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

EDUCATION AND TRAINING COMMITTEE

Subcommittee

Inquiry into promotion of maths and science education

Melbourne — 20 June 2005

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Witnesses

Mr G. McLean, Assistant Director of School Services, Catholic Education Office, Catholic Education Commission of Victoria, and

Mr P. Sedunary, Manager of Curriculum and Innovation, Catholic Education Office, Catholic Education Commission of Victoria.

Mr KOTSIRAS—I declare this hearing of the maths and science inquiry subcommittee of the Education and Training Committee open. The Education and Training Committee is an all-party joint investigative committee of the parliament of Victoria. It is hearing evidence today in relation to the inquiry into the promotion of maths and science education. I wish to advise all present at this hearing 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. In other words, you can say what you want and you will not get sued. I welcome the Catholic Education Commission of Victoria. Would you care to give us your presentation, please.

Mr McLEAN—I am Garry McLean, Assistant Director of School Services with the Catholic Education Office in Melbourne. I am going to give an introduction and then hand over to Paul Sedunary, who will go into a little bit more detail. The Catholic Education Commission of Victoria is proud of the achievements made in the areas of maths and science education, and has an ongoing commitment to these areas. There are a number of key initiatives that have been undertaken to promote science and mathematics education within the Catholic sector. One is the SINE project—that is, the Success in Numeracy Education. It is designed to support the raising of the level of student achievement in numeracy across both primary and secondary schools. The other is our Leadership in Science program and there is also a relatively new initiative: nuclear schools, exemplar schools, in science education.

While we acknowledge our achievements, we are concerned that there are a number of factors that require ongoing attention if we are to ensure quality mathematics and science education in our schools. Our level of concern and commitment is evidenced by the conduct this year of a number of CECV seminars that take into account research, dialogue, consultation and strategic planning. It just so happens that this month there were two seminars conducted, one in the area of mathematics and the other in the area of science. Today we wish to take this opportunity to highlight a number of the key issues described in our submission to the inquiry under the headings of 'Factors supporting high-quality teaching', 'Professional development', 'Research to practice', 'Community and industry partnerships' and 'Gender'. I will hand over to Paul at this point.

Mr SEDUNARY—Good afternoon. I am Manager of Curriculum and Innovation for the Catholic Education Office. All of the issues that we discuss this afternoon are related to high-quality teaching in science education and maths education. I particularly draw your attention to three factors in supporting high-quality teaching. The first is the nature of learning and teaching that we want to engage in in science and mathematics education. We want our students to engage in exciting, innovative, hands-on, inquiry based learning that relates to real-life situations, so that the relationship between what happens within the school and the classroom is readily transferable to what occurs in the students' lives at their current stage of development and beyond school.

We see a critical importance in the use of information and communication technology to support learning and teaching within our schools. This year, for example, to support our secondary schools in science and mathematics we have developed portals, an online site where our secondary teachers and coordinators of mathematics and science can access information. It also facilitates the sharing of knowledge between those practitioners across schools.

Another avenue for effective use of ICT in supporting learning and teaching in maths and science is having access to data so that schools and teachers can make informed decisions when planning their numeracy and science programs. Currently, within our sector we have access to AIM, the VCE data service, TIMSS and PISA data. One of the achievements

within our sector has been that, as we have had a greater reliance on and use of data, our teachers have become more data-literate. Schools are becoming more data-literate as organisations and have access to data that assists in their planning.

We see that the data we collect through assessments needs to be diagnostic, which enables the teachers and schools to focus on the students' strengths and weaknesses and to plan for necessary learning interventions, should they be required. We do need to develop further tools and methods of data access for our schools. We do not have a strong sector base of mathematics data, other than AIM, and it is the same for science. It is an area we would like to devote attention to, but to do so would require significant resources.

There are two key issues that we highlight in regard to mathematics and science. Particularly for mathematics, it is the ability to link the learning in mathematics across key learning areas or across domains of learning. At the recent seminar that was mentioned earlier, one of the key issues that was highlighted was that it is difficult for teachers and students, when working in areas other than mathematics, to make links across the curriculum. In science the key issue is the development of scientific literacy for all students in a highly scientific and technological society. We see that all students, not just those who specialise in their upper years of secondary school, should develop key scientific competencies.

A key issue that supports our work and the teachers' work in schools with maths and science education is professional development. The Catholic Education Commission of Victoria has a strong commitment to ensure that teachers of mathematics and science have access to ongoing high-quality professional learning. Supporting teachers, and innovative and engaging practice, is done through the provision of central professional development programs. What we do know is that we have an insufficient number of suitably qualified and trained teachers of mathematics and science, particularly in our secondary schools. It is of major concern.

We are aware that in secondary schools particularly there may be teachers who are teaching outside of their subject area, so are trained in areas other than mathematics and science but are teaching mathematics and science. They do so without sufficient support. Recognising that problem, the CECV has provided sponsored study leave for teachers in both science and mathematics. This study has been at postgraduate certificate level. In regard to science, another area of concern is the teaching of physics. We do not have the required number of qualified teachers available. Due to a lack of financial resources, we are unable to sponsor teachers to pursue postgraduate studies in science. We do so, though, in mathematics. Since 2000 we have had in excess of 100 teachers receive sponsorship from CECV for postgraduate studies. Of those teachers, in excess of 30 have gone and continued their studies up to masters level, using their own resources.

Key issues are the time required for teachers to access professional development, the money for schools to support professional development and the replacement of teachers whilst other teachers are out at development. Teachers and schools require incentives to study. I will use the Postgraduate Certificate in Early Numeracy as an example of the costs involved. We sponsor teachers to do that course. It is $2,000 per unit of study and there are four units of study in the course. There are also ongoing teacher replacement costs during the term of a teacher's study, so it is in excess of $10,000 per teacher to undertake that study. That is big money and is not money that schools or sectors have readily available. Innovative solutions are required to tackle this problem of teacher expertise.

A key issue in science is the ability of teachers to keep up with innovations in the world of science. I draw an example from our science seminar last Friday. We had a very experienced science coordinator speak about how in VCE they are referring to and teaching about the synchrotron project, but there is difficulty with teachers keeping up to date with that

information. Again, it is a time and resource issue.

There is a wealth of national and international research regarding mathematics and science education that is available, and the CECV is committed to accessing and participating in that research. A key issue in that is the need for greater dissemination of the research to both the system level and school level. Schools see that the link from research to practice is the development of research based materials and resources that schools can use. Schools see a rather large divide between what happens in the school and what happens in the research world. Bridging that gap is critical.

In mathematics, where we have a strong research base, we use multiple research partners to garner expertise and to help with the development of those resources. For example, we work with the University of Tasmania in chance and data, we work with the Australian Catholic University in the area of number, and we work with Southern Cross University to support our work with children who are experiencing difficulties in mathematics.

In science we work with Monash University on an action research project, making the link between science teaching and learning. Where possible we are committed to research; research leads to resources, which leads to practice in school. We have a number of innovative practices occurring in schools. For example, one of our schools, a primary school in Gisborne, has developed a vineyard in their school grounds and it is linked to their science project: real-life, engaging, developing scientific literacy.

Community and industry partnerships are crucial to success in maths and science education. Schools cannot create partnerships alone. It requires expertise from staff expertise and time from staff, to go out and develop partnerships. We have a number of examples, particularly in science. We have St Mary's in Williamstown, for example, that has a strong partnership with Scienceworks. St Matthew's in Fawkner has been working with Scienceworks and is about to run a performance of science work based on the work they've been doing at primary level about Einstein. We have a Science at Work program. We have secondary schools who engage with scientific organisations or other industry bodies, where their investigation and their work has a scientific bent. The critical issue is that these schools have been innovative; but, given the time and financial resources and expertise required to create those links with industry, without support they cannot do it.

I would also like to highlight the issue of gender. In both the areas of mathematics and science education we are concerned that there is not enough known about the impact of gender differences on achievement. We are aware of proportional underrepresentation of girls in the study of mathematics in the later years of schooling. We are also aware that boys have a greater spread of lower scores in VCE science subjects. During the 1980s there was significant research. It seemed that research into gender was flavour of the month. There has not been significant ongoing research, and we believe it is timely to revisit the question of gender and to research its impact on student learning outcomes.

I would like to take this opportunity to acknowledge the work of our CECV mathematics and science staff, particularly George Toth, Gerry Lewis, Dr Pauline Sharma and Simon Lindsay for their work in preparing our CECV submission. Thank you.

Mr KOTSIRAS—Thank you very much. We will open up now to questions.

Hon. P. HALL—Thank you very much for your presentation, first of all, Garry and Paul. In terms of student engagement, what do you see as the main criteria to achieve in that area? Is it the quality of the teacher or is it other resources?

Mr SEDUNARY—I would argue both. We know the quality of teacher, regardless

of whether it be mathematics or science or any other area of learning, is critical, so absolutely that is a core issue. I draw again on the experience of the discussions we had last Friday afternoon at our science seminar with a key group of 50 to 60 primary and secondary teachers. The discussion that we had was informed by some research that we had undertaken. We kept coming back the issue of teacher quality; it is critical. But many of our quality teachers say they are hamstrung by not having the resources available to them within the school. It is not just the physical resources within the school; it is that access to outside the school.

Particularly at secondary level, if we are to engage our learners in secondary school, we do need to take them outside of the school in their learning. That can be physically taking them out of the school or it can be done through ICT and taking them out, but that in itself requires a level of teacher quality. It is having the ability to get out, having the ability to bring science and maths that is happening outside of the school into the school, but again it will all boil down to the quality of the teacher that you put in front of the children, the teacher who is managing their learning.

Hon. P. HALL—I would agree with that point. Can you tell us a little bit more about the Success in Numeracy Education program that you spoke briefly about. Is it specific to CECV? Is it your own program being developed?

Mr SEDUNARY—Yes, it is. It has been developed in partnership with the Australian Catholic University, also based upon work with the Early Numeracy Research Project, which was the foundation of our work. It is based around a train the trainer model, where key focus teachers are identified within the primary schools. Those teachers receive significant professional development in mathematics education. Then they take their learning back into the school context and they will work with their school leadership team in developing their school development plans in improving mathematics. They will also deliver professional development.

In support of their work within schools, we have what we call a numeracy resource officer, who works in each of our zones, who is a teacher based within the school, who is released for a day to provide support to our key focus teachers in the schools. As well as the ongoing professional development for key focus teachers, we have professional development programs where schools will send teams of teachers who might be working on interpreting data that supports their program.

One of the key initiatives with this has been the introduction of a clinical interview, where teachers will sit with a child and will, through a process of interview and activity with the child, assess the child's growth point on a learning continuum in early mathematics understanding.

Hon. P. HALL—How long has that program been going and have you made any evaluation of the success of that program?

Mr SEDUNARY—It has been running about five years. At the end of 2004, ACU conducted a major evaluation. The evaluation highlighted that it had had impact on the learning outcomes of students but one of the major problems was the train the trainer model. The train the trainer model was adopted as the most cost effective with the resources available. Also it was enabling, with the initiative being contexualised within an individual school setting, so individual schools could respond at their point. Not every school was involved in SINE, so while it has had growth to those schools that have been involved, still it requires ongoing development, particularly around the train the trainer model.

Hon. P. HALL—And is that the intention of CECV, to try and extend that model

across all schools?

Mr SEDUNARY—Through the seminar series, that is one of the questions we are discussing through our seminar. There is a process of wide consultation. Through the seminar which we had on 3 June for mathematics, we looked at some research, one piece of which was our SINE evaluation. A paper is written based upon that research and the discussion and then we consult back. All CECV schools have an opportunity to consult back, and that will inform our strategic planning.

Hon. P. HALL—Did you mention Leadership in Science? Is that a parallel program in the science area that you are developing?

Mr SEDUNARY—Yes. It is done in consultation with Monash University. It is essentially about building capacity at local level. It looks at developing the capacity of science coordinators' work in innovation in science education and in their work as leaders and managers within a school. We do not have widespread coverage of people participating in that. It is a smaller program.

Hon. P. HALL—You are making sponsored study leave available to some people so that they can gain qualifications to teach in the maths area. Is that popular? Do you have a strong take-up of that?

Mr SEDUNARY—It is oversubscribed for the number of places we have available.

Hon. P. HALL—Does that link in with the numeracy program that you spoke about that costs you $10,000 per teacher to put through?

Mr SEDUNARY—That is right.

Hon. P. HALL—That is part of it?

Mr SEDUNARY—Yes. Currently it is only available in mathematics.

Hon. P. HALL—You spoke quickly about those seminars that you offer in both the maths and science area. What is the extent of access of the classroom teachers to those seminars, and can you tell me a bit about their nature? Are they a one-day seminar or are they over a longer period of time?

Mr McLEAN—There are four seminars conducted each year, basically, involving all schools across Victoria, being Catholic Education Commission Victoria, both primary and secondary, and there is a piece of research which underpins each of those seminars. For example, in maths it was the ACU evaluation of SINE, and also a very brief research study that Kaye Stacey from Melbourne University undertook in terms of the achievement of students at VCE level in the area of mathematics.

