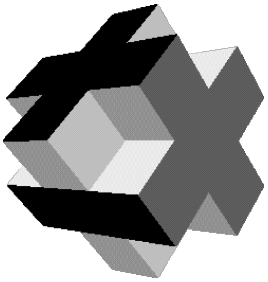

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Friday, 17 December 2004

Mr Steve Herbert, MP
Chair
Education and Training Committee
Level 3, 157 Spring Street
Melbourne VIC 3000
Sent by e-mail transmission only: etc@parliament.vic.gov.au

Dear Mr Herbert,

PARLIAMENTARY INQUIRY INTO PROMOTION OF MATHS AND SCIENCE EDUCATION

The Mathematical Association of Victoria (MAV) is a membership driven association, which provides a voice, leadership and professional support for mathematical education. The Association currently has over 1,700 members drawn from all levels and sectors of the education system in Victoria. A Council elected from its membership on an annual basis governs the MAV. The Association is responsible for planning and delivery of specific services to members, such as professional development, publications, the Mathematics Talent Quest, an Annual Conference, policy development and advice, advocacy and information services.

The Council of the MAV has spent the last month consulting widely amongst the membership of the Association seeking their views on the matters raised by your inquiry into the promotion of maths and science education. The following submission has been prepared and endorsed by Council as a result. We trust that it will assist your Committee in their deliberations.

Members of the Council of the MAV also seek leave to appear before the Committee to expand upon the MAV's submission and to respond to any queries that members of your Committee may have.

Yours sincerely,

SIMON PRYOR
Executive Officer

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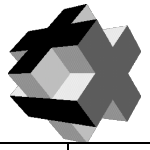
1	Determine which factors will support high quality teaching and learning of mathematics and science including teaching method and environment, subject knowledge, pedagogy, and teaching expertise.	**P-12 and the AAMT Standards** The MAV, through is affiliate AAMT, contributed to an extensive study into excellence in the teaching of mathematics. The outcome of this project was the production of the "Standards for Excellence in Teaching Mathematics in Australian Schools" which is now the benchmark for all teachers of mathematics at all levels of education. A copy of the standards is attached and they are available online at http://www.aamt.edu.au. The standards describe factors concerning mathematical content and pedagogical knowledge (professional knowledge), environmental considerations (professional attributes) and teaching methods and expertise (professional practice). Further information about the study that was conducted by a team of researchers from Monash University and members of AAMT and MAV can be found at the AAMT web site. **Early Childhood** Early learning is now recognised as the foundation on which later learning, including school learning, occurs. Young children readily learn basic knowledge about maths and science but it is regarded as equally if not more important that they develop a disposition towards learning in that area. On the basis of this perspective it is recommended that: ♦ Early childhood; i.e. Preschool sector should also be requested/ directed to provide core learnings in mathematics and science (as they now do in literacy). ♦ That core concepts and effective learning approaches in these subjects are identified and made explicit for this education sector. ♦ That early childhood teachers are provided with pre-service training and in-service professional development that enables them to effectively educate young children in mathematics. The MAV has recently created an Early Childhood Committee with the brief of providing support to Preschool teachers. The development of Professional Learning programs and resources is planned. **Support would be welcome and timely.**
2	Examine national and international trends and report on innovative initiatives that promote the teaching and learning of maths and science.	**National** ♦ Early Years Numeracy Programme (Vic.), Count Me in Too (NSW), First Steps (WA) and SINE (CEO Vic) are examples of programs at the Primary level that have produced marked improvement in numeracy learning and improved teacher knowledge and confidence. The experience, expertise and knowledge gained from programs and models like these need to be



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		capitalised upon and extended into the Middle years. The programs listed above help to provide students with a positive foundation in numeracy. While these programs meet the needs of most students, a percentage of students will require more intensive numeracy support through a structured intervention program. Unlike literacy there is no funded intervention program for numeracy which means that these students are at extreme risk of not becoming scientifically, mathematically and technologically literate. **Effective programs, including intervention programs, at the upper primary and lower secondary levels are in need of development, promotion, and publication.** ♦ **Early reports of the Getting It Right Literacy and Numeracy PD delivery model in WA are very promising and warrant further consideration.** ♦ A Direct Instruction program, Elementary Math Mastery, designed for students in years 5-8 according to research (Farkota, R., PhD Thesis, 2004) and anecdotal reports from schools suggest that significant gains can be made in student achievement and confidence. ♦ The Mathematics Talent Quest conducted every year by the MAV for students from prep to year 12, indicates what excellent results are possible when teachers use investigative approaches to learning of mathematics. AAMT conducts the national MTQ. ♦ The MAV contributes to the documentation and dissemination of innovative practices in mathematics teaching through a number of its services to members. The proceedings of the Annual Conference of the MAV report on initiatives and trends in mathematics education, especially those taking place in Victoria. The most recent publications are: Tadich, B. et al (Eds.), 2004. *Towards Excellence*. Brunswick: MAV. Clarke, B. et al (Eds), 2003. *Making Mathematicians.* Brunswick: MAV. Vale, C., Roumeliotis, J. & Horwood, J. (Eds.), 2002. *Valuing Mathematics in Society*. Brunswick: MAV. Vale, C., Roumeliotis, J. & Horwood, J. (Eds.), 2001. *2001: A Mathematical Odyssey*. Brunswick: MAV. AAMT holds a national conference and publishes proceedings every second year. ♦ The Australian Mathematical Sciences Institute (AMSI) is based at the University of Melbourne. The Centre will work with education authorities to strengthen the teaching of mathematics in the school and VET sectors and make young people more aware of the

