C O R R E C T E D V E R S I O N

EDUCATION AND TRAINING COMMITTEE

Inquiry into promotion of maths and science education

Melbourne — 18 April 2005

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Dr N. Lane, manager;

Dr M. Evans, schools project manager; and

Ms J. McIntosh, schools project officer, International Centre of Excellence for Education in Mathematics, Australian Mathematical Sciences Institute.

The CHAIR — The Education and Training Committee is an all-party joint investigative committee of the Parliament of Victoria. We are hearing evidence today in relation to the inquiry into the promotion of maths and science education. I wish to inform those present that all evidence taken by the committee, including submissions, is subject to parliamentary privilege and is granted immunity from judicial review pursuant to the Constitution Act and the Parliamentary Committees Act. We welcome the representatives of International Centre of Excellence for Education in Mathematics to give evidence today. I will invite you to make a presentation, and we will then ask you some questions.

Dr LANE — If it is okay, I thought we might give you a very short overview of ICE-EM and AMSI, talk a little bit about our projects and then about some general issues. The Australian Mathematical Sciences Institute was established with funding from the Victorian government in November 2002 as part of the science, technology and innovation infrastructure grants program. It found matching funds from mathematical sciences departments and related research parts of universities throughout Australia, and now represents about 26 different organisations. A few years ago AMSI applied for funding from the federal government for the International Centre of Excellence for Education in Mathematics and we received that funding in June 2004, so we have been around for a bit less than a year. Part of the requirement for our federal funding through the Department of Education, Science and Training is to facilitate professional development of teachers, especially their knowledge of mathematics content; to develop and disseminate materials that illustrate contemporary mathematics applications; to promote student interest in studying mathematics — particularly through careers materials; to develop schools materials — and that is jointly with the Australian Mathematics Trust — for teachers and students, including a textbook series, and to support indigenous students and students from low-income and remote areas through collaboration with relevant agencies. Given that background I would like to talk about some of the projects we are involved in. I will give a bit of an overview and then turn it over to Michael and Janine to give some of the more detailed information.

One of the projects we have been involved with is developing an overview of what mathematical content is relevant for teachers at three different levels: years P to 4, 5 to 8 and 9 to 12. To that end we have held meetings with mathematicians, mathematics educators and, of course, teachers around Australia. We held one meeting in Melbourne, one in Brisbane and one in Adelaide. A report on that has been finalised by Peter Galbraith who is the person running that project from the University of Queensland. We will be putting together a short version of the topics which we feel are valuable for teachers teaching at each of these levels. That will be going to our educational advisory committee that meets on 30 April, and we hope to have that material available publicly some time after 30 April for any groups who would like to look at it.

We are also holding a number of professional development workshops for teachers. Professor Hung-Hsi Wu from the University of California, Berkeley, who is a mathematician who has been working with teachers. We will be having John Mighton from the University of Toronto who particularly works with students who are not doing well with mathematics. Through working with the Mathematics Association of Victoria and other state mathematical organisations, along with the Australian Mathematical Society we are hoping to provide opportunities for teachers to have professional development in mathematics, not so much just in pedagogy but in what is happening in mathematics — and Michael will shortly talk a bit more about that. We are also working on a number of school materials in the years 5 to 10 range — and I think before I go on and talk about some of the other types of projects that involve industry, I would like to turn it over to Michael to talk a bit more about the workshop program and the school text program.

Dr EVANS — Thank you. I actually went to Professor Wu's workshop in Melbourne where approximately 15 teachers from around Australia came in. He inspired people by talking about fractions for a week! It amazed me too — that someone could catch the attention of 15 teachers for a week on fractions! He actually taught the mathematical aspects of fractions — of course, it is mathematics. He showed the relationships that existed and the reasonably deep mathematical thinking involved. It was quite an eye-opener for the teachers involved about how much there was in that topic. It was a valuable experience for me and for the teachers involved in that. John Mighton will be coming later on in the year. He is running a program around the Toronto, Ontario, region, which is really a tutoring system which he has built up. He is a university mathematician at the University of Toronto. He has a belief that every child can be taught mathematics, and his program is showing that that can be done. In many cases he has had huge success. It does depend on a lot of individual attention to students, but he believes in a sustained effort in the subject will produce the results. It is something that we believe in, too — the continuity and sustaining of a particular line.

ICE-EM will also be bringing people out like Professor Art Benjamin, who is a prominent mathematician. He is actually visiting the University of New South Wales at the moment, and he will be coming down here to speak to schoolteachers and students. He has the art of being able to do rapid mental calculations as one of his party tricks. It is a way of promoting mathematics in the state. We have also proposed a visit by Professor Bill Grassman, who is Canadian. He is the technology editor of the American Mathematical Society notices, and he will be showing how technology can be used in education. He has done a lot of work on it. One thing that can be said about the people who have been brought out is that they have put a lot of work into the area and thought about education. They are university-based mathematicians, but they think mathematics education. I would like to add in a rather minor way that we have been involved with MAV in workshops and programs. I have presented five workshops with MAV this year and on invitation have started to talking to clusters on schools about VCE and our other program. We want to continue to do that and build on that as well.

I will talk briefly about the schools material program, because that is going to be the basis for our PD and reaching out into the schools in the next few years. It is an Australia-wide program, and we see that as one of its strengths, because we actually have people involved from all states. It would certainly be useful for its desired use in Victorian schools as well. We see the backing up, the interaction between professional development, the texts and the other materials. We believe there is a need for a clear course of study that goes through particularly the middle years 5 to 10. The state authority does that — the Board of Studies puts out its essential learning statement, but this is more just backing it up with sound mathematical thought and to provide support for teachers and schools. Would you like to add something?

Ms McINTOSH — I think the interesting aspect of this is that it is working across from the primary school into secondary. Those connections have not been made very strongly before. We are looking at building on the knowledge that children acquire in primary school and taking that into secondary. So the teacher in the primary school is aware of what comes after and the teacher in secondary is aware of what has come before.

Dr LANE — I might just say that we are starting in the middle and working towards the edges — that is, we are starting with books 7 and 8 and PD for teachers at that level. We hope to have those in draft form by the end of the year and piloted in schools next year. That is the plan for the first two books of the series.

Dr EVANS — It will be a piloted publication, so we will be getting interaction from the schools, and that will be seen as part of the professional development, too. It will be a way of schools connecting with each other through that process.

Dr LANE — I might go on then to talk a little about some of the activities that we have that relate to industry and careers. I have brought you a pile of goodies. I know I have to have 10 copies. I am not sure who does the distribution. We have been working with MAV and ran an exhibition at the Age VCE and Careers Expo this year. It was so successful that we have actually used that as a model for taking that to other states. What we have done is develop a booklet through La Trobe University to give students an idea of the sorts of jobs that are available. As you may be aware, there are very few jobs that actually advertise for a mathematician. Often it is disguised as wanting someone else, from a field such as finance banking or sciences, and then in the smaller print it says they actually want someone with a statistics or mathematical background. So what we are trying to do is give students and their parents and teachers a better feel for the range of jobs that are available.

The other sorts of materials that we make available at the expo are these brochures which are designed to look like CDs so that they will at least get picked in the first instance to give people an idea of some of the careers that real people are working in. I have not brought 10 copies of these, but I will give a copy to the secretariat. We have posters that we have developed that talk about young people who tend to be in their 30s and have used mathematics, such as an oncologist, a man who basically runs a brewery but is an operations manager, a young girl who works in fisheries as a fishery scientist and is dependent on mathematics, and someone working as an analyst in digital technologies. It is trying to give students at both high school and university levels an idea of the range of careers. The display that we did at the VCE and Careers Expo is promotional material, which basically says, 'Careers in mathematics — the possibilities are infinite'. The idea we are trying to get across is that if students stick with mathematics — the highest level of mathematics that they feel comfortable doing — it really does give them a much wider range of career options than if they cut it off too early.