A similar thing happened with science. It was underpinned by a study that was undertaken in this instance by ACER, again looking at VCE achievement in science. What happens is that representatives from a wide range of schools, both primary and secondary, teachers and administrators—and principals, for that matter—are invited to the seminar, where there is input from one or other, if not both, of the researchers involved in the research studies that enables, during the course of the seminar, discussion to take place on the findings et cetera. That is then fed back into the bigger group, and there are writers there who take responsibility then for putting together a seminar paper that is distributed to all of our schools within the CECV.

Mr SEDUNARY—Once the paper is distributed, we have a portal that has been developed on the CECV web site and schools can provide feedback to the paper. Then that feedback will help in our strategic planning.

Hon. P. HALL—CECV is not on its own addressing this issue about maths and science teachers, the shortage problem and the student engagement type issues?

Mr SEDUNARY—No.

Hon. P. HALL—Do you have much cooperation with the other sectors of education, the government sector or bodies like the Mathematical Association of Victoria, those sorts of organisations, in addressing the common issues?

Mr McLEAN—I think it is fair to say we have relationships with all of the professional associations. Certainly SINE would not have eventuated in our system if it were not for the cooperation that led to the Early Numeracy Research Project, which was right across all of the systems here in Victoria, and certainly in some of the science initiatives they have been across-system, across-sector initiatives. We would probably like to see more of that opportunity opening up and involving all of the sectors. When you think about the contribution that the Early Numeracy Research Project in particular has made—I was going to talk about our sector, but I would suggest also to the government independent sectors as well—that kind of thing needs to be encouraged a lot more.

Mr KOTSIRAS—You said that there was an imbalance of male and female students doing science and maths at senior level. Have you done any studies or research into the attitude of students, perhaps up to year 10, into what they think of maths or science, and when an initiative is introduced in the school to encourage them to undertake maths or science, into whether it has worked?

Mr SEDUNARY—No. One of the issues sitting under that is: where does engagement start? While we see the end result in levels of participation in the secondary schools in the upper years, does that level of engagement of disengagement begin earlier on? We recognise that that needs to be looks at.

Mr McLEAN—The other thing we are aware of is that in some of the international studies—the International Mathematics and Science Study, and PISA, the Program for International Student Assessment—some of the results seem to vary from other research, and I think it probably is timely to again look at some fairly high quality research into gender. I think Paul mentioned that we have noticed that, while there seem to be more boys, for example, undertaking science subjects at VCE, they appear to have a greater spread of lower scores in the VCE than girls. It is not as clear as perhaps we thought the gender issues once were. As I said, some of the international studies are indicating that that appears to be a growing concern.

Mr KOTSIRAS—Do you see a problem with teachers teaching maths and science in the primary school? Are teachers confident enough to teach maths and science in the Catholic system, or is that a problem?

Mr SEDUNARY—Whilst not every school has been involved in science, the level of professional development open to primary teachers in mathematics in the last five years has been huge, and we do not see it being as big an issue as science. The release of the essential learning standards, where science is being assessed as an essential learning, it will cause some angst and, again, it was part of a discussion we had last Friday among primary teachers about their level of expertise—really, their content knowledge. Their pedagogy is fine; it is their content knowledge which is an issue. We are far more comfortable with

mathematics.

Ms ECKSTEIN—That is very interesting. You have indicated in your submission that there is a lack of content knowledge for mathematics, but you did not make a similar comment for science. Do you see a similar problem there? After all, primary teachers would expect to teach mathematics, but they do not necessarily expect—or they certainly have not in the past been expected—to teach science. Or is it that with science they can deal with things they are comfortable with, like nature study, and they do not have to get into the hard stuff like physics?

Mr SEDUNARY—I can draw on some personal experience if that is okay.

Ms ECKSTEIN—Absolutely.

Mr SEDUNARY—Until recently I was a primary school principal. One of the issues with the teaching of science is, absolutely, the content knowledge. Primary teachers do tend to get into their comfort zone. Again, take the example of the school in Gisborne: they are being really innovative and they are out of their comfort zone. But for many primary schools their experience is, 'Well, it's year 3, we'll do the solar system. Year 6, we'll do earthquakes or natural disasters,' for example. It is comfortable; it is known; there are a lot of resources that they can easily get their hands on. Also, it does not require significant resources within the school to study those areas. It is nice and safe. In the primary school setting, the teachers' knowledge base is widespread, and what they are expected to teach.

Now, with the release of the essential learning standards, where it focuses on the nature of the scientific inquiry as well as the nature of the scientific content, it will be a stretch initially for many primary teachers. They do need support in developing engaging programs within their schools. A lot of schools do their best and are innovative and will try, but it is hard. It is a very hard area. Curriculum integration at times varies and the science gets lost. It is about being explicit and naming it as 'science' at times.

Mr KOTSIRAS—Are primary schools to blame for the level of interest of students in science in high school?

Mr SEDUNARY—No, I do not see it as a causal link. We have not researched it.

Mr McLEAN—I worry about the resources devoted to science in primary schools when there are so many other competing calls on those resources. An opportunity arose about 18 months ago for two of our schools, when they were looking at transition arrangements. In the discussions, the primary school indicated that one of their areas of concern was science, and the secondary school indicated that one of their strengths, they felt, was the year 7 science program, which seemed to be really engaging children. With a mixture of ICT they set up a link between the secondary school and a particular year 7 class and a particular year 6 class. The key to it was ensuring that the year 6 class, in their primary setting, had all of the safety and other equipment that was necessary for them to be able to undertake the actual science activity.

Actually being there enabled me to see the engagement of those primary students. They had the safety equipment and all of the other equipment that was necessary for them to be able to undertake the activities that were involved. The year 7 teacher was using his particular class to get the students to demonstrate what they were going to be involved in et cetera. What it demonstrated to me was that in a lot of instances there is often not the infrastructure in place for primary schools to be able to provide the resources and equipment to really capture and engage the interest and the enthusiasm of the students.

Mr KOTSIRAS—Should there be specialised science teachers, for example, in primary schools or a cluster of primary schools employing a qualified science teacher?

Mr SEDUNARY—The notion of clusters or innovation networks is certainly something worth pursuing, whether it be in science, mathematics or literacy. For example, what we are doing with our numeracy resource officers is that we have an expert in maths education who is a primary teacher working in the schools and who understands the context. He provides support for what the schools are doing. If we were to translate that model, for example, to science it would enable schools to have support in their school development planning and it would enable schools to be networked with other schools. They might say, 'We've got the same problem; let's address it together,' or, 'We have this resource and we've run this program; let's share it together.' Breaking down the walls of schools is an important issue if we are to get improvements in learning outcomes.

Ms ECKSTEIN—Surely primary science does not require a lot of specialised equipment. At that year 6 level, where they are doing something a bit more specialised, I accept that that may be the case, but in the primary area isn't it more about teachers feeling comfortable with the content, not being concerned that they do not know the answer and actually being able to structure activities which sometimes just need a tub and some water? You would need to know what the consequences are of the things that you are actually doing. It is not so much the equipment, it is the knowledge, and if they do not have the knowledge they are not going feel comfortable doing it.

Mr McLEAN—It is the knowledge and the expertise and the quality of the teaching. I will give another example. In Footscray they were doing just that. There were experiments related to dye et cetera—which can be quite an interesting experience when you are working with eight-year-olds! There was a tremendous teacher working with a third of the group doing the actual experiment. Another third of the group were following it up and writing it up, having taken part in the experiment. The other group—which I thought was just brilliant—were working around a group of three computers because the teacher had downloaded, from the Learning Federation, an ICT science activity that was directly related. Here was a third of the group around three computers, really enjoying what they were doing. There was no need for equipment beyond, as you said, the computers. But, again, it came down to the quality of the teacher, who was able to set up three really challenging activities for those students to be involved in and, at the same time, she was able to work in what was a fairly simple experiment, I agree, with fairly basic equipment.

Ms ECKSTEIN—Given that—and given that a lot of teachers are not even comfortable running three groups—how do we solve the problem? Is there something we can do short term to upgrade teacher skills, PD, or are we really looking at a long-term solution where we are looking at the next generation of teachers?

Mr SEDUNARY—Both.

Ms ECKSTEIN—All right. What do we need to do?

Mr SEDUNARY—Our teachers need access to ongoing professional development. We need to look at how we structure that professional development opportunity for them. We do have opportunities and, for example, we have spoken about ongoing professional development through accredited studies at university. That requires time. It requires them to be out of school to be able to do that, so schools need to be funded to allow that to occur. Any professional development work which takes the teacher out of the school is problematic. If that is to continue, schools need to be funded to do it. School principals, at times, are very reluctant to send staff out of the school for professional development.

Ms ECKSTEIN—What about professional development in off time: weekends, holidays, after school?

Mr SEDUNARY—Teachers do that anyway. That is occurring, but that is at the same time as they are doing—

Ms ECKSTEIN—Then is which professional development they go to a question of priority?

Mr SEDUNARY—Absolutely, because it will be seen within the context of what the school is dealing with and what its focus is on at that moment. Absolutely, it will be.

Ms ECKSTEIN—I have a question about your cost of $10,000, because I missed where the other $2,000 goes.

Mr SEDUNARY—In teacher replacement costs.

Ms ECKSTEIN—Thank you. So it is not necessarily a question of that, it is a question of when the courses can be scheduled?

Mr SEDUNARY—Also what they do with their learning. We know that effective professional development has an impact with change. Coming back to the clusters, where we have clusters of professional development happening, teachers have an opportunity to come back into the school and share their learning and action their learning and that is effective. When it is just a one-off, they go to one day on something, it is not effective.

Ms ECKSTEIN—But isn't it horses for courses? The cluster shared professional development is more about sharing experiences and asking 'How do we do this?' and 'Is there a better way of doing that?' If it is about content knowledge, is that the best way to do it?

Mr SEDUNARY—Again, it is about how the cluster is structured. It is horses for courses, yes.

Ms ECKSTEIN—To clarify it in my own mind, the grad cert is maths only?

Mr SEDUNARY—Yes.

Ms ECKSTEIN—It is $10,000. Is it all areas of maths, or is it only the early material?

Mr SEDUNARY—We have two courses: early and middle years.

Ms ECKSTEIN—So it is not about getting people up to speed at VCE level?

Mr SEDUNARY—No.

Ms ECKSTEIN—Thank you.

Hon P. HALL—I appreciate the example you gave about the teacher with the three groups and the whiz-bang impressive lesson that was set up on that occasion. Being a former maths teacher, I know it is possible to do that. You can really put your heart and mind and hours into preparation and you can put a whiz-bang lesson together which engages the minds of kids at all different levels in your classroom, but to sustain that for five days of the week, 40 weeks of the year, is impossible, and I would challenge anybody to suggest that it is possible.

I think Nick mentioned specialist teachers in that area, but team teaching is also an effective mechanism whereby somebody who is particularly good in maths, science or something else might team-teach at a grade 5-6 level in a primary school. Equally, in the secondary level, you might have maths teachers dividing up various components of the curriculum and specialising in those areas and rotating. Do you see any merit in that idea, to try and find that immediate improvement which we need in science?

Mr SEDUNARY—Schools are doing that already.

Hon P. HALL—Are they doing it successfully enough?

Mr SEDUNARY—I do not know if we have data to support that.

Hon P. HALL—Are you employing team-teaching people with particular interests and special skills?

Mr SEDUNARY—I am aware of a number of primary schools who have. In my own primary school, that is the way we were dealing with it as a way of covering curriculum. But there are examples of secondary schools that are trying to look at things differently and saying, 'This is not the best way of engaging our kids. Let's try it differently.' Schools are doing that. It is sharing the knowledge of the schools that are doing that. It is monitoring the learning that we get from that—is that successful?—and developing those innovations further so that they become not just isolated to particular schools but they become, to some description, systemic.

Mr McLEAN—And content knowledge is an issue, particularly in primary schools but also in secondary schools. If I link that to professional development, the more professional development can be linked to credentialled courses with our universities, the more opportunity will arise for teachers then to take that next step and perhaps take on that higher level credentialled learning that provides even more skilled personnel in our schools. In primary schools one would hope it is going to be across a range of areas: maths, literacy, numeracy et cetera. I think that, where professional development can be aligned with credits for moving on and perhaps starting with a grad certificate that moves to a masters or whatever, that is going to help in terms of having people with good content knowledge, particularly in maths and science.

Mr KOTSIRAS—Thank you very much. We will send you a copy of *Hansard* for you to read and you can make some minor alterations if you wish to. Thank you very much, Paul, for taking the time.

Mr SEDUNARY—Thank you for the opportunity.

Mr McLEAN—Thank you for inviting us.

Witnesses withdrew.

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

EDUCATION AND TRAINING COMMITTEE

Subcommittee

Inquiry into promotion of maths and science education

Melbourne — 20 June 2005

Members

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Witnesses

Prof. P. Clarkson, President, Mathematical Education Research Group of Australasia, and

Prof. P. Sullivan, past Vice-President of Research, Mathematical Education Research Group of Australasia;

Mr KOTSIRAS—Welcome, Mathematical Education Research Group of Australasia, Professor Philip Clarkson and Professor Peter Sullivan. I will ask you if you can make a contribution at the start and then we will ask you some questions at the end.