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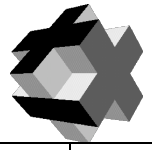
		significant career benefits possible through improved mathematics skills. The Australian Government has provided $7.8 million over four years for the creation of the International Centre of Excellence in Mathematics Education (ICE-EM) which intends to strengthen mathematics teaching in Australia and attract international recognition for our mathematicians. This is also based in Melbourne. **Victoria is well placed to take advantage of programs, resources and research and development emanating from AMSI and ICE-EM. The MAV has excellent working relationships with AMSI and ICE-EM.** **International** ♦ The recently released (Dec 2004) report of the 2003 PISA study shows that while Australian (and Victorian) 15-year old students perform above the OECD average, Victorian students performed significantly lower in mathematics than their counterparts in ACT, WA and SA. PISA assesses Mathematical Literacy where problems are set in real world contexts and require students to make connections and show problem-solving ability. **Training and professional development for pre-service and in-service teachers respectively should ensure that teachers are supported to critically refect and make improvement to their practice to ensure improvements in student learning outcomes and so that all student becomes Mathematically Literate.** ♦ Findings from TIMSS 1999 video study show that Australian teachers less frequently make connections in the mathematics they present to their Year 8 students than their overseas counterparts in high achieving countries. Furthermore, the problems they gave their students to work on were relatively low in complexity. These findings may go some way to explaining the PISA findings above. "In summary, whether Australia pursues the reform ideal of having students learn mathematics by deep engagement with rich problems or alternatively seeks to maximise outcomes obtained by emphasising standard sets of mathematical procedures, **there needs to be a greater emphasis on explicit mathematical reasoning, deduction, connections and higher-order thinking in lessons."** (Stacey, K., in Teaching Mathematics in Australia, Hollingsworth, H. et al, 2003, page 122) ♦ The recently released (Dec 2004) report of the 2003 TIMSS study showed that Victorian



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		Grade 4 students (like the rest of Australia) were only performing at the OECD average and that, unlike several other countries, no gain in achievement was evident from the 1995 study. **It is also worth noting that Australian Grade 4 students performed *below* the OECD average in the Number content domain suggesting a focus area for teacher professional development.** At Grade 8, while Victorian students in Year 8 performed better than the OECD average, in all content domains, again no improvement in achievement from 1995 was evident. **A further disturbing finding was that 30% of Year 8 teachers of mathematics in Australian schools 'did not have either mathematics or education-mathematics as their major area of study'. (Page 81). Unless urgent action is taken to arrest this situation, this percentage will increase and student outcome achievement will continue to fall.** ♦ Research reports on early learning, particularly in regards to mathematics, emerge from the UK. Also, the reports of the Reggio Emilia centres (in Italy) demonstrate innovative teaching approaches and complex learning by children in mathematics and other subject areas.
3	Determine how best practice in teaching of maths and science can be shared among schools and other education communities and identify other opportunities for cross government action.	**The Standards must inform Professional Development** ♦ Any cross government action must ensure that it is informed by the "Standards for Excellence in Teaching Mathematics in Australian Schools" developed by AAMT. ♦ Highly Accomplished Teachers of Mathematics (whether formally identified through AAMT's accreditation process or informally identified against the Standards) should be approached to open their classrooms to their peers and to act as mentors. Time release for teachers should be provided to allow this sharing and visiting to occur within and between schools. These visits should be structured and focussed with time for debriefing and reflection. **Funding to help implement research findings** ♦ The MAV was a member of a large network of mathematics, science and information technology educators (Enabling Sciences Education (EnSE) Research Network) that sought Federal Government funding through the Australian Research Council for a research network. The application for funding was coordinated by John Pegg from the University of New England. The objective of the research network was to bring together the most experienced researchers and educators to meet, work and disseminate the findings from research of national and international importance in order to promote the high quality of teaching and

