Melbourne.

### Acknowledgments

This study was made possible by an Australian Research Council Grant. We would like to thank the Department of Education and the Catholic Education Office for giving permission to conduct this study and to all the teachers who generously contributed within their limited time. We would also like to thank Anne South and Julie Ryan who assisted with the data collection and the initial interview analysis.