Prof. CLARKSON—We have prepared a short opening statement for you. I am going to run through a couple of points and then ask Peter to come in at the end with a couple more. I am here as President of MERGA, the Maths Education Research Group of Australasia. I am also a professor of education at the Australian Catholic University. ACU has campuses in Queensland, New South Wales, ACT, rural and city in Victoria, so one who works at ACU gets an overall feeling for education throughout Australia.

I was the foundation editor of the *Mathematics Education Research Journal*, one of the journals of MERGA, and I did provide copies of that and other publications of MERGA to the committee. MERGA has a membership of 200-plus. It draws its membership from virtually all the tertiary maths education lecturers in Australia and New Zealand. We also have about 15 per cent of our membership who are teachers in the classroom. We have a number of people from the different systems—ministry and CEOs and others—of curriculum development project officers et cetera.

My colleague Professor Sullivan is a past vice-president of research in MERGA. He was also a professor of education but is now a pro-vice-chancellor at La Trobe University. La Trobe, like ACU, has got a spread of campuses, both in city and rural. Both of our institutions teach in pre and secondary education programs and we have had experience in teaching in all of those courses. We both started our professional lives as teachers in the classrooms.

I will make a couple of general comments first about the promotion of maths education in Victoria. One of the crucial points to take into consideration is that mathematics is inherently difficulty. It is perhaps the most abstract system of thought that our culture has created. We have, however, formed wonderful ways of bridging to this abstract system. In the end, the abstract nature of mathematics does need to be taken seriously, particularly from about mid-secondary school on.

There is a lot these days talked about mathematics or numeracy and literacy. I need to point out that mathematics is different to literacy, and hence there are different ways of understanding, and hence there are different ways of teaching mathematics. Mathematics itself is also different to numeracy, although there is clearly a bridge between the two. I can elaborate further on those points later, if you wish.

Another crucial point is that mathematics in the education system, historically—and still is—is used as a sieving mechanism to identify bright kids. This has skewed public opinion about mathematics and the sorts of ways that mathematics is regarded as it should be taught in the schools. It has also skewed what is taught and how it is taught, and even what teachers teach what students.

The third point is foundational and is that—given those first two points—as a society, however, we do need a healthy number of students taking on board the study of mathematics; not because it will enhance their interschool and tertiary institutions but because it is simply a critical part of our culture. What to do? I would hope the committee would see its way clear to supporting the continued and increased funding of mathematics education research that leads to change or endorsement of good practice in schools.

I have noted in our submission some of the research projects that are going on in different universities in Victoria: Doug Clark with the ENRP came in at the tail end of the previous speakers and heard some mention of the Early Numeracy Research Project that was carried out—ACU and Monash; Professor Dave Clark, with his innovative classroom studies at

Melbourne Uni; Professor Judy Mousley from Deakin University, who has had Victorian government support for supporting teachers teaching mathematics and science; Professor Di Siemon, working in middle school maths out at RMIT. And there are many other projects into the use of technology, values, language and so on, that we could enumerate for you.

There has been much made of mathematics content and teachers knowing the appropriate—and I would emphasise 'appropriate'—mathematics content, particularly in the pre-service education courses that they undertake. We would endorse that. That needs to go on, and I think my colleague will make some comments about that in a moment. We would suggest that there need to be continuing community programs that bring parents into the equation. Family Maths has been a program that has been going for many years now. It is a good one and projects like that should be supported and be continued to be supported.

There needs to be continuing and increasing support for teachers who are continuing and wish to continue their own professional learning—rather than 'professional development', I think the new term is 'professional learning'—in mathematics education and that, of course, would include appropriate mathematics content. I think the kudos for actually doing some of that is lessening as teachers are expected to do more and more performativity tasks in schools.

Lastly, I think it is absolutely crucial and foundational that there need to be longitudinal studies that find out just who is teaching mathematics, at what level, and how they are teaching it.

Prof. SULLIVAN—I would like to make two points, but I will start with the second of the points because it follows on from what Phil just said. I am conscious, in the point that I am going to make, that it is very difficult in the nature of the political system that we operate, where there has to be an adversarial approach between parties. In the field of health, policy development and practice is driven by data. They mine their data, they collect their data, they make the data publicly available, so doctors are making decisions based on the best available data related to treatment types, and nurses are basing their practice on the best available data.

We have a culture in education of keeping data private and I believe that this is a serious problem. Even ACER, for example, cannot get access to the data that is collected broadly by the VCAA. We tend to have a system where we say, 'We want to promote the good things that are happening in schools,' but in hospitals they do not feel any compulsion not to say, 'We have got a waiting list of 2½ years. We need more resources.' I am in a sense making an appeal. Given the nature of this inquiry and given the nature of the huge amount of data that is collected on a school by school basis, on an individual child basis, related to achievement testing, make that data available for researchers so that their research and policy and practice development can be based on informed knowledge.

It is a really important issue. I understand the complexity of it. For example, the government does not want to release the information because the opposition will then say, 'Look, the government is not doing its job.' But that means we are not going forward. It means that we are actually keeping secret the information that would help us develop better policies. That was actually the lesser important of the two points I wanted to make.

The first one, as Phil said, is going to follow on from what Garry, who was sitting here, was saying. It is related to teacher development. We do have a situation where, particularly in the junior secondary years, there are many teachers who do not have a strong maths background who are teaching mathematics. That has the net result of perhaps fewer people reaching the end of secondary school being interested in mathematics and so the number of students studying the top mathematics in secondary school is declining. There are fewer students

studying mathematics at university and that means that fewer people are coming through as highly qualified teachers to teach mathematics, and so people are progressively becoming mathematics teachers with what previously we would have thought were inadequate formal qualifications.

Therefore, the only way to address this issue is through professional development. As I understood what Garry was saying, it is the concept of formal, accredited, professional development that is sustained, that is planned, that is sequential and is assessed, that is important for long-term teacher development and that is a way to educate teachers to the right level. The key issue there, of course, is that somehow the commitment that the teachers make to their self-education has to be acknowledged. It has to be acknowledged by salary, or even by the fact that it is seen as enhancing promotional opportunities, or whatever.

The notion of saying that we can educate the people who do come through to be mathematics teachers so that they can be better mathematics teachers seems to me to be somewhat critical and, rather than addressing a number of issues on the side, I think that it is possible to say that the individual teacher, the individual classroom, is much more important than the school or the region or the system, in terms of affecting individual outcomes. Those are the two points that I wanted to make. Thank you for the opportunity.

Mr KOTSIRAS—Thank you. Before I open up to questions, what is your connection with the MAV and the national body. Is there any connection there, any work done with them?

Prof. CLARKSON—Which national body?

Prof. SULLIVAN—AAMT, I guess.

Prof. CLARKSON—AAMT?

Mr KOTSIRAS—Yes.

Prof. CLARKSON—I certainly—and I suspect you have too—have been a member of both of those organisations for 30 years or more. MERGA is an independent organisation where research is the goal. However, it is true to say that all the different maths education groups in Australia—and there are others—do tend to work closely together. Apart from anything, many of us have joint membership across the boundaries, but our focus is mainly in research, for us.

Mr KOTSIRAS—Where do you get most of your funding from?

Prof. CLARKSON—We get most of our funding from our own back pockets. We are a self-funded institution. We do not get any grants from anyone, which is sad.

Ms ECKSTEIN—I would like to ask you to elaborate on the difference between numeracy and mathematics.

Prof. CLARKSON—'Mathematics' is the big, global term that is used culturally. Numeracy is, I suspect, a subset—that is a mathematical term—of that. Numeracy is normally regarded as those areas of mathematics where you get a real-life application, so in the school context 'numeracy' is normally referred to lower down in the school where you are trying to draw the notice of the children towards how that can be applied in their real-life situations.

Ms ECKSTEIN—Given that, and given that you also said there is skewed teaching

of mathematics, what should we teach and what should we not teach, in broad terms? I do not expect you to go into individual problems.

Prof. CLARKSON—I said that because I think any good curriculum developer is going to have a mind-set of who is going to do the teaching. If you are restricted because you know that a number of the teachers out there in 'school land' may not have the mathematical content background that once might have been the case, then you are perhaps going to cut off some parts of content, or not go as deeply into them or spread your wings as far as you possibly can. It gets skewed in that way.

Ms ECKSTEIN—That was not my understanding from what you said earlier. You were referring to mathematics being used as a sorting device for universities and TERs. I had assumed—and correct me if I am wrong—that you were saying that some of what we teach is really about sorting and not about mathematics and what kids need to know.

Prof. CLARKSON—No.

Ms ECKSTEIN—If I have got that wrong, please correct me.

Prof. CLARKSON—What I was meaning was that the results that school students get in their maths classes are used for a sieving device. It has been that way for years. If you go back to when some of us were in school, you went into the science-maths course, you went into the humanities or you went into commercial. Most of that was based on whether you were doing any good in mathematics. It is not so obvious these days in schools but there is still an undercurrent of that thinking. That is a pity.

Ms ECKSTEIN—I do not disagree with you. What I am trying to get at is, given all of that and given that that has been there forever and a day, what should we be teaching? Are there things we should be not teaching? We are only teaching them because they are a sieving device or for some other reason and it is—

Prof. CLARKSON—It is not what we teach; it is the way that the assessment is used. That is what is used for the sieving device. That in turn means that in some schools you will find that there is a narrowing of what possibly could be taught. Our kids do very well on what might be regarded as the nub or the core of what is here. All through secondary school—certainly through the middle years and up into maybe year 10—I would hope there would be a different mind-set where teachers would be wanting to follow the interests of their particular classroom cohorts. If things grip them they can take an extra two or three days exploring this, that or the other thing rather than saying, 'No, we've got to stop that now because we've got to get onto the next thing.'

Ms ECKSTEIN—Thank you.

Hon. P. HALL—I am glad that you provided a distinction between numeracy and mathematics. I have always felt the same. I have always had the view that mathematics is more a discipline of an abstract nature, as you described it, whereas numeracy is the application of many of the things we need to apply in terms of numbers in our everyday lives. Virtually, numeracy is what used to be described as arithmetic, is it not?

Prof. CLARKSON—There is a good overlap between the two.

Prof. SULLIVAN—Some people say that the comparison between literacy and literature is a bit similar to the comparison between numeracy and mathematics.

Hon. P. HALL—Yes. Should we not then re-label some of our teaching at a

primary level, particularly junior primary level, and call it numeracy rather than mathematics?

Prof. CLARKSON—That issue has been debated long and hard. My feeling is no. My worry is that then you start cutting off. You again get a mind-set—of those that are teaching—of where does this lead to? If you are teaching numeracy it leads to just the practical aspects of mathematics. Is that going to cut off that mind-set, not only for the teachers but for the students, that there is more to this than just that? I have always been on the side of the argument that says no, we should be actually calling all of it mathematics. I do not like the term 'numeracy'. However, I have had to come to live with the term 'numeracy' over the last 10 years because it has become common parlance.

Prof. SULLIVAN—Just to follow up the metaphor I used, no-one would suggest we only teach literacy in the primary school. Everyone would understand that literature is at least part of the experience of children as they are growing up, and the same thing for mathematics.

Hon. P. HALL—I have always found it interesting that when I did an arts degree the prequalification was either a branch of mathematics or a language—one or the other—to qualify for an arts degree.

Mr KOTSIRAS—Maths was considered a language.

Prof. CLARKSON—There is a difference, but we will not go into that. Yes, it emphasises the point that mathematics is a fundamental and critical part of our culture. Surely education in its totality is making that bridge—with other aspects of our society, including family and other things—for the kids into our culture. Mathematics is part and parcel of that.

Hon. P. HALL—Are competitions like the Australian Mathematics Competition helpful in terms of teaching, engaging, attracting the interest of students?

Prof. SULLIVAN—In terms of what Phil was saying, one of the issues for us as a society is that clearly we are going to need a much better educated populace to compete in a global market or even to be able to cope with the technologies that are going to govern our lives shortly. It is also true that we are going to have to educate the best very well. We have to find a way to educate all of the people, including the people who are going to be leading the innovations and developments in new fields. Competitions serve a very important role in helping the kids who are specialists in mathematics to develop their talents. We have someone who is a specialist at football or table tennis; these kids are specialists in mathematics.

Hon. P. HALL—Those competitions extend down to primary level, don't they?

Prof. SULLIVAN—Yes. They are not necessarily just for the elite kids but they serve as a way for the elite kids to demonstrate their excellence. It is a very important function, as well as making sure that we do have a broadly literate and numerate population that can lead the new directions in developments through society.

Hon. P. HALL—Do you think we are making the most of the research in the area of mathematics by getting the messages out, getting the results out and applying it in terms of educational programs for teachers?

Prof. CLARKSON—That is an interesting question. I have just finished editing the next conference proceedings of MERGA that will be held in Melbourne in early July. Our

theme this year is research theory and practice. We have gone out of our way to try to invite some papers which talk to that issue of bridging between what we might do and what might happen on Tuesday morning at nine o'clock in Surrey Park or wherever. It is an issue that for many of us still drives us and still is an absolutely critical part of the research that we do.