The other work we will be doing with industry is setting up soon a contemporary mathematics applications web site. We are getting funding from the mathematical and information sciences group of CSIRO. We will be doing

interviews with the same sorts of young people so that students can read the interviews or hear the interviews — there will be some audio clips — or see short video clips. Our aim is to have in the first year interviews with about 10 to 12 people, and each year to add to that, to give students an understanding of why it is important to stick with mathematics and the range of careers they can have that are not just as mathematicians. With that, we might turn it over to some more general issues that are on the list that you are looking at. I did want to mention some of the research, if you have not looked at it yet, from Heather Hill, Brian Rowan and Deborah Ball in the United States. The report is 'Effects of Teachers' Mathematical Knowledge for Teaching on Student Achievement'. When we have been talking about our programs, what we are really concentrating on in our textbooks, our teacher PD, is the teachers' mathematical content knowledge.

That is some of the first research that has come out to show that teachers' content knowledge for teaching mathematics was a significant predictor of student gains in mathematics. They looked at a range of teacher attributes, including their knowledge of mathematics methods, whether they were certified, the number of years of experience they had, the length of the mathematics lessons, how often they were absent, and so on and so forth. The summary says that the content knowledge for teaching mathematics is the strongest teacher-level predictor. This was undertaken at the first and third grade levels. It was as important as any of the students' background — whether they were of different ethnic origin, their gender and so on. Basically they said that this suggests that knowledgeable teachers can positively and substantially affect student learning of mathematics. That is supporting, I guess, our rationale for firmly believing in the importance of content knowledge as the area that we are promoting very strongly.

Now I would like to turn it over to Michael and Janine to talk about some of the issues. The second strongest predictor, I might say, is the length of time that the mathematics lessons went on every day. Michael and Janine might want to comment a bit on that as well.

Dr EVANS — I will just go through a number of points. It is probably worth mentioning my background. Up to this year I had been in schools for 33 years and taught in all three systems. I must admit that in the Catholic system two years part time, right at the beginning of my career when I was a postgraduate, but it still counts. So I am speaking partly from that experience. I also still hold the position, besides my present position, as the convenor for VCE mathematics in this state. I have been working with the VCE for a number of years — probably the last eight or nine — so I have had that sort of interaction at the level as well with schools around the state. These comments are based on that and what we have been working on as well.

One of the things Janine mentioned before, which has been somewhat the bane of my life, is the connection between primary and secondary schools and the break in culture. In mathematics it is not a good event in students' lives in many ways — how the style and practice change and that their experience in primary schools is different from their experience in secondary schools. It is a quite difficult issue. I taught in a large private school for a long while. One of the things I had to work on very hard was to try to get those connections even with my junior school to make sure of getting that continuity. In maths you can lose years very easily by not having the right structure. We see that as a very important issue and one of the things we hope we can contribute towards solving — by having materials that go across the year levels.

Another thing I know is very important, just from that experience, is just having a well-connected strongly led department inside the school, so that there are connections between teachers and there is a coherent program that goes right throughout the school. If you do not have that, there is no chance. I can say that at the moment that is not true of every school in the state. It is very important that the teacher in year 8 knows what the teacher in year 7 has done et cetera. You need to have that sequencing of the course. Things which have also come to the fore again in recent times include that the time devoted to teaching mathematics in schools has diminished. This is anecdotal because we do not seem to have tight figures on it, but everyone complains about it. If you speak to any teacher of mathematics they will always say, 'The time I've got now is less than I used to have'. This does have an effect on teaching. Maybe I am addressing my comments to secondary schools. Janine will follow up with comments about primary. So we are in that situation. The fact is that there is a movement towards integrated learning. I cannot speak ill of it of itself but it can have the effect of diminishing the time at mathematics. That is one of the things we worry about. In Victoria the essentials of learning seem to have been interpreted quite sensibly for mathematics but there is still the danger that that will contribute to this effect. We have to be very careful. I know that people in the field are very worried about the fact of the generality of that new structure and the emphasis on the different aspects. No-one can argue against them — they are all good things — but there is a danger that they will have some effect on teaching mathematics.

The age of teachers of mathematics is a worry. The recent TIMSS survey put a large proportion — I think in Victoria it is 30 per cent — of teachers of year 8 at over 50. That is a very large proportion and it is going to have an effect in the next few years. I have been giving sessions for teachers of specialist maths for the MAV and I look reasonably young in there. It is an ageing profession at that end of the school, too. One of our concerns too is that people without maths qualifications are teaching years 7 and 8 in secondary schools. It is a quite severe problem. I was lucky at the school I was at. We could enforce that the person actually had to have qualifications. When something changed and one year that did not happen, there were complaints by the parents and the school was in a situation where people could not defend themselves. So I won that one from then on. The fact is that we know that all around the state people who are not qualified in the subject are being pushed in to fill those vacancies. As Nancy said, that could affect the progress of those students. Not every one of those teachers, by the way, is a bad teacher of mathematics. If enough effort is put in and they think about it enough, I am not going to say every one of those teachers is going to do it badly, but the chances are increased, basically. I think that is how you would put it. I know there are good people who have not been trained formally teaching the subject. I would not like to detract whatsoever from their effort.

On the Victorian Institute of Teaching, I welcomed the standards of professional practice when I saw them, but then there was the question of how you could ensure that professional knowledge was ascertained, monitored or measured. It says that a practising teacher has to have professional knowledge and know the content they teach.

Mr PERTON — How would you do that?

Dr EVANS — I think it is probably a quite difficult thing, to base registration somewhat on a subject base as well. If you are going to be a teacher of mathematics, there should be some mention of your qualification and it should be public knowledge. That seems only fair. In every other job, in the obvious areas of medicine or accounting, if you are actually practising you need to be registered as a doctor or accountant, and everyone knows what that means. Sometimes there are specialisations which are further put forward. I know that is particularly true in medicine.

Mr PERTON — How would you test content knowledge?

The CHAIR — Sorry, we would rather have the presentation finished and then open it up for questions.

Mr PERTON — If you would like to answer that in your presentation.

Dr EVANS — Sure. I certainly think that that is one of the things that should happen from the Victorian Institute of Teaching. I would like to see that enforced. I mention Professor Adrian Smith of the United Kingdom's report only last year. It is relevant to what is happening here in Australia, too. It seems they have a worse situation in mathematics teaching than our own. The recommendations include things like that the issue of pay must be addressed, that there should be incentives for people to actually join the profession and a data-collection strategy that provides an evidence base for a coherent policy approach to the supply of appropriately qualified teachers. It is quite hard to ascertain who is qualified. That UK report outlines to some degree ways of classifying teachers. That would be worth looking at as a method; it would be a worthwhile thing to do. The report also suggests that professional development should be rewarded. So if someone goes out and improves their mathematical or teaching knowledge, that should be rewarded in some way, either monetarily or by addition to some promotional structure. That seems to be a sound procedure because it is like any profession: things are changing all the time and we need to keep up with what is going on. They are the main points.

Ms McINTOSH — I will begin my explanation by introducing myself. I am trained as a primary teacher and until December last year I was working in a 5–6 classroom as a numeracy coordinator in a school in the northern suburbs of Melbourne. I have experience teaching undergraduate teachers as well: I lectured for three years in mathematics education at the University of Melbourne. So I come to this with a teacher background but understanding a little bit of what goes on in the universities as well. We found two main areas of concern. We recognise that there are some very good teachers of mathematics, and certainly the middle years numeracy research project has identified those teachers and said these are the kinds of things that we know work. We have some areas of concern with pre-service education — teachers before they have graduated — and then once teachers are out there maintaining that level of professional development, in mathematics particularly. With the pre-service teachers, we would like to see the focus on pedagogy as well as mathematics content. We have done a survey of some of the teacher courses as they have been described on university web sites. We have found that a lot of the

courses described focus a lot more on the pedagogy, the teaching and the ways to do it, and a lot less on the actual mathematics content. We would like to see a little more of a balance that way.

The CHAIR — Are you talking mainly about primary?

Ms McINTOSH — I am talking about primary teachers having an understanding of the mathematics that they are teaching. I am aware that a lot of that is done in the courses but a lot of the courses do not require them to have mathematics as a prerequisite, so they are coming in with year 11 mathematics and mathematics probably was not their favourite subject at school. They were probably one of those students who did not think they were going to need mathematics when they started working. It is certainly my experience in teaching undergraduates that their level of confidence is not good. It is our position that it is difficult to teach something when you are not feeling very comfortable in the area. So we would like to see teachers build up their content knowledge. That way they will feel more comfortable teaching it and come across as a lot more confident. They must pass that on to their students. There is a bit of a cycle. If you mention that you are a teacher of mathematics, there is a groan, and then you get on with your dinner and that kind of thing. I think teachers really would like some support in that area. It is certainly where we are working from.

