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

EDUCATION AND TRAINING COMMITTEE

Maths and Science Evidence Committee

Inquiry into promotion of maths and science education

Bendigo — 1 August 2005

Members

Mr S. R. Herbert
Mr P. R. Hall
Mr N. Kotsiras

Chair: Mr S. R. Herbert

Staff

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Witnesses

Cr D. Jones, councillor, City of Greater Bendigo;

Mr J. Bothe, executive officer, Bendigo Manufacturing Group;

Ms G. Bowyer, educational community affairs, Bendigo Mining Ltd;

Ms S. Roberts, general manager, CVGT;

Ms M. Semple, training consultant, Victorian Employers Chamber of Commerce and Industry;

Mr T. Brenan, recruitment services, Bendigo Bank;

Mr A. Walker, manager, Ceramic Oxide Fabricators; and

Mr N. Davies, science projects officer, Department of Education and Training.

The CHAIR — I declare open this meeting of the subcommittee of the Education and Training Committee. The Education and Training Committee is an all-party joint investigative committee of the Parliament of Victoria. The subcommittee 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 meeting that all evidence taken by the subcommittee, including submissions, is subject to parliamentary privilege and is granted immunity from judicial review pursuant to the Constitution Act and the Parliamentary Committees Act.

Welcome to the committee hearing — you should probably be welcoming me to Bendigo! We very much appreciate the time you are giving this morning in terms of having some input into our inquiry.. When you first introduce yourselves could you give your name and title for Hansard.

Our inquiry is into maths and science education, basically looking at secondary education but its major ramifications as students go through. We look at how they go through into university and into TAFE or different types of further education, or apprenticeships for that matter. The issue we are seeking to resolve in terms of our basic terms of inquiry is how adequate the education system is right through in terms of maths and science education for the individual, for the needs of our economy and the needs of specific regional economies such as this area, and how adequate it is in terms of industry and the needs of industry to grow and prosper into the future. We are inquiring into ways we can look at improving that education, particularly the number of young people undertaking maths and science, to ensure that our competitiveness as a state in terms of international and interstate trade is kept high because of the high calibre of people we have.

We have no viewpoints at this time on whether it is adequate or not adequate, whether we are meeting the needs or not — that is where we are seeking input from a whole range of stakeholders. In particular we are seeking input from industry and as many industry groups as we can to try to see where their views are because they are often quite distinctly different to the views of education communities. We very much value what you are about to tell us. As I say, we value the time.

I think David is going to speak on behalf of Bendigo council and then I thought we might go around the table for a bit of an introduction and any views you would like to put. We will then open it up to questions and discussion if that suits the participants.

Cr JONES — On behalf of the mayor, who unfortunately cannot be here this morning — interestingly enough the reason he cannot be here this morning is he is in front of a year 12 maths class; it is an area of great interest to him and he sends his regards — and the council I would like to acknowledge Mr Steve Herbert, the chair; Mr Nick Kotsiras, the deputy chair; and Mr Peter Hall, MLC for Gippsland. We have apologies from Mrs Helen Buckingham, Ms Anne Eckstein, Ms Janice Munt and Mr Victor Perton. On behalf of the council I would like to acknowledge that we are meeting today on Jarra Jarra land, which is the traditional home of the Djadja Wurrung community, and pay our regards and respects to them.

On behalf of the city I would like to welcome the Victorian parliamentary Education and Training Committee to Bendigo. We are really pleased that you have taken the time to ensure that the inquiry is extended to school communities and industry in rural and regional Victoria. I will not go on much longer; I want to welcome you to Bendigo and thank you for coming here.

The CHAIR — Thank you for that. If you like, we will go around the table. Take as much time as you like if you want to put viewpoints or a brief perspective or just introduce yourselves.

Mr BOTHE — Jeff Bothe is my name. I am the industry development officer with the City of Greater Bendigo. I also play a supporting role to the Bendigo Manufacturing Group. The Bendigo Manufacturing Group is not a membership-based group, it is a manufacturing sector representative-type group where different sectors bring their issues, inhibitors, and maybe opportunities that for one reason or another cannot be realised, to the table for the group to discuss on behalf of industry, not on behalf of individual businesses. With that background, I am not really sure how relevant this is just to maths and science. You gave us a bit of leeway with what we said — —

The CHAIR — Physics, chemistry, on to university, engineering courses — it is a broader maths-science we are doing.