However, to look for that direct follow-through from dealing with a blue-sky research project, which is part of our job in universities, through to what messages are there at the whiteboard is an issue that is more and more getting cut off for us. The performativity standards that we have to sign up to these days are not what the research quantum of the universities is interested in. They are interested in this bit here: 'What refereed papers have you given at conferences? What refereed papers have you given in journals?' The notion that it might go on to being the basis of a terrific professional learning episode for teachers is something that we have got to see through to that conclusion—which I suspect many of my colleagues do—but that is not what you get kudos for any more. As the pressures come on in our workplace, that is the thing that is starting to wane. It is something that really does need to be addressed. That is the first point.

The second point is that maybe funding from departments of education could come in to target specific funding for that sort of research; researching that process between here on to there. We get not enough but we do get some money from bodies like the ARC to do more of this blue-sky research. They, too, are not interested in this follow-on, although the linkage grants do go some way to dealing with that. I suspect that could be a targeted area for state governments, state ministries of education that could target that aspect of the research enterprise.

Prof. SULLIVAN—Can I build on that? It is quite an important issue in terms of government policy. The Department of Education and Training seems to have a policy of either sourcing research that is conducted by individual researchers without any competition or, where there is competition, they fund small and rather focused groups. It would seem to me that many of the problems in education, and in particular in mathematics and science education, is because they are large multidimensional projects. The real way to solve them is by putting together a highly skilled team with a large number—eight to 10—of specialists in their field who would address the problem. That is the way that medical research is done. They get rather large teams with complementary skills who bring all of their skills to the solution of the problem. Rather than necessarily seeking funding, either without competitive tender or by competitive tender between small groups, put together large multiskilled groups that can address the problem that you are seeking an answer for.

Prof. CLARKSON—That of course is high risk. That means putting faith in the people that can do the job.

Ms ECKSTEIN—But isn't there already capacity for that through the tender? My experience with the department of education is that they seek research in the areas where they need research. I am thinking of the Early Years Literacy and Early Years Numeracy middle years projects. They were all tendered. It is up to the tenderers to put together the team.

Prof. SULLIVAN—I have been involved in a number of those tenders. The advice we have received from the department is that they do not want broadly based teams; they want narrow teams where it is easier to communicate. It is an interesting challenge. You are right, the people could put together the teams, but I am raising the issue that maybe it is a mind-set in the Department of Education and Training that needs to be considered.

Hon. P. HALL—Here is a simple question. Who commissions a lot of the research that is undertaken in maths education? Is it the state government or is it anybody else, such

as universities themselves?

Prof. CLARKSON—It is a mixture, I guess.

Prof. SULLIVAN—A lot of research is undertaken by graduate students, teachers and others, who are in a sense volunteers. In terms of the number of research projects going on in the country, there are probably as many of those as anything else. Certainly there is research that is tendered by the Department of Education and Training. The Australian Research Council has two types of research that they commission. One is discovery grants, which are more or less pure. The other one is linkage grants, in which a partner is sought. One of the challenges for the Department of Education and Training is that it appears that the Catholic Education Office and Catholic schools are much more likely to be partners in such research than the Department of Education and Training. Maybe a system whereby the Department of Education and Training was able to prioritise approaches from people proposing linkage applications would be helpful.

Prof. CLARKSON—A lot of good small research gets done by university staff who have very little funding at all.

Hon P. HALL—I suppose then there is that question I asked before. What happens to the outcome of that research? What are the links back to Surrey Hills Primary School at nine o'clock on Tuesday morning? If it is not built into a tender document, as such, then is there not a risk that will get lost along the way?

Prof. CLARKSON—Yes, there is. However—going back to Nicholas's original inquiry—at least in maths education we are in the happy situation where many of the researchers do see their role as progressing on and are members of still what are essentially professional teachers' organisations, and many of my colleagues Australia-wide would also undertake to publish in the MAV small journals for teachers. You will normally find the people that I have mentioned would be giving papers at the MAV conference on the first Thursday and Friday of December every year et cetera. That again is something which is a mind-set of the community that we belong to, which is terrific, but there is no structural imperative for that to happen.

Prof. SULLIVAN—Plus using the information sought from their research in their teaching of undergraduate students.

Prof. CLARKSON—Yes, of course.

Hon P. HALL—Throughout the inquiry the issue has been raised repeatedly about the difficulty that a primary school teacher has with teaching across a broad range of subject areas and therefore not having the content knowledge to effectively teach well in maths and science. As educators, do you see any ways in which that issue can be better addressed?

Prof. SULLIVAN—I am not as concerned about the issue in the case of maths as I am in the case of science, although I think that it may have been you who mentioned it when the people were here before. In fact, a lot of primary teachers, if they are teaching social studies and someone asks, 'How do volcanoes work?' are quite happy to say, 'I don't know. Let's find out.' They do not seem quite as confident saying that in the case of science or even mathematics. Maybe that is just an attitudinal thing. I am not sure. You mentioned the idea of having specialist teachers, particularly in the upper primary years, but I am not sure whether the schools that have done that have necessarily found it was extraordinarily successful.

We probably need to find ways to support the ongoing professional learning of teachers,

particularly upper primary teachers, in both mathematics and science so that they do have the content knowledge. In most cases they certainly have the pedagogical knowledge, perhaps much more so than some of the junior secondary teachers.

Mr KOTSIRAS—Should the universities and the teacher training institutions change? I understand that teachers who are out there now have PD, but how about the teachers who are going in to become primary teachers? Should something change at the university level, at the training level, so that when those teachers come out they are confident in teaching science?

Prof. SULLIVAN—Because of the very fact that the primary teachers are multiskilled, there is a lot of pressure on the curriculum of the undergraduate programs. We have to cover art and phys. ed. and music, as well as psychology and sociology, and their own personal development and health. It is a broad based curriculum. I think most universities have moved towards increasing the amount of mathematics and science studies undertaken by prospective students, but it is still going to be a challenge in the future.

Prof. CLARKSON—I think that goes back to the Smithers report in 1989. That was the first time they said, 'There does need to be some mathematics and some science taught in the undergraduate courses.' Since that time all of those courses have moved into universities, away from colleges, and one of the factors that has come in that train is the actual amount of contact time that we have in pre-service courses. This may be a good thing from some points of view, but it has meant that a lot of that contact time has been eased back and back and back, so we just do not see the students as often as we used to, say, in the mid-1980s. That is the first point.

The second point is that I think you have to go back and start asking, 'What is it about primary school that you are really trying to do?' I think one of the things that you are really trying to do is introduce the students of primary schools to a generalist appreciation of the culture. There is an argument that I could put—and if I was not President of the Mathematics Education Research Group of Australasia, I would put it very forcefully—which is that there is simply not enough time spent on art and music. They are incredibly important aspects of our culture. It seems to me that if there were a different mind-set about what the primary school is on about, and if kids came out of primary school still really loving to learn, what you did not teach in mathematics in primary schools that we teach today could be very quickly picked up if in fact you had students that wanted to do it later on. That is something that I think does not get much airplay but perhaps should.

The third point is that it is a misnomer to say that in fact the pre-service course is there and you are set up and you are a teacher then. You do not find that in our literature and I do not think you find it in any literature of university courses. What we do is credential beginning teachers to start their teaching profession. I do not think there is any teacher who really is qualified until they have spent three or four years in the classroom, learning a lot of what they do not know, learning a lot of what they do know. On an RN program the other morning we got a big serve, but in fact what we do in universities is simply start that process.

One of the critical things that for many years was—and still is—a factor not taken into consideration is the support that those young teachers get, not in just their first year but in their first three years in schools. That does not just mean how to keep chaos at bay. That is important. If you have been a teacher you perhaps can remember back on that being one of the things that really did concentrate your mind for the first six months of your teaching. 'What do you do? What happens if someone does this?' Of course that is important, but there are these other deeper issues of content, the pedagogy of, in our case, teaching mathematics, the pedagogy of teaching science, that also should be continually addressed through those first three years of teaching.

I have a lot of regard for senior members of staff in many schools who really do try to undertake that role as professionals. But when you see all the other things that a principal of a primary school or a principal of a secondary school or the deputies have to do, it is not surprising that this is not always first priority. I think universities, professional associations and central systems people would welcome the opportunity of providing that sort of support in a combined fashion but, in my opinion, it would need to go on for something like three years, not what is normally said as, 'We will give them support for 12 months and then we will see whether they are making a fist of it or not.' It is a long answer, but it is a crucial question, I suspect.

Mr BUTLER—In your opening statements you mentioned something about the Family Maths initiative.

Prof. CLARKSON—Yes. Family Maths was a program that started in—

Mr BUTLER—1984, wasn't it?

Prof. CLARKSON—Yes.

Mr BUTLER—Or 1985.

Prof. CLARKSON—It started in California and came to Australia in the mid-1980s. One of my colleagues at ACU wrote a PhD on it and submitted that, I think, in the late 1980s, so it has been around for a long time. I certainly could get some literature on it for you. There are a number of schools around still using the Family Maths Program as is and a number of schools have progressed their programs that started as Family Maths but have gone into different ways of doing it. Essentially, the Family Maths Program is premised around the notion that, for kids to enjoy and understand mathematics, parents are an incredibly important resource. Family Maths brings parents into the school for one or two nights a year where there is a whole program—the kids come as well—and they are taken through different things, often reflecting some of the teaching that goes on in school, but other issues as well. There are some of the spin-offs—for example, the homework type stuff that gets done as well. If you want some literature on it, we can provide it.

Mr KOTSIRAS—There is also the cooking, the recipes at home, adding the ingredients—'a third of this' et cetera.

Mr BUTLER—There is the Family Science Program on the internet now as part of the software that I think has a similar focus.

Prof. CLARKSON—That is right. Whether one grew out of the other I am not sure, but they are very similar now. The essence of it is quite right: schools should not be seen as something apart from families. You should build those bridges.

Prof. SULLIVAN—It is clear that the family involvement in a kid's education is the most important determination of educational outcomes. Even though there is a high correlation between socioeconomic status and family involvement—there is an indication that high-income families tend to be more involved in their kids' education and read to kids at home and so on—the fact that lower socioeconomic groups are not involved is not a resource issue, it is just a lack of familiarity. The projects that are very successful are those involving Indigenous parents, encouraging them to take a much more active role in their kids' education in the early years. It seems to me that that is a very exciting initiative because it is supporting them and trying to redress the very low success rate Indigenous kids have throughout the system. Anything that can be done to support parents helping their kids is

going to be helpful.

Mr KOTSIRAS—We thank MERGA for attending. As I said earlier, you will get a copy of *Hansard* and, if you need to make some alterations, you then send it back to us. Thank you very much for coming.

Prof. SULLIVAN—Thank you for the opportunity.

Witnesses withdrew.

Hearing suspended.

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

EDUCATION AND TRAINING COMMITTEE

Subcommittee

Inquiry into promotion of maths and science education

Melbourne — 20 June 2005

Members

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Mr P. R. Hall
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Witnesses

Ms V. White, Chief Executive Officer, Victorian Schools Innovation Commission, and

Ms S. Gunningham.

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Mr KOTSIRAS—I reopen this hearing of the maths and science inquiry subcommittee of the Education Training Committee. I remind you that we are under parliamentary privilege and that you will receive a copy of the transcript from the hearing. Welcome. You know the procedure: you give us a presentation and then we ask some questions.

Ms WHITE—Thanks for having us, Nick and Karen and Anne and Peter. I have not met you before. I am Viv White, the CEO of the Victorian Schools Innovation Commission. I will just table the required numbers of copies of the presentation and introduce my colleague and member of the teaching profession, Sue Gunningham, who sits on my left. Sue will do the major part of the presentation today.

Sue worked with the innovation commission for 18 months and has been very involved in professional development in terms of maths education and will give you a very good grassroots feel about the issues at the school level, but she brings to that an extraordinary experience from a theoretical and research base. She is just about to complete her PhD on maths education, and is very involved. When she was working with me, she helped design the Brotherhood of St Laurence and ANZ Bank financial services package for the one-on-one savings program for poor communities, and currently does most of the training of the trainers to deliver those financial services packages to the community. She has a great passion and sense about what is doable and what are the major issues at the community level, as well as at the school level. It is a bit unusual for teachers to have that community and school based experience. I am really pleased to introduce Suzanne to you and she is going to take you through our presentation.

Ms GUNNINGHAM—As Viv said, I worked for some time with the innovation commission and I am currently out at a school at Lalor, a very blue-collar, underachieving school probably, by all the data that is out there, and we are doing as much as we can to change the outcome for our kids in maths in particular. I might just say that what we are talking to here is just the maths component, too, not maths science, because while I am good at science, maths is my preference.

From people you have had here before, you have identified, I am sure, that the problem we have with maths in Victoria at the moment is that we have lots of kids not making it through to later-years maths, and we have lots of kids in the early and middle years that are turned off maths completely and do not want to go any further and, as a result, we are finishing up with almost nobody at the top of the schooling system that has the maths that we are going to need for tomorrow's society.

Australia, internationally, keeps showing up on the PISA and the TIMSS stuff as having one of the largest gaps between our highest achieving kids and our lowest achieving kids in maths, which is a real concern for people like me, particularly out in the suburbs where the kids are struggling. It is no good if our highest kids are doing really well but our low kids are miles behind and they keep staying miles behind. The gap is getting wider and wider.