The other area we are looking at is teachers who are out there currently teaching but may not have the areas of strength that they need. I am not talking about people who are numeracy coordinators; I am talking about the normal classroom teachers and the professional development they are getting. We feel it needs to be coordinated at probably the state level. It needs to be sequential so that they are developing skills, not just picking up a bit here and there — it is not just a make-and-take idea of professional development. We would like to see them working towards something that is quite coherent. The need for this kind of work is in the TIMSS data. Year 4 Australian children perform significantly quite low on just the area of number and not looking at the other areas of measurement. Certainly a lot of data has come out of an early and middle years numeracy research project in New South Wales, Count me In Too, that targeted teachers. Finding out what a child knows, looking at those misconceptions and actually targeting teaching with some knowledge of where you are going with mathematics is helpful. We would like to see teachers spend some time on professional development and then in the classroom spend quite a substantial amount of time actually teaching mathematics. As Nancy said, in the United States as the time that mathematics is taught increases, student outcomes also improve. We are a little concerned. I think if I said to most teachers, 'We'd like you to teach an hour of mathematics a day', it would be very difficult to fit it in but it would certainly be a good thing. That is all we are looking at: we are certainly looking at linking the writing of our texts and supporting materials to those ends. We are looking at supporting teachers who need that content knowledge and at supporting undergraduates with professional development as they come out into the schools.

Ms ECKSTEIN — You touched quite a lot on content. I want to go back a step. Has the institute or the profession more generally, and as far as you can comment on that, engaged itself with what mathematics knowledge should be covered at the various levels of schooling? We can all think back to the mathematics that we learnt at school and perhaps say, 'What I have actually used of that is not a great deal' or 'It's been in a fairly narrow field'. I once heard a university mathematics lecturer say that most mathematics is taught to train more mathematics teachers. If that is the case, I think we have a serious problem. Clearly there is a body of knowledge that we ought to be teaching and that will vary, depending on what professions people want to pursue later in life. Is there a view about that sort of thing and what that should be?

Dr LANE — I am a little unsure of your question. You are asking what is the body of knowledge that the students should have or what is the body of knowledge that the teachers should have for teaching at that level?

Ms ECKSTEIN — I am actually asking both because if we know what the body of knowledge is that the students should have then we probably know the body of knowledge that the teachers should have. If that body of knowledge is mainly around producing more maths teachers, then maybe we are coming at it from the wrong end.

Dr LANE — What we have started with is the basis for what students should know. We have looked at the statements of outcomes, essential learning and so on. We have really gone to the state curricula as the basis for this is what the state expects students to know. So we are not trying to judge that. What we are then looking at is: what is the sort of mathematics that teachers need to know in order to teach that body of information?

Ms ECKSTEIN — But you do not have a view on the former?

Dr LANE — We probably do.

Ms ECKSTEIN — You probably have individual views rather than collective views.

Dr LANE — I guess the point is that we have to start with certain givens and we have to assume that that is the job of the state and the state education boards or authorities; it is not our job.

Ms ECKSTEIN — But as we have heard, they are very much informed by what the profession, including your part of the profession, says. So they go to people like yourselves, academics and teachers to form that view. I am asking: is that debate happening anywhere? There is an argument that says you do mathematics like you do a language other than English or music because it is a certain discipline and it trains the mind. That might be a legitimate argument, but is someone having that discussion about what is all — —

The CHAIR — Is it essential?

Ms ECKSTEIN — What is essential?

Dr EVANS — First of all, I guess there was a national statement about mathematics in the mid-1990s which has been hugely influential throughout the country in the fact that most state curriculum follow that particular pattern and that particular pathway. We have not completed but we are well on the way to completing a comparison between all the states and the different study designs, the different syllabuses.

The CHAIR — Excellent. When will that be finished?

Dr EVANS — We have substantially done from 7 to 10 through five states. We have not done Tasmania because for Tasmania the total state applies, and I have not narrowed down what it is yet so we have not worked with that. We are working on level 4 in Victoria now, the grade 5 and 6. So we are starting to go through the states there.

The CHAIR — Is that publicly available, or will it be?

Dr EVANS — We can make it publicly available.

The CHAIR — We would very much like that. It is one of those things we need to get a grip on.

Dr EVANS — There is no reason why we cannot.

Ms ECKSTEIN — That would be very useful.

Dr EVANS — It has been a valuable process. One of the things is — and this does not answer your question altogether — that all the states are doing very much the same thing. There is huge similarity between states, which is some argument in itself. It might be just a huge con sheet, but in actual fact everyone is doing the same thing. My belief is, and it is a view held by a lot of people, that mathematics is central in the modern world. Everything around us is geared on mathematical thought — all technology is. If Australians want to move away from just being consumers of technology to being initiators of technology, then we have to have that sort of education present. You cannot do it without mathematics. Everything works on that basis.

Ms ECKSTEIN — I disagree with you, but what is the mathematics that is essential?

Dr EVANS — It is the thought, actually. It is very hard to put down. In talking about fractions, algebra et cetera, it is the thought processes that are developed through.

Ms ECKSTEIN — That is the trained-mind argument.

Dr EVANS — You might use elementary algebra in those processes, but to say that you do quadratic equations when you are doing computer science, well, you can — you certainly can — but it is not a central part of it. It is background knowledge. I think we have got to the stage where it is seen as a unit of knowledge of mathematics which is useful to spread out from, to go out and do different things. It will not be exactly the same thing you learn in school, just as I suppose there are aspects of language. Most language you use time and again — it is not a perfect analogy — but it develops out. You have a core alphabet that you do in school, then you can develop into the other areas. I think we are seeing this taking place so that in the universities there is an awful lot of

mathematically based courses now. Commerce is totally mathematically based et cetera too. I would say one of the most important aspects is the technological change we are going through and its structure.

Ms MUNT — That is interesting, because my husband is a maths nut and an engineer. One of his favourite sports when our kids were going through school was to challenge the maths teacher about everything he could think of. Mostly he challenged the primary school teachers. It is interesting what you were saying, that a lot of primary school teachers perhaps did not go through to year 12 maths and do not have a full maths understanding. What you are talking about is a maths language. Maths is the second language. If you know the absolute end point, then you can much better teach the first point. If you know where it ends, then you know where it has to start. I think what you were saying about primary school is relevant because you do not know the end point to start from the start point to teach that language as a building block.

Ms McINTOSH — We are not saying to do an advanced mathematics course at university level. That is not what we are about. It is the maths that the teacher needs to teach, what they know and then where it is going to — like you said, that end point.

Ms MUNT — That is right, and getting the connectivity along the way.

Dr EVANS — And more importantly, or just as importantly, is to understand that mathematical thinking that puts it together. You can learn mathematics in different ways, but you want the mathematical thinking process to be there. This has become quite a big thing in the states at the moment, to make sure that in-service training for teachers includes developing thoughts of proof and logical argument. They are not going to teach that in primary school. It is thought important that teachers be aware of that way of thinking, and I certainly agree with that.

Ms MUNT — So do I.

The CHAIR — Janine, on primary school educators, a friend of mine who is doing teacher education recently told me about a lecture she had in mathematics — not that she did a lot, I must say; it was at second year under bachelor of primary education. The class was told that it is not so important to understand mathematics or know it all, but what you have to know is how to teach it; that is, that the pedagogy — and this is absolutely true but I will not refer to the institute — of teaching maths was important, but that the content knowledge per se, and your never actually understanding it yourself, was not.

Mr PERTON — And she rang you to complain?

The CHAIR — If only you knew! It seems to back up the point you were making before, particularly in regard to primary. I wonder whether you have looked at perhaps the British model, which we have looked at in our previous inquiry, but basically having a test of proficiency for teachers in maths. Would it be that hard to say, 'Okay, with English and maths let us have a basic content knowledge test to see if you are proficient'. Have you looked at that? Is there any debate on that?

