



**MAV Submission  
to the VCAA  
in regard to the  
Consultation paper for  
VCE Mathematics examinations:  
2006 and beyond.  
(Supplement 2, December Bulletin, 2003)**

**Submission prepared by  
the Executive of the MAV Council  
in consultation with  
Members of the MAV  
March, 2004**

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## 1. Background

The MAV is the key professional association representing primary and secondary teachers of mathematics in Victoria. The MAV has over 1700 members (including over 1200 schools) and in 2006 celebrates 100 years. Many MAV Councillors and members have taught VCE subjects for a number of years and have served on VCE Mathematics Committees, Reviews or Setting Panels.

In order to gain feedback from members the following initiatives were undertaken during February

- the MAV member email list was used to remind members of the VCAA consultation, encourage them to respond to the consultation and forward a copy of their submissions to the MAV.
- on Friday, February 13, a discussion involving 50 teachers at the MAV VCE Day held at Monash University was convened and chaired by the President of the MAV.
- MAV Councillors contributed on the basis of their considerable experience, knowledge and institutional situations.

The intentions of this submission are to

- identify perceived strengths and weaknesses of the proposal and the process
- actively support members of the MAV and represent their views
- identify areas where further clarification, research or information is felt to be warranted
- make recommendations, where possible, on a preferred model (or aspects) and process

The hopes are that through this submission

- any changes will have the maximum chance of support from schools, teachers and the wider community.
- any changes will be implemented in the most effective and harmonious manner possible.
- any changes will be in the best interests of student learning, success and enjoyment of VCE mathematics.

In responding to this submission, it was understood that the examination models proposed make it clear that access to CAS is *optional* rather than compulsory.

However, it was clear from discussions and responses received that, even though CAS is optional, member schools still strongly felt the need to ensure access to CAS before 2006 so that

- there could be no *perception* that their students would be disadvantaged
- that positive gains reported from teachers in the CAS Pilot might be experienced
- that students and teachers would be prepared to take advantage of any related changes to courses.

This submission assumes therefore that most schools will feel the need to ensure access to CAS for their VCE Unit1/2 students in 2005 and their teachers in 2004.

## **2. Alignment with other countries**

The historical overview provided in the VCAA December bulletin, Supplement 2 (here after referred to as Supp. 2) is interesting and relevant to the proposal at hand. It is important that any review of school mathematics in Victoria takes into account developments overseas.

Regrettably, the 5 countries reported on (together with the IB) do not represent the majority of OECD countries, and do not include the highest achieving countries (e.g. Japan, Korea, New Zealand, Finland, Netherlands, Sweden, Iceland, Norway) on international measures of mathematics achievement (e.g. PISA and TIMSS)

For example, of the 10 highest achieving countries in PISA 2000, only three, Australia (5<sup>th</sup>), Switzerland (7<sup>th</sup>) and France (10<sup>th</sup>) are referred to in Supp 2. Admittedly, only the TIMSS 1995 study relates to a final year student cohort while PISA 2000 and TIMSS 1999 relate to the achievement of students in years 10 and 8 respectively.

While this submission does not wish to argue that Mathematics education in Victoria should emulate that in any other particular country, it does believe that any comparisons with overseas countries, and the relating conclusions drawn and directions taken, should be informed by the widest and most appropriate view. The MAV believes that the VCAA examination models should endeavour to reflect the widest and the best world practice.

## **3. Taking advantage of developments in technology**

### **3.1 CAS in Victoria**

Computer Algebra Systems (CAS) technology has existed and been affordable to schools for well over a decade. Academic versions of Derive, Mathematica, Scientific Notebook have enabled some teachers and schools to obtain site licences and use CAS to explore senior mathematics in new and exciting ways. Some schools and teachers have found ways for students to have access to CAS at home and on laptops either through extended licences or online access through school intranets.

More recently, with the advent of handheld CAS technology, this access has become more widespread and affordable. Professional Development in CAS has been available to teachers in Victoria through the MAV, the University of Melbourne and T-cubed.