I have done research on lots of things to do with maths, internationally and across the state, for the education department, for Viv and for the ANZ as part of their financial literacy stuff, so the things I am going to be talking about today have been collected from a range of sources. This one is the nearest and dearest to our heart at the moment. Primarily, this is what our education department is aimed at doing at the moment. It says the *Victorian Essential Learning Standards*—which is our most current document—promises that we are going to do this: equip all our kids with the ability to participate fully and effectively in their community. And, of course, literacy and numeracy figure very highly in there.

In the paper I have written for the innovation commission, we have identified three areas that

I think are our major areas of concern in Victoria, and I have some suggestions for how we might even go about fixing some of those. First and foremost is the problem of teacher capacity, and I will move into that in a minute. Then I see that we have problems with our curriculum. Despite the fact that we have the new Victorian essential learning standards, I can still see issues with the curriculum in relation to maths, and the actual education structures that are operating in Victoria do not necessarily serve to support improved outcomes for our kids.

All the research everywhere keeps coming back to the fact that the teacher is the thing that is going to make the major difference for our kids in the classroom. You can have the most fabulous resources, you can have the most fabulous school, you can have small numbers, large numbers, but if the teacher out the front is not up to the mark, then this is going to impact significantly on the kids' outcomes. I can see a range of things just within teacher capacity. We have again, across the research, a number of our teachers whose maths content knowledge is an issue for our students. I do not want to label across the board, but it is a well-known fact that many of our primary school teachers have more of an emphasis on their literacy skills than on their numeracy skills and that there is a significant gap in the content knowledge for many of our primary school teachers.

There is another piece of research I looked at over in California. They identified the same thing: that you cannot lay a fabulous foundation at primary school in maths if the teachers do not literally have the content knowledge. In California they have begun to introduce PD for teachers that is not about teaching and not about learning, it is about maths content. I do not know how the logistics of it would work in Australia, but as an incentive they pay teachers on top of their holiday pay to come in over school holidays to do maths lessons, to pick up their content knowledge. and they have a significant outcome as a result of that improvement in teachers' knowledge.

We had something similar in science here in Victoria about four years ago, where DEET funded primary school teachers to pick up our science content knowledge. I know I did the course at Melbourne university. The idea there was the same kind of thing: that that would eventually impact on our kids down the trail because we would know what it was that we were talking about. We do not do anything like that in maths in Victoria, so we have a content problem with some of our teachers.

On the other hand, we have a problem in that some of our teachers do not necessarily have the pedagogical skills to put the maths content across. From the work that I do as a cluster educator across primaries and secondaries, I have to say there is an obvious divide, in that we have primary school teachers who have fabulous pedagogical skills but not much content knowledge in maths, and we have secondary teachers who have fabulous content knowledge but not much pedagogical skill. Trying to get the two of them together in the same room to help each other is a nightmare, but that is another way forward.

I keep suggesting to my schools that some of the best PD they could get would be to bring the secondary school teachers down to teach the primary school teachers maths, and perhaps only primary school teachers would be willing to sit through some of the incredibly poor pedagogical experiences that that would require, but at least they would get the content knowledge; and then for the secondaries to go down to the primaries and find out just how you actually group your classes and interact with kids in a way that is meaningful.

There is that part that is a problem for us: the content knowledge of some teachers and the pedagogical knowledge of the others. I will give you one example. RMIT are the leaders in stuff to do with decimals in Victoria, and one of the biggest research papers they did was to do with whether or not people even understand decimals. They went out and interviewed people out in the public arena and they found that 25 per cent of adults could not tell, when

given two decimal numbers, which was the larger decimal. It is frightening enough that 25 per cent of adults cannot do it, but what is even more terrifying is that that research was primarily conducted with pre-service teachers at Melbourne university. That is very scary!

There is another issue with our teachers, too. Every teacher has some kind of classroom orientation themselves that they may not even be aware of unless they are faced with a slide like this and are made to go into a corner and think about themselves, but this is a big issue and as a state or as an education department we really need to come to terms with this, too, and point to which is the one that we value here in Victoria. I would hope that it is the one at the top but I have a feeling, particularly the way that our VCE is structured, and our secondary schools with their textbooks, that we have a strong emphasis on the second one and at year 9, where the kids are at their most disengaged, we probably have a strong emphasis down on the third one. We need to put in front of teachers that this is what we expect in Victoria, that it will be the top one, if that is what we value. Or do we value the second one? I do not think it is clear for teachers. In fact, I am certain it is not.

The other issue—and this comes out of the research too—is to do with mental models. I am still with the classroom teacher. There is an old school of thought that predominates out there that maths, and probably science as well, are the elite subjects; that the very clever, very wise people are going to be maths and science people. Teachers who hang onto that idea go into their classroom and are thinking to themselves, 'Maths is for our high-flyers. Maths is supposed to be really hard and is a subject that will sort and sift society for us. Those who are terrific at maths will pass and those who are not going to be very much in the world will fail.' Think about that as a teacher. If you go into a classroom and that is your mental model, you actually expect that most of your kids will fail, because your job is to sift and sort who are the high-flyers and who are not.

How does that roll itself out in the classroom? Just follow the line of thought for a minute. If you go into the classroom with the mental mode, 'My job is to work out who are the elite academics. They will be the ones who pass,' already you are thinking, 'There are a whole pile of kids in here who are going to fail, and so in a way it's not my fault if they do. That's just the way things are.' That is an issue that needs to be addressed with teachers, too, that that is not acceptable any more. I hope that is not acceptable. If I go in thinking that everybody is supposed to pass, the problem becomes mine, in a way. As a teacher, I need to come up with new ways of approaching this so that these kids can succeed, rather than go in and think, 'Well, some of them will fail, and that's just the way life is, because they're not the elite.'

The second area is curriculum. Ever since CSF2, probably ever since CSF1 came onto the scene, we have had teachers saying that the curriculum is overcrowded, and the maths curriculum is no exception to that. There are, like, 10,001 outcomes to die for. As a result, what we have out there again are teachers—and they have to, to survive—selecting what they consider to be the important maths to teach people, and you can see therefore that a kid, depending on which school they go to or which teacher they are with, is going to be exposed to a different curriculum to the kid up the road. A teacher may not be very strong at maths, and that can happen even at secondary school—if they have streamed kids, heaven forbid—and the English teacher or the LOTE teacher who has a light-on load is told that she is to teach the year 7 low-achieving maths group. What will she pick out? She is the LOTE teacher, for goodness sake. She probably does not know a lot of maths, so she will pick out the little bit of maths that she knows and do that. Is that giving all our kids the same opportunity? Something is wrong with out curriculum if it is so large that teachers are forced to pick and choose, 'What are the things that I can do?'

The other thing about the CSF—and the VELS has not fixed it; it has made it worse, if anything, because they have added one more dimension—is that our CSF gives equal weighting to every one of the strands. There is nothing that says number should be taught for

70 per cent of our time in grade 6, space needs to be taught for only 10 per cent of our time, and chance and data may be only five per cent of the time. When you look at our curriculum documents, every one of those strands is supposed to be taught, you would assume, an equal amount of time, and that of course has issues for it.

British Columbia overcame that problem, in that they have drawn a graph that separates the strands to show that in prep 2, grade 3, 30 to 40 per cent of the kids' time is spent just doing number, and by the time they are in years 11 and 12, that is reduced to about 10 per cent of the time. Space and shape: again, certain proportions of time allocated over the prep to year 12 year for different parts of the curriculum. The teachers can see that it is not good enough to say, if they are good at chance and data, 'Well, let's just give a quarter of the year over to that,' when in fact number perhaps needs to be focused on for their particular year.

We also have a problem with the curriculum in that you can open the paper any day of the week and you will find that we have kids with inappropriate numeracy skills or low numeracy skills, compared to what the employer wants. I know, because of the work with the ANZ that I have done, that financial literacy does not really get much of a guernsey in our curriculum. Shall I dare try this experiment? Every one of us here sat in a classroom, some of us for five years, some of us for one year, some of us would sit there forever, trying to memorise the formula for the area of a circle. Does anybody remember it?

Hon. P. HALL—Pi r squared.

Ms GUNNINGHAM—Very good! Some people are saying, 'I think it had something to do with C and A,' and that kind of stuff. I have been into primary school PDs where I have said that and there is a whole 15-minute conversation to try and resurrect, 'What on earth was that all about and what was the formula?' But what if I said to you now, 'In your real life'—and it is hard for teachers to visualise life beyond the school—'how many times have you ever had to apply that in a real situation'?

Ms ECKSTEIN—Never.

Ms GUNNINGHAM—I know. I am writing maths books at the moment for Papua New Guinea, for VICAL kids, and I am looking at stuff to do with South Africa, and I have got the Australian stuff, of course. Every one of those books, at year 7-8, spends an interminable number of pages teaching kids how to measure round garden beds. There cannot be that many round garden beds in the world that this is what all those years spent learning circumference comes down to. What is going on? It is not to say that we should not do that, but at the same time most of us, if we were honest, would say we have never used that in a real-life situation other than to pass a test. Every single one of us has had to read and interpret an electricity bill. We should have had to try to work out which mobile phone deal is the rip-off and which one works for us. We have had to try to read the graphs on the back of our water bill to see if there is a leak under the ground, which happened to me and suddenly I am up for about 500 times more than I should be. How many times do we bring that kind of stuff into the maths classroom? Hardly ever. Every one of our kids will use that information, but we do not give it any precedence. Instead, we teach them to work out the area of the round garden bed that apparently everybody is going to build, from here to South Africa and back.

This comes back to authenticity, that we need our maths to be very authentic. I spent the weekend looking at some insane activities that teachers had written to try to be authentic, and I pose some of these to you. If three people built a brick wall in four days, how long would it take four people? This is put up to kids as an authentic task. In reality, if it was not a maths classroom and I said that to you, what would you answer? Would you do a maths calculation?

Ms ECKSTEIN—Who cares?

Ms GUNNINGHAM—And would you say, 'I don't know. Who is the fourth person? Is it Joe Smith? He wouldn't work in an iron lung,' and that kind of stuff? We are asking, in some cases, incredibly insane things. On the other hand, and because I know you have been sitting there all day just listening to people blather on, I have got a 30-centimetre string here and if I said to you that Ian Thorpe, the swimming bloke—do you know this task? No, you do not, because I invented it! It just goes to show. I am thinking about middle-years kids. Ian Thorpe takes a size 17 shoe. Can you believe it? Size 17. What is the first thing that pops into your head? What do you think? You think, 'How long is his foot?' I am asking you: after all the maths that you have sat through, if I gave you this 30-centimetre string and put you in a group, would you be able to use all the maths you have done in an effective way to tell me how long his foot is?

Ms ECKSTEIN—No.

Ms GUNNINGHAM—You are doing all the answering. We have got very quiet people there.

Ms ECKSTEIN—They are the two maths teachers!

Hon. P. HALL—I got the area of the circle! I believe in being taught, not participating in discussion.

Ms GUNNINGHAM—It is called quiet disengagement. I have seen it in year 8.

Ms ECKSTEIN—Unless you know how long corresponds to each size of shoe, you cannot use anything.

Ms GUNNINGHAM—It is funny, because I know the maths teacher will sit there doing a calculation and go on and on and try and calculate it. I will tell you that following all the logical pathways you get the wrong answer, which is kind of nice for this activity when I do it with maths teachers.

Hon. P. HALL—But that is what a lot of maths is about, isn't it? The abstract thinking is one of the virtues of maths. You can have the practical applications that you are talking about but you can also have that abstract thinking, which is so important as well.

Ms GUNNINGHAM—Yes. But kids need to be supported to get to there, too.

Hon. P. HALL—I understand that.

Ms GUNNINGHAM—They are supported more by these kinds of real tasks. Every time you say to kids, 'He takes a size 17 shoe,' you can see that they are thinking, and when you do this calculation logically, you finish up with a clown-size foot. Maths teachers will often just write that and they have got the answer. The English teachers will say, 'That's ridiculous. It couldn't possibly be that big.' That is real maths: that something has gone wrong; that what you think should work does not work.

Here are some ideas I am tossing around about some of the stuff that real people in the real world use as maths. I am convinced that no-one has ever done any research and interviewed 90 per cent of the population to find out when they use maths in the real world and what kind of maths they use. They are not all digging around flowerbeds. They are doing these kinds of things. I met a physics teacher quite recently and I was talking to him about financial

literacy. He said to me, staring out the window with his mega-brainy physics head on, 'Those interest-free deals from Harvey Norman'—am I insulting anybody? I hope not.

Mr KOTSIRAS—I am just trying to visualise what he looks like!

Ms GUNNINGHAM—Really big feet and a really big head, yes! He said to me, 'With those 12 months interest-free deals from Harvey Norman, I have often wondered what happens if you pay 12 months and one day later.' I screamed at him, 'That's my point! That's my point! You are teaching this other stuff and you don't know the answer to that.' How many of our people—our kids even—are becoming bankrupt at a lower and lower age because they do not know it? They do not get it. That is the work I am doing with the ANZ, with the poor adults who have the poor children. Do you know the answer to the interest-free deal question? The interest is backdated all the way right back to day one. You get the whole year and one day's interest on top.