Mr BOTHE — Okay. A number of areas have come up where skills shortages certainly exist that relate to that broader sector. We have an expanding manufactured building product sector taking into account wall frames

and roof trusses. They have issues in getting what they call estimators. It is a very basic sort of job — a lot of CAD work estimating quantities for doing quotes on jobs. There is one particular area that certainly maths can contribute to, but for one reason or another not enough people see drafting as a skill that is taught through the education system as strong enough leading into that. There are related areas to that as well.

Mr HALL — Do they require a post-secondary education to do that?

Mr BOTHE — No, they require good commonsense — that is the answer we are getting back from industry. If they have good commonsense and a background in it, they can train them. That is what we are hearing.

Mr HALL — So they train on the job for those particular skills rather than through a TAFE institute.

Mr BOTHE — A TAFE institute would be an advantage to pick up on that, there is no question of that, but that is not the answer we are getting at the moment.

In the larger manufacturing businesses, production managers are few and far between. That is usually a tertiary course. We do not have that course here in Bendigo any longer. We used to have a production management-type course. That is seen as not a well-chosen course to take because of the tag that manufacturing has. It is seen as a negative rather than a positive. Part of where I am coming from has to do more with how manufacturing is perceived, and the maths-science sorts of skills are not related to that particular area. Clearly the sector is saying that not enough apprenticeships are being proposed by businesses in manufacturing.

Some of the medium-sized businesses now are taking on a large number of apprentices to make sure they have the skill level. That line of supply and then creating the skills relates back to having enough appropriate young people with maths backgrounds coming into manufacturing. There are lots of jobs within the manufacturing environment that require measurements, quality assurance, computer skills and those sorts of things, and rely on having more of a maths background. I think that is enough from me for a start.

Ms BOWYER — I am Genevieve Bowyer. I am in the education area of where I work, which is Bendigo Mining Ltd. We are a private company in Kangaroo Flat, not far from here — probably 10 minutes up the road. The other part of my work is in community affairs — about 70 per cent is in community affairs and 30 per cent is in education. Bendigo Mining has a fairly big commitment to education in the area. We go out to all the secondary schools and lots of the primary schools and introduce kids to all the sciences, such as earth science, which we have used for a case study for VCE. They can use us for that. I will give a bit of a background on us. The environment is a huge issue for us, being in a residential area. Environmental safety and things like that are of particular interest to the education sector because we are so unusual.

What are we looking for? The big challenge for us in the future will be getting people from the right education areas to come in to where we are working now. What we are aiming to do is to have at least 60 per cent of local people working with us. That is always a challenge for us, because not a lot of people will have the science and maths backgrounds and the skills we need in areas such as engineering, geology and things like that. We are having to go interstate for a fair bit of that.

The CHAIR — Interstate?

Ms BOWYER — Yes, interstate and overseas. Ideally we would like to get way more than 60 per cent. We are keeping that as it is now, but that is always a challenge for us. We have an apprenticeship system starting up now. We have been there for nearly six years now. We are just ramping up the apprenticeship side of things now. We have been doing exploratory work for the last few years and now we are building a processing plant, so we will be taking on a lot of more staff and that is when we will start to need people with that expertise. If we can get kids coming through schools with some sort of knowledge or desire to be in the industry, that would be a great benefit to getting the local kids they are looking for.

The CHAIR — When you said engineering and geology, did you mean you are basically looking for university or TAFE graduates, or are you looking for those out of secondary? What is your apprenticeship level?

Ms BOWYER — Most people doing the on-the-surface work or the office work, say in geology and engineering and those things, would need to have been to university. But then there are other jobs underground where they will do six months of truck driving, six months of shot firing, and they will do four or five different jobs

before they do drilling, so they do not need to have been to university for that. They would learn that on an on-the-job basis, but still those from secondary, as you said, would certainly need to have a maths background.

Mr HALL — Some of that recruitment is straight from school?

Ms BOWYER — Yes.

The CHAIR — Okay, we will move on to Sandy.

Ms ROBERTS — I am Sandy Roberts. I am the general manager responsible for group training and training at CGVT TAFE. We are currently one of the largest group training bodies in Victoria. We employ more than 750 apprentices and trainees. In this region we have 350; we are about to go up to 360. About 60 per cent in this region are apprentices.