Ms McINTOSH — We have talked a lot about this. I do not think an exit test of students coming out of university would be an impossibility. Melbourne University runs a basic skills test. It is a hurdle requirement at the moment and is not assessable. The students are given multiple opportunities to pass this test and support to get through it, but by the end of it, as lecturers, they are fairly confident that they have students who have a degree of mathematical ability, who can convert fractions to decimals and who can do things that perhaps they are not teaching their year 3s, but they know the end point and the language. I would disagree with the person who said you do not need to know the content. I have done it, and it is really hard to do. I am prepared. I could teach French. I do not have a major in French, but I could teach it if I had the book. The pronunciation would be terrible, and the end product the children came out with at the end would be appalling, but I could do it without the knowledge of the content. I do not think you can do this with — —

The CHAIR — Have you spoken to the VIT about this in terms of teacher training courses, for maths in particular?

Ms McINTOSH — It would be something that would be worth investigating. Exactly how that would happen I am not sure, but it would certainly be something worth investigating.

Mr PERTON — Late last year the *Age* and the *Herald Sun* both editorialised, complaining about Victoria's place in mathematics relative to the rest of the country and the rest of the world. That was based on the PISA results and the TIMSS results. You have talked about teacher quality, curriculum and standards. In the PISA study obviously countries like Singapore, Hong Kong and South Korea are ahead of us. I saw a presentation from Geoff Masters the other day on TIMSS that showed that countries like Latvia, Lithuania, Hungary and Czechoslovakia were leading us. What is it that those countries are doing that we are not doing? If I can ask a two-barrelled question: if as a matter of policy we said we want to be the top state in TIMSS and PISA and ultimately to be equal to the top countries in TIMSS and PISA, what would we need to do and how long would it take us to get there?

Ms McINTOSH — The Japanese primary classroom teachers enter their classroom knowing the topic they are going to teach and have, as a team, clearly planned out the strategies, the mathematics, the activities and everything that the children will do in that lesson. So the time spent on professional development at the school level is probably higher than what our teachers would have available to them. That is one aspect. We cannot discount totally the cultural aspect of support from home, encouragement to achieve and those kinds of things as well. But certainly the support that teachers give each other and have, and the ongoing and constant professional development that teachers receive in most of those countries, is quite high. Certainly in Japan I am aware that the level of professional development teachers are given is quite high in the number of hours as well as content.

Mr PERTON — Geoff Masters at the Sustaining Prosperity conference said that Victoria had been in a 40-year relative decline in maths performance against the other states. If we were to set you the mission of turning that around, what would it take and how long would it take us? In fact, beyond turning it around, getting back to being equal to the best in Australia. Just to elaborate, Masters showed that the Western Australian maths performance was equal to the world's best, that the population of Western Australian students was similar to that of, I think, Singapore and Japan, which had the top-performing students. The Victorian result was substantially below that.

Dr EVANS — You have to be careful how you interpret TIMSS. That should be said first. Victoria was put in the second category of states. Some of the differences are not statistically significant anyway, so you cannot just use TIMSS to actually rank countries directly. You always take it with a grain of salt; they are only testing certain things. When I say you take it with a grain of salt — what you should do is question it to some degree. There is serious information there which we do not want to ignore either, but I would not take TIMSS or PISA results just by themselves. When you read the actual report you see it is a bit gentler than he was — in fact it is a lot gentler. I cannot remember the wording — I wish I had it with me — but it did not really distinguish between us and New South Wales statistically, for instance. If you actually read the report, it is worthwhile. Probably the model I know best is Singapore. Obviously it is ranked highest. They do it just by being incredibly well organised basically. That is how you would describe it. They actually have a program that goes from kindergarten through to year 12. It is very carefully sequenced. Schools are given advice about sequencing. If you go from one year to another, you can rely on the fact that the student actually has seen that particular material. They have testing at different levels, which we have got too, but their testing is a little bit more vicious and it determines which school you go to when you get to secondary, so they have a ranking of schools. You are probably aware that you can go into the top 5 per cent school and then the next 10 per cent school — I do not think we want that. But probably for maths education it has been very effective.

The other thing they have got is a very intense professional development program. They have got something like 100 hours of professional development a year for their teachers. So not only do they have a very carefully outlined program but they make sure their teachers know it, so they are up-to-date with modern techniques et cetera and they give them the correct backup. They give them time off for the professional development as well. So you cannot just adopt some of these things straight across because it would not work in our system. I personally think mathematics responds to organisation basically. So if you get a very organised system, performance is going to improve. The testing at 3, 5 and 7 has actually helped our system, and it is improving. Everything in Victorian maths is not bad; I will be a little bit defensive.

Mr PERTON — You have told me to use TIMSS with a degree of scepticism, but you have littered your submissions with reference to TIMSS.

Dr EVANS — That is all right, but it does not involve claiming a ranking. I would agree with that. The information given there is the only statistical information that we have got across OECD countries, but when it

comes to ranking it is a dangerous thing. It can give you some idea about the rankings, but it is very difficult to say that 5th place is better than 12th place.

Ms McINTOSH — It is helpful to use it in terms of we know we need to work on number, for example, but our measurement change data, space and shape is probably healthier that we thought, and we use it that way.

Mr PERTON — Obviously we have got a new curriculum framework which, as you have said — —

The CHAIR — Next year.

Mr PERTON — This is theoretically the validation. You will note that schools have not had any support for that year. We have been given one of the model studies here and its integrated sample task — heart rate, for instance. You have got English being mixed up with physical, personal and social learning strands, interdisciplinary learning strands and discipline-laced learning strands. You have said that Singapore's success is based on its organisation and the like. Is this sort of structure going to support mathematics education in this state?

Dr EVANS — I do not want to attack that, but I would not say that that will actually help that sort of development. In fact it will give some people the excuse not to follow that sort of procedure, which is the thing that worries me about it. They say, 'Oh, every time we have to do mathematics we have to put in these other five subjects', and quite frankly it is impossible sometimes. I do not think that in itself would enhance mathematical learning in this state.

Ms McINTOSH — In the right hands — with a teacher who knows the content that should be gotten out of an activity like that — a child will do very well, but the danger is that if the teacher cannot see the mathematics content, they cannot draw that to the attention of the children and then it is lost or watered down.

Dr EVANS — It is a higher level of expertise.

Ms McINTOSH — It comes back to the content of those activities again. They can be very rich in the right hands and with the right connections made at the end of it with the right end points.

Mr PERTON — I would like to ask one last question if I may. Whatever we may say about the validity of TIMSS and PISA in studying international comparisons and state comparisons, the data shows that in Victoria there is a massive difference across schools. In your submission you talk about the equity implications of that. Having said that teacher quality is the primary determinant of a child's performance in maths, do you want to elaborate on what you have said in your submission on the equity problems in Victoria in performance in mathematics?

Dr LANE — I think perhaps where the equity comes in, we tend to look at it in terms of gender equity or socioeconomic equity, but it is looking at where teachers with those best qualifications and best content knowledge are placed. In our submission we drew attention to the fact that in so many rural and remote schools teachers go fresh out of university, and they are sometimes asked to teach in areas outside their knowledge base. They often spend two years there and then they are off again. So in terms of equity, students in some of the schools in various outer Melbourne suburbs and in rural and remote areas do not get the same quality of teachers. You can understand why teachers want to go where their lives are easier and they have fewer problems. I am not sure I have any solutions. Obviously it would be good if we could support teachers in some of the more difficult schools to give them the additional professional development they need, additional salary or other incentives to stay there longer than a couple of years. That is where I feel a lot of the inequity comes in.

Mr HALL — First of all, thank you for your submission to us today. I was interested in some of your comments about mathematics as a discipline. As a mathematics teacher before coming to this profession I always had great difficulty in explaining the application of quadratic equations and the future use of teaching this to years 10 and 11 kids! But I explained to them — and it is always something at the back of my mind when I talk to young people about mathematics and its application — that it is not only a discipline that has application, it is also a discipline that promotes clear thinking, logic, analysis and problem-solving. One of the illustrations of that is that I did an arts degree, and one of the prerequisites for an arts degree was either a language or mathematics. So mathematics in many ways is like a language, as a couple of you have said. That having been said, let me ask you a couple of questions about what you have said here today. The issue about developing some curriculum materials to

support teachers is overdue and necessary. How is that going to be different to the curriculum standards frameworks that teachers have been asked to base their course structures on in recent years?