My son has just grown up to be a postman. He should be a doctor or something but, there you go, he wants to be a postman. What can you do? He came home fascinated because he had just learnt all about how they cut down the distances that postmen have to travel by always turning left. Postmen always go left, left, left, or they are supposed to. It actually makes for a more logistical way of delivering all the mail everywhere.

Look at this one. This just freaks me out. This is a true lift from the ANZ. Here is a $2,500 computer and there are three different people paying it off by three different methods across the screen there. One person gets the little bill from Bankcard and they say, 'All you've got to do is pay $3,' the minimum amount, and it takes them 34 years to pay off the $2,500 computer. The other person at the bottom there is very clever and realises that by paying $100 a month they pay it off in three years. This is the kind of stuff that our curriculum needs to be made of, not 'If four men build a fence' and that kind of stuff.

We have, as well, an overreliance by teachers on textbooks instead of this real stuff. At my school we introduced a financial literacy component for one session a week with our kids. The teachers really freaked out. They said, 'What will we teach?' and I said, 'All the stuff that you do every day. Start with mobile phones.' There was a terror in them. They said, 'We can't teach it because we don't know about mobile phones.' That is very scary. If teachers are only going to teach what they know, we will go backwards very fast. If you always do what you always did, you are always going to get what you always got.

Many roads lead to Rome. Our system is set up so that our kids get one chance and then it is over for them. In maths we have got, still, lots of people streaming. Our government, for some reason, does not come out one way or the other on whether that is a good thing or a bad thing. If you ask me, of course, I have got all the research to tell you how bad it is. When I deliver PD I have lots of teachers coming and asking, 'What's your opinion on streaming for kids?' The main reason that I am against streaming is because the kids streamed into the low group remain in the low group forever. The gap just gets wider and wider. There are a thousand reasons why that happens, of course.

I am going to give you some examples. Singapore and Finland have come up with some novel ideas that we should perhaps think about. When the kids get up to higher secondary school, they have a curriculum similar to our VCE. In Finland it is a three-year curriculum that the kids are supposed to go through, but they are allowed to take two years to do it or they are allowed to take four years to do it. They can stretch themselves out. The idea is, 'You will succeed. For some of you, you will succeed in a two-year time frame; for some of you it will be four years. But you will succeed.' What is the message there? That is wonderful for kids, rather than our, 'This is it and you get the one go and then you're out the door.'

Singapore is the same. They have a four- or five-year program for their upper secondary school kids to get to O-level, the emphasis being that everyone is expected to succeed. Some people need a bit of off-road assistance and some people will be able to streak through in the Lamborghini. Intervention is a problem for us, too. We do not, in maths in Victoria, have structured intervention. New Zealand has funded programs for parents in schools; parents in schools get together to do intervention. New South Wales has preschool intervention in numeracy for Indigenous kids, because they recognise in a big way—we have not recognised it in Victoria for some reason—that Indigenous kids start school way back below everybody else and they never catch up. New South Wales is trying to pick that up at preschool, before they get in.

The UK is the top of the polls for me. They run a summer school for their year 6 kids who are going into secondary school who feel that they are not up to the maths standard. They run booster programs where they put extra dough into schools to employ extra teachers, as we do for the Access to Excellence in literacy but not in numeracy. These booster programs run after-school sessions in maths as well—probably a big winner with most kids, after-school maths!

And this is the one I love the most. They have paid numeracy consultants that must work a bit like our cluster educators, but they are numeracy people who are experts in the field. They work across about 10 schools. Their job is to model good teaching practice, team-teach with teachers, run the PD, collect the data. They are driving the maths improvement all the time in a focused way. There is one person whose total responsibility is this group of about 10 schools. We have a whole pile of kids out there that need support in all kinds of different ways.

Mr KOTSIRAS—Thank you very much.

Ms ECKSTEIN—A maths educator once said to me that most of the maths taught in schools is to produce more maths teachers, and I always thought that was a very strange way to go about education.

Ms GUNNINGHAM—That is almost that elite view again, isn't it, that we are looking for this chosen few?

Ms ECKSTEIN—Yes. 'We have to teach this because maths teachers need to know this in order to teach this to someone else.'

Ms GUNNINGHAM—Yes. It is scary.

Ms ECKSTEIN—I think you have made some very important and valid points today.

Hon. P. HALL—Thanks, Sue.

Ms GUNNINGHAM—Do you want to know how long Ian Thorpe's foot is?

Hon. P. HALL—I am trying to measure mine—size 11 as opposed to size 17. Your practical applications are really good and I think they are an essential tool for engaging kids. When I was a teacher I used to use the Olympic Games and the Commonwealth Games as fabulous resource material that you can build whole units of maths understanding on.

Ms GUNNINGHAM—They only come around once every few years though, that is the trouble, and then everybody slips back to the textbook again.

Hon. P. HALL—Yes, but the Australian, the Commonwealth or the Olympic Games are in alternative years, so that is good. The other good skill there, when you are talking about skills, is approximation. Every time I go into a supermarket I apply those skills now, because invariably you get mistakes going through the register, so if you have the ability to approximate, that is also important.

Ms GUNNINGHAM—Absolutely.

Hon. P. HALL—How important are mathematical puzzles? I reckon that they also engage kids extremely well.

Ms GUNNINGHAM—Some.

Hon. P. HALL—Yes, some kids. One of my favourite activities with kids was a game I called Italian poker. They had a five by five grid and what I did as the class teacher—or I got the winning kid to do it—was to flip over 25 cards which numbered 1 to 13, and then at the end of the day you add up every row, every column and every diagonal. You get a total score out of all of that, and of course the placement of the 13s or the 12s or the 10s, where they counted diagonally or horizontally and vertically, was an important thing. The kids used to love that. They soon caught on to the tricks of doing that. I found some of those simple puzzle games also very engaging for kids. What are your thoughts about that?

Ms GUNNINGHAM—That is true. Everything works for somebody. I have also been in classes where, playing games, the teacher has said, 'I want you to play against each other in pairs and if you are a winner then you go and find another winner and play with the winner. The losers go and play with just losers.' We finish up with a roomful of losers and finally there will be one winner. Games are wonderful, but you have to be very careful about how the dynamics of it are working.

Also, it is very important to explain what the point of the game is. It is often overlooked by teachers playing games. Kids play the game and then get up and go out the door and nobody learnt or was told explicitly what the point of it was. 'What did we gain from that? What did we learn? What was it that you were trying to get me to understand in playing that game?' Teachers do not do that. It happens a lot. In some cases teachers are given a game and someone says, 'This is a fabulous game; use it,' and so they use it without any content knowledge about what the point is. The kids play the game and maybe have a lovely time or maybe have a shocking time, explode out the door and nothing was gained, except to say, 'We played a nice game and it was a maths game.' It is very important for teachers to know what the point is of doing the game and to ask, 'What do I want them to learn mathematically from it?' If they make sure it becomes explicit during the lesson, then the game is great.

Hon P. HALL—There is a great number game that the *Age* have just started printing, with all the crosswords. They have a number game which is a nine by nine grid where you are only allowed to have 1 to 9 in each row and in each column.

Ms GUNNINGHAM—Like a magic square.

Hon P. HALL—And in each little sub, a three by three group.

Ms GUNNINGHAM—Yes, for some kids it would be fascinating to do that.

Hon P. HALL—My wife goes crook because it takes me too long to work it out while I am at home on Saturday. All of that is great and I agree entirely with you. Are resources available for teachers? Do some of those ideas take time—for instance, to develop

a unit of work relating around use of mobile phones or shopping lists and things like that?

Ms GUNNINGHAM—Yes. There is an enormous amount of material out there and if people are working together in professional learning teams and they make contact with the relevant industry, there are buckets of goodwill out there industry-wise to come and help with all of that. There are the ANZ and the Commonwealth banks. You name every bank and there is a web site with 101 teacher activities.

Hon P. HALL—Does VELS describe all of that and how to get access to it?

Ms GUNNINGHAM—It is a vague document, yes. They have economics in there.

Hon P. HALL—Would that be helpful for teachers? I would have thought it was.

Ms GUNNINGHAM—The VELS document?

Hon P. HALL—If they had an associated resource document or more explicit—

Ms GUNNINGHAM—Yes. With the knowledge bank, yes. Technically they are supposed to lean heavily back on the CSF, but my belief is that in some secondary schools in particular the CSF is still being used to hold a door open or prop up the leg of a table and was not even opened the first time around, really.

Ms WHITE—Part of the challenge, too, is to go back to the learner centred notion that Suzanne was talking about. In any one classroom you can bet your bottom dollar there are 30 kids with mobile phones who have done all of the maths required to find out what the cheapest version is. You could actually use the knowledge of the students to work in new ways with that knowledge. It is about a mind-set, about how you use the resources you have, not necessarily about additional resources.

Hon P. HALL—I think in cases like that some teachers feel intimidated.

Ms GUNNINGHAM—Yes. They do not want to teach what they do not know.

Hon P. HALL—The kids know more than they do.

Ms GUNNINGHAM—That is something to really be embraced. You can inject enthusiasm into your class by using that. I use my own ignorance all the time. 'That's something I don't even know. Let's all find out.' 'That's amazing! Who can find out?' Kids will bounce back from that. There is no gain from being the teacher out the front who is the font of all knowledge, delivering stuff to them.

Hon P. HALL—It is a dangerous tactic for a first-year-out teacher to harness the enthusiasm of kids by pleading their own ignorance.

Ms GUNNINGHAM—In some cases, yes. You would not do it for everything, of course, but if you do not know anything about mobile phones, why wouldn't you? That is not a reason not to teach it. You can say, 'I don't know much about it, so can we all put out our information.' Everybody is going to have different information anyway; there is not any one person who knows it all. I keep saying that about the banks. I could get the king of the ANZ to come in and give a presentation but he would not know everything there is to know about banking per se. It is the same with mobile phones. All we can do is create situations where kids are happy to put their information out there on the table and discuss it and pool around, talk about it, get the best out of it. Nobody knows everything, thank goodness.

Hon P. HALL—You have given us a lot of good examples about what teachers can do in a classroom. This inquiry addresses the issue of how we can better train teachers to teach maths, so we will just concentrate on maths. How do you think we can better train teachers to employ the experiential sorts of things you are talking about?

Ms GUNNINGHAM—As I said at the start, we have at least the two prongs to begin with. We need some kind of professional development aimed at upping the content knowledge of teachers in the first place so that they are not frightened to even go into the circumference of a circle if they understand what is going on. We need pedagogical stuff as well. For me, the best model was the science activity I was involved in with Melbourne university. I was already enthusiastic about science, but within my limited knowledge. Being allowed to go somewhere with grown-ups and to sit around with everybody admitting their science knowledge was less than they could hope for and saying, 'Let's do something about it,' was a very powerful thing for me. I was absolutely re-energised to do the teaching of science and I know that enthusiasm flowed back. It actually flooded the classroom when I got back. There were many questions—'Gosh, I never noticed such and such!' and 'Why do you think dah dah dah?'

At the same time, the model that I talked about, the numeracy consultants attached to schools—because in my line of work I do a lot of consultancy myself—the one-off PDs, are just dead in the water. People come and listen to you very politely and they take away one game which you have shown them how to play, go back and play it and then revert to what they have always done. I have been used in a capacity where I go into classrooms and observe teachers. I might run some PD first and then observe them, write reports about what I saw that was worthwhile and what really needs addressing. You have to be a bit hard here and say, 'There are issues in your classroom, because I noticed dah dah dah.' You then work together as a team and ask, 'What can we do about that?'

Then I will come in and do some modelling and say, 'You not only just see me, hopefully who knows a little bit about how the classroom should run, but you can see your own kids reacting with a different style of teaching. You might see Billy at the back who never says a thing during your class and you give him perhaps no credit for knowing anything.' It happens all the time. Teachers will say, 'God, did you see Billy? Who would have thought that he was thinking so and so?' It is good for teachers to be in a situation where they are allowed to view their class being delivered by somebody else.

Ms WHITE—But at the university pre-service level there really does have to be an emphasis or a re-imagining of how you actually get that content stuff into the heads of primary teachers. What you do not want is a really bad, ex-secondary high school teacher teaching you that in the university context as a young beginning teacher.

Ms GUNNINGHAM—Yes, that is true, too.

Ms WHITE—There are too many teacher educators who do not themselves have the pedagogical practice to engage young and beginning teachers in mathematical inquiry. That really is a dilemma. I talked to this group before—or some of you—about other sorts of programs. I said to Sue on the way in, 'I reckon I've got a really good business opportunity here. We could go into business and teach maths to primary school teachers. If we advertised it nationally we would have our doors bashed down.'

I am a primary school teacher and I know that if I go back now to teach I will need that re-education around not the pedagogy but the content of mathematics. I ask, 'Where would I go to get that?' There is nowhere here in Victoria for me, as a returning teacher, other than a university context—which may not suit my lifestyle—or a neighbourhood centre, or a community access centre which probably would not suit me either, given my professional

background. It might not be where I am living. We have teachers who may very well want this offered to them and cannot get it. In a practical way, even a fee for service, not necessarily a free service provided by the system, could work.