Overall we have about 55 per cent apprentices and 45 per cent trainees. We find it extremely difficult attracting school leavers into the traditional trades. That is no news to anybody. In terms of maths and science, a lot of the recruitment really struggles in the electrical engineering areas, so it is a double whammy because it is hard to attract the kids into the traditional trades area, and it is getting increasingly difficult. The ones we are attracting tend to be the ones who have dropped maths quite early, so it is really difficult for them to try to do it in catch-up mode, especially in the first year of their apprenticeship. We have our own training arm that focuses very heavily on trying to assist and give extra support, particularly for the engineering area, which we do our own training in. We rely very heavily on TAFE to provide extra support. They are the areas that are getting increasingly difficult to fill, because it is not just about the attraction, it is also about the fact that the cohort that we are getting dropped maths quite early. Maths needs to go all the way through, and maybe there needs to be a different way of doing it. It is certainly an alarming situation for us. I do not know if I can say any more.

The CHAIR — Before opening up for questions, I will go around the table. It is an interesting point you have made.

Ms SEMPLE — I am Maxine Semple. I work for the Victorian Employers Chamber of Commerce and Industry (VECCI). I am a training consultant there. My role is to work with employers in this region — in central Victoria, actually — to sign up their apprentices and trainees and make sure they are registered, have the relevant qualifications and are doing the relevant training. A lot of what I have found is that — I agree with Sandy — we cannot find people who have the skills to go into the traditional trades particularly. Also I believe a lot of kids at school do not see the relevance of maths and science until they are actually in the work force. They cannot translate what they are actually learning in school to what they are going to do on the job. They cannot see why they need maths to do cooking or engineering or even building. They cannot see the need for it until it is too late, and then they are really well behind.

Relating maths to the practical world — maybe I should not be saying this, but my sister is a maths teacher and has written books on maths, which I have read. I know she is trying to make maths far more relevant, but it just does not seem to be coming through to a lot of kids; it seems they do not feel they need it. Then they get into the workplace and are well behind where they need to be. That is my little comment on it for the moment.

Mr WALKER — My name is Alan Walker. At the moment I am the manager of a small high-tech manufacturing company here in Bendigo. During my chequered career I have been a research scientist at the CSIRO, a maths teacher, and now I am the manager of a manufacturing company. This is just like training. I figure that there are a few different aspects to what we are trying to do in science. My experience has been similar to what other people have been saying. We have found, for example, that for our manufacturing process, for which some knowledge of maths and science is required, we have had to dumb it down so we can say, 'Look, you just do it like this. You are not going to understand why, although you might eventually'.

I find that the university graduates do not know the stuff I learnt in high school. Yet I am also involved in tutoring primary school students in maths, and there seems to be some strange parallels going on with the teachers. They all seem to be quite good at teaching learning and research skills and so on, but they do not actually teach maths. I am putting that very crudely, but I see primary school kids who have great research skills but do not know the times table. It is exactly as you were saying; by the time they start to wake up that it matters, it is too late. I think there are ways of improving the situation, or I would not be here. That is my background.

Mr BRENAN — Obviously as a fairly major employer within the region and also nationally, it is of interest to find out what is happening in education and certainly in the science and maths areas. I think from our perspective within the Bendigo area itself we are quite happy with the quality of the skills coming through with the young guys in the maths and sciences. I think we take the approach that as long as the people have those base-level skills where they can understand and learn once they get on the job with us, then that is what we are looking for.

Carrying on from the point Maxine was making a little bit earlier on, it is important to ensure that what is being taught by our educational system to the students, if they do not want to go on to university and are looking to enter the work force, is that it is practical and helps them make that transition, as opposed to being theoretical where they do not necessarily understand how to make that transition.

Certainly what we are looking at is the longer term, rather than just over the next few years, as to how people gain those skills and use them in an ongoing career, because at the moment we are obviously finding it difficult to source certain roles in regional areas because it is not seen as being a sexy career path for students to think about. That is something that is of interest as well, as to how we promote an awareness and understanding of the opportunities that are available in banking and finance and how that relates back to what is being taught in the sciences. It also goes on to university in terms of what sorts of courses are being taught at university and how is that going to be relevant to industry 10 or 15 years down the track with changes in technology, and then being able to attract people to regional areas with those skill sets.

The CHAIR — That is fairly broad but there are amazing similarities in some of the viewpoints. I might open it up to questions. Can I just say if a question is asked of one person and you have a viewpoint, chip in; that is the easiest thing. Also we have some people in the audience from the education department and the university. If you have something you would like to contribute, I would ask that you just come forward and have a say. Thank you.

Mr KOTSIRAS — You talked about students in secondary school deciding not to do maths or science because they see no relevance in maths or science at maybe year 11 or year 12. My question is: what role can industry play to make students more engaged? Could industry and education work in partnership to actually do something to encourage kids to do maths, to understand why they should be doing maths? Firstly, is there a partnership role for industry and education; and secondly, what should be done to encourage students to do science or mathematics?