In 2001, Swinburne University of Technology held a mini-conference for teachers entitled, Computer Algebra Systems in School Mathematics. This coincided with the Sixth Asian Technology Conference, also held in Melbourne at RMIT.

In September, October and November of 2003, five regional CAS PD activities were organised by the MAV in conjunction with VCAA and attended by 50 teachers.

CAS has been a significant part of the MAV December Conferences in recent years with 18 Sessions at the 2002 conference attended by 730 participants and 16 Sessions at the 2003 conference attended by 590 participants. This included a Keynote Address by three CAS Pilot teachers, Sue Garner, Allason McNamara and Frank Moya outlining ways in which CAS had significantly and positively influenced both their teaching of mathematics and their students learning, understanding, thinking and enjoyment.

In 2001, VCE Units 1 – 4 were accredited by the VCAA and the CAS Pilot Study in Mathematical Methods, jointly conducted by the DSME at the University of Melbourne and the VCAA, commenced with three schools. In 2002/3, sixteen schools were participating and the Pilot Study was extended to 2005. Resources for, and

papers about, teaching mathematics with CAS are available for download the VCAA and DSME websites.

While no final report from the CAS Pilot study is available, the MAV is aware of and for the purpose of this response, has drawn on papers and presentations by Kaye Stacey, Lynda Ball and teachers involved in the CAS Pilot Study. While raising some cautions, these authors overwhelmingly indicate the advantages gained by students and teachers who have access to CAS technology in senior mathematics classes. It is clear however, that this group is not typical of Victorian teachers of mathematics and findings need to be interpreted accordingly.

### **3.2 Level of CAS awareness and knowledge**

Despite all the CAS activity and development in VCE Mathematics, it is true to say that a significant number of VCE mathematics teachers in Victoria have not felt the need to get involved in CAS in any depth. Although aware of the CAS Pilot, for most this was not urgent and something to find out about later when the report came out. They believed that the date of any wider move to CAS was in the undefined future. Instead they gave time and priority to other more pressing issues such as preparing and assessing School Assessed Coursework. The proposal in the December 2003 bulletin to allow CAS in VCE examinations in 2006 came as quite a surprise to most teachers given that, in March 2004, the report of the CAS Pilot has yet to be published. Many teachers were unsure of the implications of the models proposed and felt unable to comment.

### **3.3 Cost of CAS**

There is also the belief that CAS technology is still too expensive to be a serious option for most Victorian students and schools. The cost of even Graphics Calculators is still a frequently raised issue for some schools and students. At the time of writing this report, CAS handhelds were around \$300 compared to \$200 for Graphic Calculators. No doubt the price will drop with increased sales however the *current perception* is that CAS is expensive and beyond the reach of most students (and even teachers). It is also apparent that there is no clear data on the extent to which CAS technology (in all its forms) currently exists in Victorian Secondary schools.

#### **Statement 1: (Immediate Need for State wide Professional Development)**

There has been considerable interest in CAS shown by mathematics teachers in Victoria over the past two years. There have also been a number of PD opportunities around the State. By far the best attended were the MAV December conferences. However, in general, PD activities to date have been limited in scope and introductory. Also, of the 400 secondary schools in Victoria, only 16 are participating in the CAS Pilot Study.

*If CAS is to be successfully, seriously, effectively and harmoniously introduced into Victorian schools and VCE mathematics subjects in 2006, then it is clear that extensive PD will be needed across the State throughout the second half of 2004 and throughout all of 2005.*

While one member school sensibly suggested that CAS should be first introduced into Years 9 and 10, the minimum emphasis in 2004 should be introductions to all teachers intending to teach any VCE Unit 1 and 2 subject in 2005 and any VCE Unit 3 and 4 subject in 2006. Local CAS clusters should be established and time release given to teachers similar to when CATs were first introduced.