Secondly, the retraining of the teacher education programs is really important. The third thing that is important is what Sue has identified. Already, in a way, we have the content specialists in our secondary schools and the pedagogical specialists in the primary schools, so bringing them together is a strategy that we should be thinking about.

Ms GUNNINGHAM—Shall we solve it? Can you just organise for that to happen?

Mr KOTSIRAS—Yes, all right, let me think about it! What importance do you think a child's learning of science at primary school has when it comes to the child's take-up of science at a senior level?

Ms GUNNINGHAM—Of science or of maths?

Mr KOTSIRAS—Or maths.

Ms GUNNINGHAM—Both, yes.

Mr KOTSIRAS—We have heard some people say it is not really important because primary school is very general and students can pick up science or maths.

Ms GUNNINGHAM—They hate it by the time they are in grade 4, usually. At parent-teacher interviews the parents say, 'That's okay, because I always hated it too.' I think it is very important, but I am struggling with maths and science. I think everything we teach is very important for kids, even poor LOTE. If that is what I am teaching, it is my job to be enthusiastic about it. I am enthusiastic about it. That is why I am the teacher of it. I go into my classes hoping that the kids pick up my enthusiasm for whatever it is I am teaching—in this case maths. If you are in my class my expectation is 'You are going to succeed at this. This is going to be so good for you. We are going to set the world on fire because you will be so inspired with all the things that you are able to do, all the answers you are able to come up with, all the problems you are able to pose.'

Mr KOTSIRAS—But if you are not confident enough, there could be trouble.

Ms GUNNINGHAM—If I am not confident then that is not going to work for the kids.

Ms WHITE—But also I think what I am hearing you ask is: if the kid is struggling with maths in year 3, can it be resuscitated by the time they get to high school? If they do not have a really good-quality maths program in primary, it does not matter so much.

Mr KOTSIRAS—And a poor teacher.

Ms GUNNINGHAM—But it does.

Ms WHITE—I think the evidence is pretty clear that 85 per cent of kids going to high school, after primary school, are not wanting to do maths. If motivation is about wanting to actually do what you do—

Ms ECKSTEIN—Mind you, hasn't it ever been thus?

Ms WHITE—Absolutely.

Ms GUNNINGHAM—But it comes back maybe to that mind-set. They know that, 'I am going to be sifted out in the maths lesson.' Maths is the most streamed of all the KLAs. Why is that? Because we are still hanging onto the fact that there are those who can and those who cannot. As long as you keep that mentality, you are not going to change things. Kids will come, knowing that at some stage they are going to be sorted into those who can and those who cannot.

Mr KOTSIRAS—Are you saying that our primary system is at fault? I mean the independent system, the public system.

Ms GUNNINGHAM—The primary system is at fault if the teacher is not confident in the teaching of maths. That will flow on to the kid as well: 'This is a subject you approach with caution. Speak softly. Do not have eye contact with the teacher'—all the stuff that anybody who does not like maths has done, just hoping at the end of the lesson they would get out the door alive. We have teachers who do not make the connections between maths and the real world. Maths is something where kids come into the classroom and maths is done to them. Then, if they survive it, they go on to live another day; whereas the whole purpose of maths is so that you can make sense of the world outside. It is just a language. Half the world is understood through maths and half the world is understood through language.

Mr KOTSIRAS—Should students have a prerequisite of mathematics or science to go into primary teaching?

Ms GUNNINGHAM—Should student teachers?

Mr KOTSIRAS—Yes. Should they have done maths at year 12 or science at year 12, to be able to go into primary teaching?

Ms GUNNINGHAM—It could not hurt. In a way they do, but they have a vegie maths course for primary teachers. In most tertiary institutes the primary school test the teachers are doing is the equivalent of a vegie, about year 7 maths. They would say on their Bachelor of Education that they did some third- or fourth-year maths, but it would be vegie maths.

Ms WHITE—I was listening to something interesting on the radio the other day. They were talking about 100 Harvard graduates who had come into first-year science from the best schools across America. Of the 100, only 15 could answer the question, 'What are the seasons and what causes tides?' In a way, it is about making connections with the disciplines of knowledge and the word in which we live and work. I think maths has probably been one of the subjects that we have been slow to realise the importance of.

Hon. P. HALL—Given your comments about streaming of kids, what are your views about advanced learning programs or accelerated learning programs?

Ms GUNNINGHAM—The same.

Hon. P. HALL—You do not believe they can assist.

Ms GUNNINGHAM—I do not mind kids being within a classroom and in groups within a classroom. If we are talking about the ocean, there are sharks, there are octopuses and there are rocks. In classrooms, many teachers would see that this is what is happening for them. If you take all the sharks down the corridor to the shark-infested pool and they do fabulous shark activities and they have fabulous shark conversations and they solve things in

a sharky kind of way, how are the rocks—who do not have the strategies or the imagination or the background skills—ever going to hear about the shark strategies and learn shortcuts and interact with people other than rocks? If the rocks are in another classroom, they are put in the rock pond, they are given the PE teacher who hates maths or the mother out in the corridor who also hates maths but will take the three remedial rocks outside and do times tables or something with them.

They get the really boring 'skill and drill' kind of stuff. Why wouldn't they hate maths? Why wouldn't they stay at the bottom of the pile? Where are they going? Nowhere! They often have the lowest skilled teacher. They often have the most boring curriculum. They are taken away from where the shark strategies are being discussed. In the classroom, I keep saying to teachers to put them in groups. Put the rocks with the octopuses—a bit of a mix—put the octopuses with the sharks—a bit of a mix—sometimes bring the rocks over here and do a rock lesson with them so that they get the bit of the jigsaw that is missing for them. Sometimes in the classroom take the sharks over here and do a bit of shark stuff with them, because they can go a bit deeper, a bit faster, a bit broader, a bit wider, but do not take them to the far ends of the school so that they cannot hear or see what the other is doing, because the rocks often have street skills and street knowledge. They would be able to solve this Ian Thorpe thing in a flash.

The sharks, in the meantime, will be doing the calculation and come up with the wrong answer. Sometimes it is good for the sharks to see that the way that you think mathematically is not always appropriate to solve every problem. That is very important. I am not averse to a bit of streaming that way, but—

Ms WHITE—Not permanently, say.

Ms GUNNINGHAM—when they put the kids in the rock garden, they will stay there forever and that gap keeps widening.

Hon. P. HALL—I appreciate that there is more than maths skills being taught in the classroom. There are social skills as well.

Ms GUNNINGHAM—Absolutely.

Mr KOTSIRAS—Thank you very much.

Witnesses withdrew.

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

EDUCATION AND TRAINING COMMITTEE

Subcommittee

Inquiry into promotion of maths and science education

Melbourne — 20 June 2005

Members

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Witnesses

Mr D. O'Keeffe, Secretary of Education Committee, Victorian Branch, The Australian Institute of Physics.

Mr KOTSIRAS—Dan, welcome again. This is the second time in two weeks.

Mr O'KEEFFE—Yes.

Mr KOTSIRAS—If you would care to give us a short presentation, we will ask you some questions afterwards.

Mr O'KEEFFE—I sent a submission in November last year, which I do not see any value in going through.

Mr KOTSIRAS—No.

Mr O'KEEFFE—I wanted to spend my time following up some of the issues I raised that have perhaps changed since I made the submission. I particularly wanted to address the issue of qualifications of physics teachers. You may have seen an article published in the *Age* on Wednesday, 20 April, which was a report of the Australian Council of Deans of Science—a survey of science teachers across Australia. It cited that more than 40 per cent of senior physics teachers do not have a tertiary physics major.

I was somewhat alarmed at that, knowing what happens in Victoria, and I got in touch with the people that did the survey to find out some more details about what they did and how they went about it. While the headline is accurate in terms of what they did, the words 'survey', 'Australia' and 'major' have particular meanings and need to be read carefully to interpret what is going on. A couple of weeks ago Christopher Bantick took that headline and translated it to 'Victoria', as opposed to 'Australia' and got things wrong. I wanted to address that particular issue to make you aware of what is actually happening in Victoria as opposed to Australia.

I have written an article which has been published in the science teachers journal. There are five copies there, one for Andrew and one for each of you. My first point in regard to the three words that were mentioned in the Australian Council of Deans of Science report is that it referred to Australia as opposed to the different states. Secondly, it used the word 'major', which is legitimate but you needed to go through the report to find out what 'major' meant. Thirdly, while it was a properly constructed survey—and the survey was conducted by ACR—there were only about 1,200 students Australia-wide that were actually surveyed, and that was science teachers, not physics teachers.

When I got in touch with them, I asked, 'How many in Victoria did you question and how many of those were physics teachers?' They said, 'There were around 40 or 50 that we actually spoke to.' I was concerned about that because, as you may see there, we have surveyed physics teachers on their qualifications and other aspects of their career aspirations several times over the last 10 years—the most recent survey was in 2002—and what we found in each of those surveys, as I explain in the second paragraph there, was that over 85 per cent of secondary physics teachers in Victoria have at least two years of tertiary physics. As you are probably aware, that is what is required to teach year 12.

The other aspect about the headline referring to 'physics major' was that the report defined a 'major' as having done three years of tertiary physics. They also defined a minor as having done two years of tertiary physics or tertiary anything, and that made their figures closer to ours. However, talking to them unofficially, they indicated that there were differences between the states but they were not allowed to talk about that because some states not too far from here are only prepared to participate on the basis of state by state comparisons. So Victoria comes out quite nicely. I am aware, from talking to my physics teacher colleagues in other states in the academic area, that they have some serious concerns—in one state in particular—about what is happening.

I think it is a reflection of how teacher training is done and how induction of teachers is done. The situation in Victoria is that teachers have two methods and they teach across two subject areas and, therefore, they have more fluidity. That is not always the case in other states. We are in a very good situation as far as physics is concerned, and I suspect it is the same in the subjects of chemistry and biology on a similar basis. Over the page you can see that figure 1 indicates the distribution across the different categories.

Some of the survey results also looked at retirement, which might be of interest to you as well. Table 2 has a breakdown of physics teachers by the number of years that they tended to teach before they retired. That has the data going across the four principal surveys that we did in 1997 to 2002. With the 2002 survey, we had 237 questionnaires responded to as opposed to 50 in the Australian Council of Deans of Science survey, so we feel we have a very good sample of physics teachers in the state. You can see in table 2—and this is data that you are probably well aware of—that the average age of teachers in the state now, and probably in the nation, is in the high 40s, if not the low 50s.

Mr KOTSIRAS—Why is it that they only work for six to 15 years before they leave? The figure is between 23 per cent and 25 per cent. Is it because they find other jobs that pay better?

Mr O'KEEFFE—No. The one to five, six to 10, and 11 to 15 refer to the number of years that teachers expect to teach before they retire.

Ms ECKSTEIN—Yes, but 23 per cent to 25 per cent of them—

Mr KOTSIRAS—Leave after—

Ms ECKSTEIN—That was 1997, though.

Mr O'KEEFFE—No, not that they tend to leave. It is not how long they have been teaching, it is asking them, 'How long do you intend to teach before you retire?'

Mr KOTSIRAS—From that time?

Mr O'KEEFFE—From then. If you take the most recent survey of 2002, 20 per cent of the teachers expected to retire within five years and so on down. As you go down the years, the number at the top—one to five—has increased, as you would expect as people got older. I am sure that you are aware that we have an ageing teaching profession and a lot of them will go within the next five to 10 years, as I have done.

There is other data there in terms of how the distribution of qualifications varies across the different years until retirement. Those retiring within one to five years are the oldies like myself. Those who said they have another 26 to 40 years of teaching are the ones who have come in within the last year or two. You can see, looking through table 2, that there is not much variation in the qualifications of the teachers over the years. We are still getting reasonable numbers coming through.

The other two tables that I included indicate the other things that physics teachers were doing. There was an image that physics teachers just teach maths as their other discipline, but in fact quite a large number of them teach science 7 to 10 and quite a large number of them take on positions of responsibility as science coordinators in schools as well, so the last table gives an indication of what the population is like. The other things that I wish to address relate to my submission. Do you have a copy of the submission?

Mr KOTSIRAS—Yes.

Mr O'KEEFFE—If you have a look at figures 1 and 2, one of the things that has concerned me for a couple of decades really is the reporting of participation in subjects in the media and by politicians, because the easiest thing for the media to report is just how many kids enrolled. It is a nice number, you get it from VCAA and you publish it and you can look at comparisons with the previous year and get a good headline out of it.

The difficulty with using that as a number is that it is not a reliable one because it is going to change with the birthrate. As more kids are born, you are going to have more kids coming into grade 6, going right through the school, so you are likely to get variation in what is happening at year 12, just on the basis of birthrate. One of the things that people then do to try to work out what is going on—particularly in physics but any other subject—is to look at the percentage of or the number of students doing physics as a proportion of the total year 12 population. That is not a bad measure, but that is inadequate too, because in the last 20 years we have had quite significant variation in retention rate. We have had situations where students who have previously left school in year 10 are now staying on to year 11 and year 12, so we get an increase in retention rate. If you look at the number of students doing physics as just a proportion of the year 12 population, yet you have more years 10s staying on to year 12, it is unlikely that the same proportion of those that do physics is the current population, so you would expect that measure to go down. A number of people even in the physics community will use that as a measure to try to boost and promote physics by saying the numbers are dropping, and that sort of thing.