Dr EVANS — What we are trying to do is make sure that we actually have an absolutely coherent mathematical presentation of material, which is not existing at the moment. Existing textbooks which go from 7 to 10 have a particular formula, which does not involve any explanation. It is usually just a matter of a three-line introduction, worked example and exercise. That is the commercial formula. I write textbooks so I know what the instruction is; I try to avoid it but I know what the instruction is. What we want to do when we are doing this is make sure we are presenting information so that the teacher can follow through the development as well. They can actually go through what is on the state syllabuses but they can read through what the mathematics is at the same time. We are making that information more available to both students and parents, which we see as quite an important thing, and the teacher, because we have gotten to a situation where a lot of people are not trained in the subject. They can actually learn from the text; that is our hope. It is quite an ambitious aim and I can say we have plenty of very strong arguments between ourselves about how to put that together, but that is what our aim is. We are trying to do something substantially different to what exists.

Mr HALL — Does that work have the support of the professional associations, the major employers and various government departments?

Dr EVANS — Have we got that sort of support?

Mr HALL — Yes.

Dr EVANS — I suppose we have. I have not asked for any direct support from those people, but people have made pleasant responses to what we are doing; I think we can say that.

Ms McINTOSH — Most people have been involved in the meetings where we have mapped out content; we have mapped out things we think are important. So that information has certainly come from those people right across the country; it is not just us.

Dr EVANS — We want to make sure this is so widespread that we will have a large team of people working with us. The pilot program will make sure we have to respond to the most important people, and they are the students. That will be fed back in and we will alter what the material is as we go through.

Mr HALL — I know that one of the most difficult things in secondary teaching is when you stand in front of a year 7 class and you have students, particularly in the country schools, who may have come from six, seven or eight different primary schools in your classroom and they have been taught using different methods et cetera, let alone the fact that they are all at different levels of capability in terms of the subject. You would think this material would need to be adopted fairly uniformly across education systems to assist with that transition, which you highlighted was a real problem.

Dr EVANS — That is obviously our wish. It depends who takes it up, but we want to influence things in that way. In the year 7 book, for instance, you cannot start from the beginning, but you make sure you try to include people at different stages; those attempts are being made. The best thing that will happen is if we can get a large number of people doing years 5, 6 and 7 so we get that continuity through. It would save a year — what happens often is years are wasted in students' maths education because there is not a lot of emphasis in grade 5, say, and they get into year 7 and all you do is repeat what you should or may have done back in grades 5 and 6. Worse still, you do quite important concepts in a very short time later on in the schooling because of the stretching out. That is what is happening at the moment. Division of fractions is a classic. I think we used to do it in grade 3 or 4 when I was at school and we used to do it for six or seven months. In school now it is given a couple of weeks in year 7 and maybe another couple of weeks in year 8 if you are lucky. They are difficult ideas, and all of a sudden these things are compressed into shorter periods of time because of what is going on through the system. It has to be thought about as a whole to make it more efficient. I think that is one of the things we will try to aim for.

Mr HALL — One last quick question. You said that ideally we should be teaching maths an hour a day in primary and secondary.

Ms McINTOSH — That is what I am saying. When the curriculum standards framework came out that was a recommendation.

Mr HALL — Is that being achieved in either primary or secondary?

Ms McINTOSH — It is difficult to say. Certainly working with teachers in schools it can happen very easily that you can cut an hour a day down to half an hour a day and you are down to 2½ hours a week instead of 5. It is not until you start to think about it in those terms that you realise that very quickly something will happen, there will be a special assembly and you will do not it today. I am aware that it is not just with mathematics that that happens, but it is very easy to cut it down. In the secondary schools there is strong evidence that the number of hours has been cut.

Dr EVANS — In the secondary level there is no way the schools are getting an hour a day; I would say it is much less. I was at Scotch College for a long while and we used to have maths once a day. I insisted on it and the principal supported it, which was good. When I used to tell that to people at other schools they would go, 'You are living in a dream world there, it is perfect.'. It virtually happens in hardly any schools in Victoria that maths is taught every day. If you do a survey, it is hardly any.

Ms MUNT — It says here that there was a campaign in the 1980s to get more girls to participate in maths, and it basically says things have gone down hill a bit since then. I was wondering what the participation rate of girls in maths is by the time they get through to the later years of schooling.

Dr EVANS — It is not bad.

Ms McINTOSH — I am not really sure what the figures are.

Dr EVANS — I do not think it is too bad. I think in methods it is over half and in specialist it is around about the one-third mark, but the performance is much better. The performance in specialist maths of the cohort that is doing it is much better than the boys. There are a lot of boys doing specialist who cannot cope with it basically, but the girls who do it can usually do it.

Ms MUNT — Fantastic.

Mr PERTON — In his presentation to the Sustaining Prosperity conference and his analysis of PISA and TIMSS, Geoff Masters suggested that by year 6 the difference between the top 10 per cent of students and the bottom 10 per cent of students was seven years. How do you teach to a class like that?

Dr EVANS — That is common. That is what we have thought for a long while; it is not a recent finding.

Mr PERTON — How do you do it?

Dr EVANS — You have to be a very flexible teacher basically and make sure that you are looking after every student. That is part of what being a teacher is. You have to make the effort to do that and to cater for the best student and the lesser students.

Ms McINTOSH — One of the key findings of all the studies that have been done in Victoria over the past five or six years is that first the teacher needs to find out where those children are and needs to know the next step. They are small steps but by the end of the year you can move most children along a reasonable amount.

Mr PERTON — But the tail is not coming back in secondary, is it?

Ms McINTOSH — No. Most teachers would accept that that is the nature of the classroom.

Mr HALL — The art of teaching is the accommodation of mutual difference.

The CHAIR — Thank you very much for your information, we look forward to receiving some more detail as we have discussed. Thank you very much for your contribution. We wish you well with your curriculum material.

Dr LANE — If there is any opportunity for you to come to visit us at the Australian Mathematical Sciences Institute, we would be pleased. We are at 111 Barry Street, off Grattan Street, just south of the University of Melbourne campus. If you are meeting at some other stage and would like to talk in more detail, we would be pleased to see you there.

The CHAIR — Thank you, we may take you up on that.

Dr LANE — Also, may I just add one more set of things? This is the annual report from AMSI as well as information about the International Centre of Excellence for Education in Mathematics. Here is our most recent newsletter. I only talked to you about what we are doing in school education, but our role at ICE-EM is basically to look at school education clear through to advanced post-doctoral research in terms of the mathematics education that is needed. A lot of the work we are doing is at the undergraduate and graduate university level. Those materials will give you an idea of the spread even though you are only interested in the school education.

The CHAIR — Thank you very much. We may come back to that in the second part.

Witnesses withdrew.

C O R R E C T E D V E R S I O N

EDUCATION AND TRAINING COMMITTEE

Inquiry into promotion of maths and science education

Melbourne — 18 April 2005

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Witnesses

Mr R. Peck, president;

Mr D. Tout, vice-president; and

Mr S. Pryor, executive officer, Mathematical Association of Victoria.

The CHAIR — The committee welcomes the Mathematical Association of Victoria. The way we normally proceed is for you to make a short statement or presentation and then we will open up to questions and discussion. Would you mind running through your names and positions for Hansard; it will make it easier. The Hansard transcript will be sent out to you for verification and correction, but it takes a few weeks. Welcome.

Mr PECK — My name is Ray Peck, and I am currently the president of the Mathematical Association of Victoria.

Mr PRYOR — My name is Simon Pryor and I am the executive officer of the Mathematical Association of Victoria.

Mr TOUT — I am Dave Tout and I am vice-president of the Mathematical Association of Victoria.

Mr PECK — I understand that it is permissible to distribute some additional material. We also have a sample bag for you — a show bag.

The CHAIR — Do we each get one?

Mr PECK — You will be fighting over it as we only have one. I will get Simon to pass it up to you. The main reason we prepared it was to give you a little background in case you are not familiar with the association, which, by the way, is about to celebrate its 100th year, so we have been around for a little while. Inside the bag you will find our most recent annual report, for example, which will give you an indication of the sorts of activities that the mathematical association tends to run.