*The six 2003 CAS workshops offered by the University of Melbourne could be usefully adapted perhaps into a package of 3 whole day sessions with teacher commitment and activities in between. Online equivalents would provide an alternative for those unable to attend.*

*2004 Unit 1/2 focus. Terms 2/3 and 4 in 6 Regional and 3 Metropolitan Centres*

*2005 Unit 3/4 focus. Terms 1, 2 and 3 in 6 Regional and 3 Metropolitan Centres*

To be effective and well attended, the cost of these workshops would need to be perceived as reasonable by teachers and schools and also allow for the cost of any significant travel (> 100 km) in Regional areas.

**Statement 2: (Need for CAS Supplier Equity Access Programme)**

*The VCAA, DET and the MAV should jointly approach suppliers of CAS technology as a consortium to find ways to minimise equity concerns and ensure that students and schools have maximum access to approved calculators.*

*Equity Access Models should be devised and made available to schools. These could include*

- *Individual student purchase at special one-off introductory prices. Subsequent years would benefit from second-hand pricing.*
- *Supplier loan to school to be paid off over 2 or 3 years by student instalments.*
- *School purchase of class set and subsequent hire to students.*

*Similar schemes should be investigated for Derive and Mathematica.*

**4. The Consultation and Review Process**

It is regrettable that at the time of writing this report (March 2004), other than Supplement 2 in the December 2003 Bulletin, there have been no published reports in VCE Bulletins from the Mathematics Expert Studies Committee as indicated in the VCE May 2002 Bulletin.

In the VCE May 2002 Bulletin, it was announced that the accreditation period for Mathematics studies had been extended by two years until Dec 31, 2005. It was also reported that;

Progress reports on the work of the Mathematics Expert Studies Committee (MESC) and the review of the VCE Mathematics study will be published in the VCE BULLETIN, and schools and other stakeholders will be invited to respond to proposals.

In July 2002, it was reported that the ‘final report’ of the MESC would be published in November 2002.

A further progress report will be presented to the July meeting of the Curriculum Committee with a final report due by November 2002.

This ‘final report’ did not appear in any VCE Bulletin in 2002 or 2003 and it was not until December 2003 that Supplement 2 was published. The idea of reporting on the work of the MESC with opportunity for stakeholders to respond to proposals also differs substantially from the notion of a final report.

Teachers of mathematics in Victoria may well wonder why there was such a delay in publishing the three examination models devised by the MESC.

Furthermore, to then publish the models in December 2003 for consultation by February 27, 2004, is insensitive to the position of teachers at the end and beginning of the school years and invites low response rates, cynicism and frustration.

**Statement 3: (Possible Delay until 2007)**

The MAV is concerned about the drawn out and untimely process of review conducted to date. It was, however, pleasing that the VCAA agreed to a request for extension of time until March 19.

*If either the State wide PD programme or the CAS Supplier Equity Access programme cannot be established during 2004 then the MAV requests that the introduction of CAS technology and related changes to examinations and courses be held off until 2007.*

**5. Responses to the three proposed examination models**

Regrettably, only 9 responses were received from member schools. While this may reflect the lack of involvement of MAV members in MAV processes, given the huge support for other MAV activities, it is more likely to reflect the timing of the consultation and the perceived lack of real involvement of teachers in the consultation process and the decision making process in general.

The length and lack of clarity in the second paragraph of Supplement 2 in regard to the meaning and extent of ‘approved, in principle’ was interpreted by some schools as suggesting a fait accompli. This perception was further reinforced by the format of the response pro-forma that discouraged the opportunity to express preference for the ‘Status Quo’ model. These two aspects of the consultation, together with the difficult timeframe, discouraged many from responding. The VCAA consultation, therefore, cannot claim to be representative of the views of teachers and mathematics departments in Victorian secondary schools. This is of concern to the MAV.

**Model C**

From the responses received, however, it was clear that Model C is the least preferred model. 7 of the 9 schools put this model down as their last preference. It was mostly the open-book aspect that member schools objected to. For some this was an equity argument in that affluent schools would be in a position to provide more resources for their students. For others, the loss of the incentive to summarise and the potential for students to be leafing through textbooks during examinations was of concern. Another argument was the potential clutter in exam rooms.