I see inadequacies in both those measures, so I measure the participation in physics by looking at the number of students doing physics, comparing them back to a time when in fact the whole age cohort were all together, which is, say, in year 7 or prep or something like that, so all the young people in the country were in year 7, they were all in schools, so we know how many there are, and I use that as my measure to see what is the intrinsic popularity or attraction of the subject, and that is how I get my measure of the participation in physics or chemistry, looking at just what proportion of the age cohort is actually doing physics at year 12 as a true measure of what is actually happening in society. That is how I have generated those two graphs there for figure 1 for physics and figure 2 for chemistry.

You can see from those graphs there that during the seventies and eighties things were fairly low. There is a significant increase in the late nineties, with the introduction of the VCE, and I think the reason for the increase was the elimination of a lot of the other secondary certificates we had at the time, like T12, STC, Group 2, all those sorts of things operating at that time, trying to cater for the increase in retention rate. With the Group 1 subjects, the HSC was not really catering for their needs and a lot of other certificates were coming in. The VCE, which tried to incorporate all that, meant that students were moving across in preparation for that, and then they sort of hit it in 1991, found that it was not to their liking and some numbers dropped a bit in the next two years, and then pretty much stabilised but, as you can see, at a significantly higher level than we had in the eighties. In fact, if you wanted to be optimistic or positive, you could say the proportion of young people doing physics in the last decade has been the highest for about the last 50 years on that sort of data, and I have data going back to the sixties as well.

The thing, though, that obviously is of concern from a physics point of view is that there has been hardly any change in the male-female proportion. We are still getting only around 27 per cent of females doing physics, which is probably a Western world problem, but that contrasts with the chemistry one at the bottom—

Mr KOTSIRAS—Can I ask why you think only 27 per cent of the girls do physics?

Mr O'KEEFFE—As a Western world problem, we have tried different ways of encouraging the girls: by the teaching approaches, or having a curriculum that is more inclusive in the social context, or wider ranges of assessments and so on. They do not seem to work, because that is basically what we have been doing in physics in Victoria for the last 15 years. I think it really does get back to the perception of physics in society. That is the difficulty. Going back to the primary situation, one of our concerns is this image of physics or the amount of physics in the primary curriculum. That might be a factor, because certainly it is not at year 10 where the kids are starting to make their decisions. Their images are being formed a lot earlier, so you need to start things happening earlier on. In fact, one of the initiatives we are doing this year is trying to develop some activities on playground physics for the primary area: using the equipment, talking about forces, what they experience when they are on a ride, these sorts of things. We are getting those experiences—and some of the language—into the primary area.

But it is a difficult problem. I think one of the difficulties with physics is that in society you do not really have a sense of what a physicist does. You can have a sense of what a chemist does, what a biologist does, and it is hard to get the nuts and bolts of what a physicist does.

Mr KOTSIRAS—Whose fault is that?

Mr O'KEEFFE—You could say it is partly ours in terms of not doing a good job in promoting it. It is also possibly because the word 'physicist' is not used all that much. A physicist may be working as an 'engineer'. 'Physicist' is not a word you are likely to see appearing in the job ads. They are likely to define it in a more specific way because they want someone who is a photronics expert or someone who is a radiation specialist or something like that. You are more likely to find a physics job by where it is at rather than by using the word 'physicist', whereas with chemists and biologists there is still an intrinsic starting point, I think. It is hard to be precise about these sorts of things but that seems to me a possible explanation.

The other factor, too, could I also say, in regard to the difference between figure 1 and figure 2 is university prerequisites. Chemistry is a sole subject prerequisite for a lot of the biomedical courses. Physics is a prerequisite for hardly any tertiary course. You might get the aeronautical engineer in RMIT. It is probably the only tertiary course in Victoria that has physics as a discrete requirement. Even for engineers it is 'two of the following'. Physics is not seen as something that is discrete; chemistry is. I think that partly explains why there are now more girls than boys doing chemistry, by a significant percentage. In fact, more boys do physics than chemistry, by about an additional 1,000. There are interesting variations in the populations out there. They have changed over the last 10 to 15 years.

Mr KOTSIRAS—Thank you very much.

Hon. P. HALL—Do you have any idea of the shortages in physics teachers across the state?

Mr O'KEEFFE—That is very hard to get an answer on and I doubt whether, in fact, the government departments would actually know, because I think schools are reluctant to say, 'We're having trouble finding a physics teacher.' It is not something they are going to tell you. They will try and hide it; perhaps try and put a phys. ed. teacher or someone else in there. It is very hard to know what the detail is. You hear anecdotes of a situation like that, where a phys. ed. teacher has been asked to take physics, but I just do not know the depth of it, to be honest, and I wonder also how serious it is because I think you could also argue, too, that there are physics-qualified people who are teaching maths who could come in, but you do not necessarily want to rob Peter to pay Paul. It is hard to know what the shortage is. Certainly the Council of Deans of Science did ask the schools how hard it is to find people in

the sort of 1 to 5 scale, and certainly it is difficult. I think physics was harder to find than the chem. and the biol., but that is people's reactions, if you like.

Hon. P. HALL—What about the program at Balwyn High School that you mentioned in your submission that is set up to support teachers in smaller schools?

Mr O'KEEFFE—Yes, and country.

Hon. P. HALL—Can you tell us anything about that program?

Mr O'KEEFFE—In details or effects?

Hon. P. HALL—Just a broad brush; how it actually works—you know, 'I have four students who are undertaking physics.' They may well do it by correspondence. I am not sure.

Mr O'KEEFFE—Balwyn High, as a large school, has a good number of physics teachers, probably about four or five, possibly even six. A number of the people who initiated the program have now left. They got funding from the federal government to run this program. The program was intended to support isolated teachers and isolated students, so they put together a whole range of resources on a CD-ROM which they gave to these teachers. They also made themselves available by phone and email to these teachers to ask questions. They also got into revision for preparation for half-year and end of year exams, or they went up to the country and gave revision lectures for free for the students that they were involved with. The CD they put together is certainly highly valued.

Hon. P. HALL—Are you satisfied with the level of the training course provided for teachers who will actually come out and teach physics?

Mr O'KEEFFE—Yes. I know the persons doing their own method classes at Melbourne uni and Monash. I am happy with their competence and what they would be offering to give their students a good understanding of what the courses involve and to prepare them adequately, as much as one can.

Hon. P. HALL—What is the life of a physics teacher like in a secondary school? Often you will get deposited into teaching physics because you are a very rare commodity; therefore you will get locked into the years 11 and 12 physics. Is it a problem that they may not have the same diversity as some other teachers?

Mr O'KEEFFE—It depends on the size of the school. Even at Balwyn, which is a biggish school, they have probably got about 80 to 100 kids doing year 12, and they might have a similar number—about 120—in year 11. There might be about five or six classes, but if you have five or six teachers, each teacher has one year 12 class and one year 11 class. That is not going fill your allotment, so they need to be involved in other areas, and that is probably going to be the case. It would be a fairly rare situation, I think, for any teacher to be able to fill up their allotment just with years 11 and 12. Even when I was at Camberwell Grammar, I had two year 13s and one year 11 and I had a year 10 science class, but I was still head of science at the same time, so that was basically my allotment for 10, 15 years. But the other physics teachers at my school were teaching across all levels and subjects, maths and science, for years 9 and 10. I do not think it occurs all that often, to be honest.

Hon. P. HALL—I have seen country schools where the physics teacher took the two year 11 classes and the one year 12 class and then perhaps a junior science class to make up the workload.

Mr O'KEEFFE—That could be the case. I would have thought, though, that if you had one year 12 and two year 11s, that is probably an argument for the school to advertise for another physics teacher. They are also hard to get, so you are not going to get that sort of situation happening, I suppose, in the time ahead.

Hon. P. HALL—Is that professional isolation a deterrent?

Mr O'KEEFFE—I do not think it is a deterrent. You will still have another subject. You are in a sort of community of teachers anyway. You would be in a faculty with the other teachers and you would be involved in the years 9 and 10 programs so you would be contributing to that. I do not see it as a major issue. Certainly principals would want to run schools so that in fact people could get a chance to move around or everyone gets a chance to teach at the senior level. It may occur, but I would not see it as being a principal issue.

Mr KOTSIRAS—What is your opinion of specialist teachers in the primary school?

Mr O'KEEFFE—I think you are probably better to go with a generalist. I could see an argument for having a specialist art teacher, a specialist LOTE teacher, a specialist PE teacher, but I would prefer the one teacher to be teaching maths, English, science, history, geography. I think the thing is to get the training of the primary teachers to the point where they are competent and have some sort of understanding of scientific concepts, but it is probably more a matter of looking at the incoming qualifications. It would be nice to have primary teachers having science, phys, chem. or biol., at year 12, but it is unlikely to get to that stage. As the previous people were saying, year 12 maths can be mickey mouse maths, and it does not mean that much.

It would be nice to get primary teachers comfortable with the science. It is probably more that than being knowledgeable. Even as secondary teachers, there are things that you do not know. The kids are going to ask you a question and the answer is, 'I don't know about that,' or, 'I can find out for you,' or, 'We can talk about it.' With IT and accessing the internet, kids can come up with all sorts of curly questions. You have to be comfortable with saying, 'I'm not the expert. I know some things, but I don't know everything. Let's sort this one out.' If you can get the primary teachers comfortable with an inquiry approach, almost as a mutual thing, so that they do not feel the need to be the expert on all matters, if they can be confident with using equipment or with experimental investigations, that can overcome a lot of the difficulties.

Ms ECKSTEIN—Can you comment on industry's need for physics graduates, and therefore are we getting enough kids through to VCE physics in order to get enough inter-tertiary courses to meet the industry demand, not only for teachers but generally?

Mr O'KEEFFE—I am probably making gut-feeling comments on this.

Ms ECKSTEIN—That is all right.

Mr O'KEEFFE—My feeling would be, looking at these figures here, that the numbers of students doing physics at year 12 is not too bad. We have got about 7,500. From then on, it is preliminary analysis I have done. I have looked at VTAC data in terms of where physics students go. A lot of physics students will go into the medical and paramedical. A lot of physics students will go into commerce. A lot of physics students will go into IT. To some extent, the physics students in year 12 who end up doing a BSc, to my way of thinking and looking at the data without being too categorical, tend to be more the mid-range kids, not the top of the range A-pluses. They will go off and do medicine and other bits and pieces. The basic degree courses are really picking up the mid-range, which is kids who have got some questions wrong in the paper, if not a third.

Ms ECKSTEIN—And they are the ones that will go into industry and engineering and those sorts of things?

Mr O'KEEFFE—Yes. You are not getting your higher flyers, necessarily. There would obviously be some who have got an intrinsic love for the subject and they will go on regardless, but when you talk to your bright kids about where they are going to go, they will be going into the medical. Not many physics kids do law.

Ms ECKSTEIN—Funny about that.

Mr O'KEEFFE—A lot of kids will do physics so they can get a high score, but, looking at the data, they tend not to go into the law.

Ms ECKSTEIN—Do we have enough of those kids—middle range or whatever—to satisfy industry in engineering and metallurgy and those sorts of things?

Mr O'KEEFFE—I am not especially qualified to comment on that. I do not know industry needs or tertiary needs.

Ms ECKSTEIN—My next question was going to be: are those industries saying—because, as you say, they are probably the middle-range kids—'They are not of a sufficient standard for our needs'? Is it a problem of quantity or quality, or is there a problem at all?

Mr O'KEEFFE—Certainly, as far as the industry's needs are concerned, the industry's needs probably cover a range of areas. They want the TAFE people. They want the graduates and they also probably want the PhDs. Their demands are across all areas. From the data I have seen as things come back to me now, there certainly is a big demand in the photronics area. That is going to be a high-growth area. As you can probably see for the synchrotron, the synchrotron is not a high employment area, but things like photronics will be. There is going to be a big demand for the TAFE people as much as the degree and PhD people. That is going to limit our growth.

As far as the tertiary side of things, tertiary people often complain about the ability of their incoming group, as perhaps we do about year 7s, and so on it goes. But you have to deal with what you have got, to some extent. If they are in the marketplace and all the bright kids are going off to do medicine and these are the ones who decide to do a BSc, you take what you have got and you say, 'Okay, they're being exposed to these materials and this content in year 12. There are some things they may not know or be too au fait on, but we don't know what they are, so we'd better make sure we bring them back up to scratch before they take them on.' The tertiary area needs to be a bit more understanding of the cohort that is coming through. They cannot say, 'They have finished year 12. They know all that. Let's go on.' That does not work. They are an education institution. They need to take that job seriously. Photronics is the only area where I know there is going to be a big demand in the years ahead.

Mr KOTSIRAS—Dan, thank you again, for the second time in a few weeks.

Mr O'KEEFFE—That is all right.

Mr KOTSIRAS—You will get a copy of *Hansard* in the next few days. I declare the hearing closed.

Committee adjourned.