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		learning in mathematics, science and information technology. Unfortunately the application was not successful in the 2004 ARC grants for research networks. **Cross government action that resulted in the identification of the teaching and learning of mathematics and science, as a priority for research funding would contribute to sharing of best practice.** **In general, professional learning should** ♦ Be provided for groups of teachers from each school and across schools ♦ Be on- site, intense, collaborative and run by educators who can model best practice in teaching and learning. ♦ Be held over a period of time, in small groups and with the use of follow up activities and collegiate dialogue ♦ Generate and provide publication of best practice strategies ♦ Focus on *all* areas of teaching i.e. curriculum planning; assessment; pedagogy; learning strategies that develop understandings; and content knowledge. Doug Clarke, ACU, has written extensively on best practice PD in mathematics education and his own practice exemplifies his writings. In a very useful paper, 'Enriching the Professional Development of Mathematics Teachers.' (http://www.ericdigests.org/2003-1/teachers.htm) he concludes: "For the 21st century, professional development of mathematics teachers must address several challenges, such as the need to educate an increasingly diverse student population, the change required by new goals for schooling, and the necessity for teachers and other educators to function well and create new organizations as needed. **The paradigm shift in professional development suggests a change in emphasis from transmission of knowledge to experimental learning; from reliance on existing research findings to examining one's own teaching practice; from individual -focused to collaborative learning; and from mimicking best practice to problem-focused learning** (Loucks-Horsley, 1995; Sparks, 1994). Following are a few items that teacher educators and teachers should keep in mind to enrich professional development programs. * Professional learning must be lifelong and relevant to student learning. * Schools must stop counting hours or programs that a teacher participates in professional

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		development, and start measuring what happens as result of their participation. * Teachers should stop receiving one-shot workshops and become active decision makers in the process of designing and choosing professional development opportunities. * Planning professional development should start with the end (outcomes) in mind and encourage teachers to be involved in the planning process. * Professional development initiatives in mathematics should have an appropriate level of challenge and support, provide strategies to demonstrate new ways to teach and learn, build internal capacity, use a team approach, provide time for reflection, evaluate the effectiveness and the impact of the activities, and use humour and have fun. * Follow-up to professional development should be provided--such as opportunities for practice in the classroom. * The professional development designer's challenge is to assemble a combination of learning activities that best meet the specific goals and context. * Remember that professional development alone cannot carry a reform effort. Professional development should be viewed as a critical component of reform. It must be linked to those same clear goals for students as well as assessment, pre-service teacher education, school leadership, resources, and staffing." **At the preschool level** Given the heterogeneous nature of the structure of the preschool sector using subject associations such as MAV could be the best approach to providing support to the preschool sector in sharing best practice across the sector. This could take a number of forms, for instance ♦ PD days or sessions for teachers (and or parents) such as MAV now provides for teachers and children at other levels of education. ♦ Provision and encouragement by subject associations of joint maths education activities between the primary schools, and their local preschools.
4	Determine how new business, industry and research applications of mathematics and science can be integrated into schools and learning communities.	♦ The Mathematics Talent Quest (MTQ) provides an excellent example of students investigating the application of mathematics to business, industry, recreation, community and family life. **Further support from business and industry for the Mathematics Talent Quest Project would assist with the documentation, publication, and promotion of this innovative way of integrating mathematical application.** For example, with additional sponsorship or government

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		funding, the prize-winning entries could be exhibited around the state to promote mathematics in the community and encourage discussion among business, industry and schools about possible projects for students to investigate. ♦ **With sponsorship and support from industry or government, the MAV could develop a database of people from people from business, industry or mathematics research who could service the mathematics education community in many ways.** These people could be speakers for students, teachers or the community or be consulted about the development of curriculum and teaching materials in mathematics.
5	Examine the potential for greater cross-sectoral links between industry, tertiary and training institutions and schools in the promotion of mathematics and science education.	♦ The recent Careers publication joint initiative of AMSI and the MAV featuring people working in contemporary occupations using mathematics will need regular updating and reprinting. Much more can be done here in conjunction with the tertiary sector promoting courses and linking them to careers. **An interactive and searchable Careers CD and/or online site with video clips, course and career information would make an excellent resource with National appeal.**
6	Examine gender issues in the teaching and learning of mathematics and science education.	♦ The most recent review of gender issues in the teaching and learning of mathematics was conducted by three members of the MAV. See: Vale. C., Forgasz, H. & Horne, M., 2004, Gender and mathematics. In B. Perry, G. Anthony & C. Diezman (Eds*.), Research in Mathematics Education in Australasia 2000-2003*. Flaxton, Qld: MERGA.
7	Consider ways of promoting greater interest by suitably qualified people to undertake mathematics and/or science teaching careers.	♦ The best candidates must be actively sought. ♦ Costs of pre-service training must be substantially reduced. ♦ Remuneration and career advancement must be enhanced and promoted. ♦ Work conditions in keeping with a profession must be provided and opportunities for positive job satisfaction must be enhanced. ♦ Flexible working options to allow teachers to move to industry and visa versa