**Statement 4: (Opposed to Open Book)**

*The MAV supports the equity concerns raised by member schools and also values the retention of summaries. The MAV would not like to see students permitted to bring texts or other resources to VCE examinations.*

**Model B**

Model B was the most preferred model. 6 of the 9 schools put this model down as their first preference. There is however, uncertainty about the meaning of, and reasons for, ‘technology free’. Some submissions requested that ‘technology free’ mean access to a scientific calculator, however others felt the need for two calculators further compounded the equity argument and also meant that students would be required to learn and master two (or perhaps three) different calculator technologies. Some

regarded the 'technology free' requirement as a backward step with implications down to Year 7.

Other concerns (arising from a member of the Pilot Study group) was the fear that 'technology free' may well 'equate to Year 10 level mathematics' or that teachers may see the need to start 'drilling students on operations with fractions'. Furthermore, it is not clear what it is exactly that students rely on when they use their calculators. It is also unclear why 'technology free' was not proposed as a requirement for Further Maths given that 'the general community is more vocal about numerical than algebraic functionality.'

If the reason for a 'technology free' requirement is to allay the fears of the universities, of whom some allow no calculators of any sort in mathematics subjects, then perhaps the requirement should only apply to Specialist Mathematics, those students most likely to study mathematics at the tertiary level, as proposed by Model A. There was concern however, that this requirement may discourage some students from selecting Specialist Mathematics. In hindsight, leaving the 'technology free' option undefined and without examples of curriculum and examination question changes, only encouraged anxiety and speculation among most respondents.

**Statement 5: (More discussion needed about 'technology free')**

The MAV is not convinced that 'technology free' examinations are desirable or needed. *More discussion of the definition and purpose of 'technology free' is needed before a clear preference emerges. The MAV therefore requests that an urgent meeting of interested stakeholders be held to discuss and clarify the definition, purpose and implications of 'technology free'.*

There was also no clear agreement on reducing Exam 1 to 1 hour. Some requested that 1.5 hours be retained.

**Model A**

For most schools this was their second preference. It was seen as closest to the status quo with changes being only the introduction of CAS to Further and Specialist and a technology free exam with resulting variation of exam structure for Specialist Maths. It was felt that CAS was likely to be of least benefit to students of Further Mathematics and that these students were also least likely to be able to afford (or wish to purchase) the new technology. However, given that some students study both Further Mathematics and Mathematical Methods, the MAV can see reasoning behind this option.

**Statement 6: (CAS not required for Further Maths)**

*If Model A is adopted, assuming the VCE Mathematics Course Review proposes minimal changes to the Further Mathematics course, the MAV requests that the VCAA make it clear that, in Further Mathematics, CAS is an option (to avoid some students buying two calculators), not a requirement and will not be an advantage.*

As for the Model B discussion above, more discussion of the definition and purpose of 'technology free' is needed before a clear preference emerges. There was also no clear agreement on reducing Exam 1 to 1 hour. Some requested that 1.5 hours be retained.

Again, as made clear in Statement 3 above, if either the State wide PD programme or the CAS Supplier Equity Access programme cannot be established during 2004 then the MAV requests that the introduction of CAS technology and related changes to examinations and courses be held off until 2007.

## 6. Other issues and concerns

### Specialist Mathematics

Specialist Mathematics in particular needs special consideration and careful thought. Introducing CAS technology to this subject implies very significant curriculum, teaching, learning and assessment changes that have yet to be clarified and explained. The VCAA and teachers of Specialist Mathematics have not had the opportunity to benefit from insights gained from a Specialist Maths CAS Pilot Study. The MAV has strong reservations about the wisdom of moving to CAS in Specialist in 2006 without a Pilot Study. The MAV is unable to support the introduction of CAS to Specialist Mathematics until 2007 at the earliest and only then after a Specialist Maths CAS Pilot Study has been completed and reported. The MAV realises, however, that this time frame is not likely to be feasible.