We have six committees. Of course we mainly address our attention to supporting teachers of mathematics through professional development and publications, but we also run a range of student activities — for example, in 2004, 13 000 students were involved in our Mathematics Talent Quest, and that is perhaps the one that involves most students. We have membership and marketing committees and we have an executive committee and a council consisting of volunteers. We are very proud of our council, which at the moment ranges all the way up from preschool teachers through to university lecturers and professors of mathematics and engineering. So as you can see it is a very diverse, representative voluntary council of the Mathematical Association of Victoria. We have an excellent relationship with AMSI, which has already presented to you. We are very pleased about the relationship with AMSI and will describe to you a joint project that we feel went very well in terms of careers in mathematics. We would like to use that as an example of the sorts of further things that we can do.

I have been a teacher of mathematics for 30 years and worked in both the independent school system and the government school system, so I feel I am reasonably well qualified to speak to the committee today. I have been president of the mathematical association for two years and on its council for three years. For a long time in rural Victoria I also coordinated a branch of the Mathematical Association of Victoria, so I have the rural experience as well as the metropolitan experience over a couple of sectors. My passion is mathematics. I am currently working at the Australian Council for Educational Research as a research fellow, working on a number of different numeracy, mathematics-related projects. The document that has been distributed is really a cut-down version of the main submission. Before I get into that I am perhaps remiss in not saying that we are very fortunate in the MAV in having a full-time executive officer, Simon Pryor. We also have two professional officers and an events manager. So we are a formidable association, perhaps the largest one representing teachers in Victoria, if not Australia. Thank you for allowing us the opportunity to present to the committee today. I understand we have 45 minutes. Dave and I will be sharing the presentation. Will there be an opportunity for you to ask us some questions?

The CHAIR — Hopefully your presentation will be a fair bit shorter than that. How long do you have in mind for your presentation?

Mr PECK — We will be guided by you on that.

The CHAIR — Fifteen or 20 minutes would be great?

Mr PERTON — We have the submission.

Mr PECK — Do you have some prepared questions?

The CHAIR — Each member will have questions, but they will be guided by what you say to us.

Mr PECK — Does it depend on how controversial we are?

I might start with the AAMT standards of excellence which were in our show bag. It is a blue document. We have enough copies for everybody. The first term of reference was to determine which factors will support high-quality teaching and learning of mathematics and science. We would like to endorse and recommend to you as strongly as we can the AAMT standards for excellence in teaching mathematics, which were developed over a period of three years with teacher focus groups all around the country. Not every state but most states were represented. These teachers were not just any teachers but teachers who were identified for their ability, experience and commitment. The standards have been exceptionally well received. Standards have also been developed in science and English, and the three associations have worked very closely together over a number of years. We would like to draw the committee's attention to this document. We strongly believe that it should be the key reference document for guiding professional learning and identifying and assessing highly accomplished teachers of mathematics.

If you do not already know, you should know that AAMT has successfully conducted a trial throughout 2004 assessing volunteer teachers against these standards, and we have four officially recognised, highly accomplished teachers of mathematics in Australia as a result of that process. This builds upon the United States of America experience where they have been doing this for a number of years. I will not talk too much more about them except to say that we believe they clearly outline the factors, which is quality teaching and learning of mathematics, and they are representative of the profession.

As you can see there are three domains: professional knowledge, professional attributes and professional practice. Victoria is about to undertake another major change — that is, the Victorian essential learning standards. This year is the year in which those standards are being trialled — although the correct term is 'validated'. There is a wonderful opportunity here for some serious work to be done in terms of influence. On the whole, we like and support the holistic, cross-curricular approach because it gives teachers the opportunity to re-evaluate and integrate their teaching of mathematics so that it becomes more realistic, perhaps puts a bit more pressure on maths teachers who can sometimes be a little conservative and stay within the confines of their classroom. This will force maths teachers to have a fresh look. It could or could not be good. It is an opportunity.

On Friday the MAV held a whole-day planning day. We invited key personnel, including David Leigh-Lancaster and Dahle Sugget. Will Morony from AAMT addressed as well as did Gloria Stillman from Melbourne University and Don Collins, who is the principal from Monterey Secondary College. The Victorian essential learning standards were identified as a strong area on which the mathematical association needs to focus to provide support to teachers in schools. We believe if this is going to be successful much more pedagogical support needs to be given to teachers in schools than was given when the curriculum standards and framework document was disseminated. It is one thing to have an exceptional document, is it not? To effect the contents of that, it needs to be supported. Teachers need to be given plenty of time and quality people need to be involved in the delivery of any systemic influence or change.

We would like to emphasise that there are needs for improvements to the teaching of mathematics to engage and excite young minds. These are the key things. We need teachers who are passionate, do we not, about teaching mathematics? We need to attract these people. This is a key thing: to get those sorts of people who love mathematics and want to share that love and learning with young people, we need to get them into the profession. But we need to keep them in the profession, not have them leave after three years. At the moment there are a number of reasons why young people leave teaching. We need to research what those reasons are and turn it around. As I say at the end, we need to apply the new three Rs that I would like to leave you with today. We need to recognise who our quality young and also older teachers are. We need to reward them, not just financially but with recognition. We need to retain them in the service. We need to create more of a career path in Victoria for our best teachers, so that they do not have to move into administration or leave teaching to get better money somewhere else. If we are serious about improving the quality of teachers — and all research shows that the significant factor is the quality of the teacher in front of the student, with 60 per cent of the variation — it is very clear that all our efforts in Victoria need to go towards not only attracting but retaining our best teachers.

Before I hand over to Dave to talk about his area of expertise, which is adult and applied learning, I would like to give just a little plug, if I can, for the preschool sector. They might be little in stature, but a lot of research is beginning to show that they know a lot more than we give them credit for. The ability of a lot of kids in preschools is underestimated by their preschool teachers. We have a particular problem in Victoria at the preschool level. I am not sure whether we are the only state — but I think we are — where the preschool sector is not within the

education sector; it is managed by the Department of Human Services. In some instances that could be a strength, but in other instances I believe it is a distinct disadvantage. A good example is what they have done in Tasmania, where part of their essential learning document includes the preschool level. It sends a clear message of the importance of mathematics at the preschool level. It is similar in many states in the United States. I will come back to that.

The MAV believes the preschool sector should be the first point of effort. We need to support preschool teachers. They do not feel confident down there. They do not have much professional development. The money in preschool centres for professional development is minimal. There is a lot I could say about that sector, but I just wanted to make that one of the key points in our presentation today.

Mr PERTON — I do not think you would have anyone in this room disagree with you, but what do you actually need to do in the preschools? You have the conflict between learning through play, and I think what you are saying here is a curriculum for mathematics, so how do we solve the problem?

Mr PECK — We had two recommendations — or actually three in our document. The core concepts and effective learning approaches in these subjects are identified and made explicit for this sector. The early childhood teachers are provided with professional development. It enables them to effectively educate young children in maths and science. But the Victorian department of education produces a document such as this, which supports teachers with the delivery of key numeracy concepts. I think it is all there, but I cannot go through all the detail at this point. I might hand over to Dave now to talk about post-compulsory education and make some key points there.

Mr TOUT — My background is more in adult education, and in the last years has been in the implementation of VCAL in secondary schools. I think we should look in our backyard in terms of what VCAL has been doing and giving significant opportunities to kids who have been disengaged from mathematics education, so we have some good examples that have been put in place. We are certainly supporting students to engage with mathematics; otherwise they would have not been at school or not engaged in much mathematics education. There are some good examples around, and we need to have a look at what has been happening in VCAL with its adult and applied learning approach. So we do not always have to go interstate or overseas to find examples of good practice.

The other area that I have taught in is TAFE and adult community education providers around the state. The MAV did some research about three years ago to try and find out what the story was with maths teaching in TAFE institutes, and it was very hard to identify teachers who identified themselves as maths educators. If you were to go back 10, 15 or 20 years and go into TAFE institutes, there were mathematics departments and applied maths departments. Those have all been disbanded, and maths is now assumed to be incorporated in the vocational delivery. I think that is a threat to the viability to the teaching of mathematics. Often what happens is that the people who are teaching maths in some of those subject areas are not qualified maths people. There is an issue therefore in some of the post-compulsory area in VET and in TAFE providers in terms of the quality of maths education. Those are a few issues about post-compulsory education.