Papers reviewed (Stacey, K., 2003 and Vale, C., 2003) raise other issues and concerns in addition to those raised above. Professor Kaye Stacey, University of Melbourne and Principal Researcher, CAS Pilot Study, reviewing knowledge gained from the 3-school CAS Pilot study, highlights the potential for equity issues in regards to different CAS calculators, the need for ‘greater explicitness about the value of learning skills and concepts’ and raises issues about ‘question design and marking schemes’. While Stacey is very positive that these issues can be resolved, it is clear that there are significant implications for teacher awareness, curriculum and examination design, all of which take time and commitment. Significantly, Stacey concludes that ‘effective assessment with CAS is a challenging task and it will take *some years* (MAV emphasis) and considerable creativity for new practices to be established’. As stated above, it is regrettable that the final report of the CAS Pilot Study was not available prior to this consultation.

Dr Colleen Vale, Victoria University and MAV Councillor, following a recent review of literature related to technology use in mathematics, raises many issues in regard to gender, socio-economic status and equity. In particular, Vale raised the following six useful questions.

- Will the change/model be good for mathematics in Victoria?
- Will the change/model be good for participation in VCE mathematics? Will it arrest the declining enrolment in Specialist Mathematics and Mathematical Methods?
- Will the change/model contribute to improved mathematics, knowledge, skills, understandings and attitudes of VCE mathematics students?
- Will the change/model contribute to improved teaching and learning of mathematics P-10?
- Will the change/model affect all students equally or will some students be advantaged and others disadvantaged?
- Will the change/model “close the gap”? Will it remove or lessen current inequities in participation and achievement in VCE mathematics?

Regrettably, the consultation paper provided by the VCAA does not adequately address any of these important and reasonable questions.

Vale found that the introduction of increasingly sophisticated technology in

mathematics is likely to favour males and could lead to lower achievement and enrolments of girls in VCE mathematics. She also found that the introduction of increasingly sophisticated (and expensive) technology is likely to further disadvantage students from low socio-economic backgrounds. Surprisingly, this claim received support from one of Melbourne's more affluent girls' schools. Vale (and others) also expressed the view that high ability students are more likely to be advantaged by CAS technology than lower ability students. Stacey's finding that CAS increases the need for understanding and 'algebraic insight' lends further support.

A unique view, expressed by an MAV Councillor working in a school that has embraced laptop technology, was that limiting changes to hand-held technology disadvantages those who use computers as their only CAS technology. This respondent strongly argued that the VCAA needs to 'put forward a philosophy on the purpose or goals of a mathematics education in a technology age'. It has been hard for respondents to form decisions without the full set of implications in regard to intent, course content, examination question style or middle years implications.

## **7. Conclusion**

The MAV commends the VCAA and the Mathematics Expert Studies Committee for promoting CAS technology in mathematics and attempting to find workable models in regard to assessment. Regrettably the MAV is not able to commend the consultation time frame and process.

The MAV strongly believes that it is incumbent upon the VCAA to address the genuine issues raised by this and other submissions and to endeavour to allay the anxieties and questions arising from the Supplement 2 proposals. This will be partly achieved by responding to the six Statements summarised and listed again below.

### **Statement 1: (Immediate Need for State wide Professional Development)**

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The MAV wishes to thank the VCAA for extending the submission deadline by three weeks and for the opportunity to respond to this important review. In particular, the MAV thanks Mr David Leigh-Lancaster and Mr Gary Motteram for their considerable time during telephone consultations.

This submission was prepared by members of the MAV Executive in consultation with contributing member schools and submitted by email to Mathematics Manager, Mr David Leigh-Lancaster, [leigh-lancaster.david.d@edumail.vic.gov.au](mailto:leigh-lancaster.david.d@edumail.vic.gov.au) on March 24, 2004.

**8. References**

Garner, S., McNamara, A, and Moya, F., CAS the Safe Approach, Keynote address to the December Conference of the MAV, Monash University, 2003.

Stacey, K., Using Computer Algebra Systems in Secondary School Mathematics: Issues of Curriculum, Assessment and Teaching., University of Melbourne, 2003.

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Vale, C., Response to Consultation Paper VCAA Bulletin, December, Victoria University and MAV Council, 2003. (Paper also submitted.)

Various submissions (9) from member schools.