The other thing we wanted to look at was your second term of reference, which is to:

> Examine national and international trends and report on innovative initiatives that promote the teaching and learning of maths and science.

Whenever you look at any research from overseas or international research in terms of maths education you will always find that some of the leading people are Australian maths educators, and a lot of those are from Victoria. Australia is seen as a leading light in terms of maths educational research, and again I think we need to look around at what has been happening in Victoria. The issue is how the message of that knowledge, expertise and research has got through to teachers so they can take note of what has been researched. It is very easy in your maths classroom simply to be dominated by the curriculum and the content and not have the time and the opportunity to learn what has been going on around you and by researchers in universities. It is important somehow to be able to make that connection in order to improve maths and science education — that is, to make the connection between researchers and teachers. I think Ray was going to talk a little bit about some examples of where we think that has happened very well.

Mr PECK — Victoria had two particularly good programs that I think we should revisit. They were the Early Years numeracy program and the middle years numeracy program that took place a couple of years back over several years. I think they would be good examples of national trends and initiatives that promote the teaching and learning of maths and science in good ways. They made a number of excellent recommendations too. Some of those are being picked up by clusters. There has been a bit of change, has there not, in the way that professional development is delivered in Victoria, and money disseminated to school clusters. That is good because it promotes school-based professional learning, but it can also be a bit ad hoc as well and may not use the resources as efficiently as they might be used. The good thing about the Early Years numeracy program is that it is a train-the-trainer model, and I would like to draw your attention to Getting it Right. Some colleagues of mine at ACER are involved in its evaluation. That is a Western Australian program. It is a very similar model to the Early Years numeracy program. Lawrence Ingvarson would be a good person for getting more details on that. The evaluation is still being written. It is a situation where numeracy support personnel were trained centrally using best practice and then attached to schools. They worked closely, side by side, with teachers in their schools over a number of years. I think it is in its third year now. It is a very similar model to the Early Years numeracy program. The outcomes of the Early Years numeracy program and Getting it Right are very encouraging. In the Early Years numeracy program, for example, the gains made by students in the schools receiving that support were clearly and significantly above the students in control schools. I commend your attention to that.

Ms MUNT — Have you had a look at tracking them through so you can see the gains are continuing?

Mr PECK — As far as I know, I am not aware of any follow-up on those students at that level of detail. That is a very good question and an obvious one to follow up on. At the moment the Catholic Education Office is doing great with the Success in Numeracy Education project. You should have a close look at that one. There is the Count Me In Too program in New South Wales. There are excellent outcomes from that program. That has been running for a number of years and there are seven or eight years of evaluation reports on the Count Me In Too web site, are there not? Those references are listed on the most recent document at point 2.

Moving on to the third term of reference on the best practice in the teaching of maths and science and how it can be shared among schools, we support the idea of clusters in teaching networks, but we also think it is important to back that up with a more widely disseminated program like the Early Years numeracy program and the Getting It Right-type model. I think you need both. I do not think you can do one or the other. A school-based thing is very important, but you need people in the schools who are expert in their fields and who can support and work alongside teachers in the classroom. It has got to have that sort of flavour. We believe this needs to be based strongly on the AAMT standards of excellence. It needs to be like a benchmark for evaluating quality professional learning. We want to emphasise that quite strongly.

I would also like to draw your attention to Lesson Study. Ballarat and Clarendon College has implemented a very successful lesson study program. It has taken off in a big way in America. It came out of the TIMSS video study in 1999. This is a Japanese model of professional development in schools where Japanese teachers work together, observe each other's lessons and improve them over time. It is very interesting. Have a look at what they are doing at Ballarat and Clarendon College. Hilary Hollingsworth has good experience in the US, and she is now based back in Australia. She is an Australian, and I think she is a great contact for Lesson Study.

Please interrupt me if you want to; I am happy to take questions. Your term of reference 4 asks you to:

> Determine how new business, industry and research applications of mathematics and science can be integrated into schools and learning communities.

I think the MAV already has a pretty good model — that is, the Mathematics Talent Quest. It is a great opportunity for kids to apply their learning and to work with people outside their school to research and collect up-to-date information from people and web sites and what have you. That goes very well. As I said, we have 13 000 students involved in that. We are very proud of that, and it has gone national as well. We think that is something that has even more potential to get more widely into schools in Victoria as a model.

Ms MUNT — Is that the one where you get awarded a distinction, excellent or — —

Mr PECK — That could be the Australian Mathematics Competition that you are thinking of. We certainly do award prizes and certificates in ours. We would also commend to you the program that is running successfully in Boston. It is called the Focus on Mathematics program, which involves mathematicians visiting

schools and working with teachers and students. There is a lot of potential for a program like that to operate in Victoria. It could also, of course, involve people from many fields, including universities. I know Melbourne University has already been involved in programs like this in the past. We think there is scope to revisit that and get together people who are interested in supporting teachers in the schools in that way. It would have a big effect.

Mr HALL — What about the Teacher Release to Industry program? Did that have merits for mathematical teachers?

Mr PECK — I actually nearly put that in this submission. I think it was very popular with the teachers who were involved in it, but it might have been shown to be ineffective or expensive or something. I am not sure why it was discontinued, Peter, do you know?

Mr HALL — No, I do not. That is why I asked whether MAV had any view on the merits or otherwise of that program.

Mr PECK — I think the new professional learning opportunities that are available to teachers in DET lend themselves to similar experiences, and we are behind teachers having some time off to reflect and catch up with what is happening out there in the real world. I know the best teachers do not have any trouble doing that, but there are plenty of teachers — —

Ms ECKSTEIN — The problem was they never came back!

Mr PERTON — Why did Deakin University recommend the doubling of the program if it was so bad?

Ms ECKSTEIN — They never came back.

Mr PECK — They never came back, yes. So we want to make sure that they do come back. We want teaching to be so attractive that they do come back. You just reminded me — I will skip ahead to point 7. I have said here that I think we need to promote the teaching of maths and science — teaching in general, I suppose — as a more attractive career by putting more money into advertising in the same way as the armed services have done very successfully. They are wonderful ads that they run, are they not? They make the armed services look very attractive. I have never considered the armed services to be attractive, but the quality of their ads on the television are just brilliant. It would be lovely if we could promote teaching in the same way. I know that there is a good brochure that DET has on the web site entitled 'Consider a career in teaching mathematics'. But really who would read it? Who is going to find it even? I did not know it existed, and I am the president of the MAV! I only found it today because I was presenting today. The work that we did with AMSI is a start. It is a little brochure in the show bag. It is very small, a little square one. You have got it, yes, of course you have! We want vibrant, good-looking, articulate, energetic young people out there to come and talk to our kids about why maths is so great, what it did for them, why they studied it and how much fun they are having in their careers using their mathematics in exciting ways. That is what we want to make maths sexy.

The CHAIR — I am just thinking of a young lady with maths and sex when you are — —

Mr PECK — Yes, Cleo Creswell — she is a star, is she not? We have been careful that we do not just focus on sex, of course. But why not, sex sells! We want to make maths sexier in the sense that kids really do get excited and think it is okay — you do not have to be a nerd to do it. That is the message we want to get across. We would really like to explore that further with AMSI. We also think a contemporary Australian web site is needed. Kids are so tapped into the Web and the Net these days. We can do a lot more. I have given at point 5 a couple of examples, which I think are good. The Mathematical Association of America has some nice career profiles; the Association for Women in Mathematics is an excellent site as a model. We need to do all this to make mathematics appear an attractive career so that kids continue with that and will want to come out and teach it. I am realising now that I am going over time. I think I have probably covered everything that I want to say.

The CHAIR — I will open it up to questions.

Mr PERTON — A couple of years ago I visited MAV — it was Simon and some others — and you were working on some projects like a video of teaching maths through cricket, for instance. You had this real connection between what children are interested in outside of school and mathematics. How is that going, and does it need additional funding and resources from the state?

Mr PRYOR — Yes. Working mathematically is an overriding theme I guess for a lot of maths education, and helping people place that in a context is also very important. So it is essential to be able to unlock support for people who want to create a video that discusses the mathematics of cricket, or people who are trying to show kids new ways of looking at buildings or their environment around them and understand the maths that underlies that. We would like to see some of the resources that we have already taken to the new technologies as well so that they are there on the Web and on DVD rather than videotape — that sort of thing. So yes, we would, of course, love support. But I guess it is also useful to realise that nowadays as there is a stress on an interdisciplinary approach there is an opportunity at a school level for people to find the maths in the context.

Mr PERTON — So has Maths Through Cricket been demonstrated to work?

Mr PRYOR — It is out there, and it is bowling a few winners!

Ms ECKSTEIN — You talked about how the quality of teachers was central, and with the institute we were talking about the concept of an exit test for teachers — I think we were talking in the context of primary teachers, but it would certainly also apply in the secondary area to maths teachers. Firstly, would you support that concept, and secondly, how easy would it be to get beyond just the 'Can I do it and get it right?' to 'Yes, I actually understand what it is going on here', because it seems to me that teachers need more than just 'Can I get the right answer?' to actually understanding the process.

Mr PECK — I would be happy to answer that. The research has shown that it is not just content. Some good research studies have shown that having strong content knowledge in mathematics is not necessarily strongly related to effective teaching or a high student outcome. You need also pedagogical knowledge as well. Certainly you need good content knowledge, but the focus has to be squarely on the pedagogy as well. I support the idea of trying to increase the importance of content knowledge. I know Melbourne University, for example, has already trialled — it is in its second year of using an entrance test. In addition to VCE ENTER scores it has an entrance test of mathematical content knowledge. But I would say we need to go further and, for example, look at including some classroom scenarios in that test so that it would not just measure content but also give student responses to a particular situation in a classroom and see how the teacher interprets that response and what the teacher would do about that response in terms of teaching. That would be critical. I understand there is a problem for teacher trainers in universities getting out and visiting trainee teachers in the setting.

The CHAIR — You should read our previous report.

Mr PERTON — It was a problem of rather than for — they were not getting out there.

Mr PECK — It also hard for them, I understand, let us be fair. That is the best place to see teachers at work too. I think we need to complement that sort of observation with a measure of some sort, but I would be very careful about the nature of that measure.

Ms ECKSTEIN — That is what I wanted to explore with you. I agree with you about the pedagogical stuff, but let us put that aside for a minute. If I can give an example: getting a simple subtraction correct — getting the right answer — is one thing, but actually understanding the process and where the 1 comes from, is quite another matter. Can we do that sort of testing, because it seems to me that teachers need to understand where the 1 comes from, and not just get the right answer at the end?

Mr PECK — There are plenty of examples of that sort of assessment that looks at process as well as product. I do not think that would be an issue. I think you would find plenty of experience in this country that could put together those sorts of measures.

Mr HALL — Does the MAV have any estimate of the shortage of qualified maths teachers in Victorian schools?

Mr PECK — The MAV certainly has not conducted a survey. The recent TIMSS report gives a national figure on that, of course. I do not see why Victoria would be all that different, although it might be. It states that 30 per cent of teachers in Australia at year 8 could cite no mathematical training in either an undergraduate degree or even their teacher training. That would be roughly the same in Victoria, I suppose — anecdotally it certainly is. We did not highlight our concerns about that and that is an obvious concern we have about the lack of background

and confidence that teachers have in teaching especially junior mathematics. There is a shortage, is there not, and people who do not have the qualifications are being forced into it.

Mr HALL — Do you have any view, then, about the impediments to attracting and retaining enthusiastic teachers that you spoke about? Are there special problems associated with attracting those sorts of teachers to mathematics? Are they different from those for teachers in other subject areas?

Mr PECK — I think there is clearly a difference. Maths graduates are sought after and maybe can earn significantly higher incomes than arts graduates — it is not necessarily the case. Mathematics as a vocational qualification is sought after and tends to lead to higher paying careers. That is one of our issues. These days young people have a different attitude to work, too. They might work for three years and then want to travel and see the world, or try something different. So we are facing that issue as well. I think the first point I made is peculiar to mathematics.

Mr HALL — So for your three Rs — recognition, reward and retention — do you believe now there is a need to reward better financially our maths teachers, above and beyond other teachers?

Mr PECK — Definitely. This is long overdue. The only way teachers can gain higher pay is by moving into administration. I think Western Australia has successfully introduced level 3 teaching, which identifies and rewards high-skilled teachers without moving them into — —

The CHAIR — Is that just subject specific?

Mr PECK — No, it is generic. So that would be worth looking at. It would be great if we could support the AAMT move towards recognising highly accomplished teachers of mathematics and then backing it with some additional financial support. Then you have some hope, do you not, of retaining your best maths teachers in teaching?

Mr PERTON — How much extra would you pay them if they attained highly accomplished status?

Mr PECK — That is a really good question. In the US it is about US$10 000, on average.

The CHAIR — We seem to have in Victoria broad standards, as you know, for maths and every other subject, which has good things and should encourage creativity in the classroom. But in terms of maths, what is wrong with having a standard sequential curriculum that runs across all schools from prep through to VCE, breaking off into areas of expertise in the senior level and concentrating all our efforts then on pedagogy, engagement, retention et cetera? What is wrong with a system like that, which would be a bit different from what we have now?

Mr PECK — Do you mean a more prescribed curriculum?

The CHAIR — Yes, a quite prescribed sequential curriculum across all schools, and we put our efforts into pedagogy and student engagement, the way you teach that curriculum — that Singapore model, with our pedagogy.

Mr TOUT — From my point of view the problem with a very structured, hierarchical approach is that a lot of children miss the boat somewhere along the line, and as soon as they have missed the boat they cannot get back on. I have had a number of discussions with teachers about that particular issue. Because it is hierarchical, particularly in maths, it seems to be a bigger issue to get back on that boat. It is very difficult. Having worked with thousands of adult students over the years who all failed mathematics at school, their common story is that they can tell you when they missed the boat. They can tell you which class and which teacher, and it is very hard for them to get back on that boat. It seems to be a bit more particular to mathematics than it is to other subjects. So I would be arguing about the lock-step approach, and that it is about pedagogy and enabling students to engage at all levels. I think VCAL is an example of where there are a lot of students who are now having great success in mathematics who probably would have otherwise failed mathematics in years 7, 8, 9 and 10, and suddenly in year 11 they are finding some success. I think there are models around through which you can re-engage.

Mr PECK — To finish off, you may not necessarily have been implying the lock-step approach. Mainly what you were talking about, Steve, was having a high-quality curriculum and putting effort into developing a higher quality of prescribed — —

The CHAIR — You will define it in terms of what is taught at different year levels or expectations?

Mr PECK — Yes, sure. We do have that in the form of framework or guidelines at the moment. They recognise the fact that we have a range of abilities in our classroom. We are talking about levels rather than years or grades. Philosophically we support that notion. However, it is clear that teachers do need high-quality resource materials. Some of the textbooks leave a lot to be desired, for example. Fortunately in Victoria we have a long history of excellent resources that show mathematics applications, reality, investigations and what have you, but only our best teachers source and tap into those. That would be good. What we really need, and supporting Dave's answer, is schools which are flexible and cater for the wide range of ability.

It does not matter how good your curriculum is; if you do not have ways of differentiating that curriculum and meeting the individual child's needs, then it is going to fail with significant proportion of the kids, is it not? It always comes back to the teacher's ability, commitment and belief. If you believe that all children can learn and you set high expectations for each child, and then you find ways to achieve those outcomes, that is far more important than having a prescribed curriculum. You will find the best curriculum for the kids in your classroom who have individual needs. The mindset and the skills of the teacher are most important. But I would like to say we do need to support our teachers with higher quality, clearer curriculum materials, and there is a crying need for them. I know Michael is working on a resource at the moment — a book on the shelf for a teacher who is unsure how to teach division — whatever — or subtraction. To have a good understanding and refer to it when they need it would be excellent, with lots of suggestions about how to implement those concepts and processes that we are talking about. That is the sort of resource that teachers need.

The CHAIR — Thanks, Ray. I am sure we will pick up some of those comments in our report. Thank you very much for attending. We have 1000 other questions, and we may come back to you later on once we have gone through a few more hearings. Thank you very much for your input and good luck for the association.

Mr PECK — Thank you.

Committee adjourned.