Ms BOWYER — Can I butt in there. When I sent the letters out that was the thing I underlined. I thought, being from a working mine up the road, that was the part that interested me, because that is one of the main reasons that we do what we do. We go out to schools, and all the time I come back delighted that it is the boys in the group who are often the ones — and if the teachers in this room have ever taught — with their feet on the desks and who roll their eyes when someone comes in. But by the end of the class they love it. They do not realise that to mine, with rocks and drills and all that, they are going to need maths and science. It just motivates them to think, 'All right, I have got to put in now if that is the sort of life I want to lead'.

A lot of the talks I give, especially for secondary students, are career based. The students say, 'How do I do that?', and are told, 'You need this and this, and you do this'. Then you can see them thinking, 'Yes, all right'. There should be more people doing what we do in all the careers, getting out there regularly. I probably go out three times a week to different schools just in this area, and it really motivates them and inspires them to think, 'Yes, that sounds pretty good'. But that happens especially with the boys. There is a real boy thing, is there not? I think that is the area we have got to worry about, young boys and the early teens. A lot of them just cruise along and, as you say, they get to the time when they need the skills and it is all too late then. We have got to get out there.

The CHAIR — Just on that, Genevieve — or others — what is happening with careers education in schools? Is there an issue here? I am just picking on what you are all saying. I know way back in the past there would have been careers teachers who would have started counselling young people in year 9, and I know there are some private companies out there that do a skill match and then give career advice. What is happening in secondary schools with careers? Sandy?

Ms ROBERTS — From our perspective careers education and selection of subjects, of course including maths and science, go hand in hand, and in the traditional trades area, which is our greatest concern, there is an assumption that it is all hands on, that subjects that are often more challenging, like maths and science, can be

sacrificed. And boys do struggle with them; they struggle with maths and science. There is no correct careers advice saying, 'You really do need those, the whole curriculum, to underpin what you can do, no matter which area you go into'. That is a perception that has to change and change right at years 7 and 8, and even earlier in the primary school years. There is a conditioning going on that you only need the more academic subjects if you are going to go on to an academic career; you do not need them if you are going to go into a traditional hands-on trade. We find that a lot when we go out to schools. There is this mind-set that you do not need it if you are going to dirty your hands, basically. It is so wrong.

I agree that we need to get into schools and have a lot more dialogue and do some case studying about what happens in a number of vocations so that kids can actually understand the benefit. One of the criticisms we get from builders, for example, is that kids do not know their tables; they cannot instantaneously do a calculation — the biggest frustration for a builder. The kids have to manually try to work it out or get their calculator out and rely on calculators, which is very frustrating for a builder who wants instant calculations and measurements. That is not uncommon; it is common right throughout all the trades.

The CHAIR — So do most secondary schools have careers teachers? Are there regular sessions between groups such as we have here and the careers teachers? Do you provide that feedback into the schools?

Cr JONES — I know at Bendigo Senior Secondary College there are three or four people who work in the careers area — that is, only years 11 and 12 in Bendigo at a public level. I think one of the great difficulties that this generation of students face that maybe our generation and older did not, is that they do not have one career to look forward to; they probably have three or four or five. Careers guidance now is far more challenging, I think, than it was where you set someone on the path of being a tradesperson or working in a bank or whatever. They have to be much more generalist now. Students in that age group face huge challenges in being generalists, and whilst they have difficulties I do not think that we should forget the amount of talent they have in things like computers, whereas when we were at school computers were not really there.

I think they face far greater challenges and far greater complexities, and careers guidance is one of those which is really a huge challenge. I have not worked in that area but I know people who have, and they try not to make students too specific because of the world we live in now. They have to be more generalist in their advice. However, surely maths and science would be part of that. If you are going into computers or any — —

The CHAIR — I guess that is what I am trying to get to the bottom of with this question. On TV last night Bendigo Senior Secondary College was advertising that it does VET, apprenticeships in schools and VCAL. There is a lot of vocational emphasis there, and they have a good reputation statewide for that, a very good reputation. But we are hearing here from Jeff that there are substantial skill shortages in the apprenticeships areas and they cannot get kids with practical skills. We have heard around the table that there is an issue in terms of maths-science, particularly with the students who would do those vocational subjects and might go on.

I am just trying to get to the basis of whether or not a bit of tweaking needs to be done here. The status put in place has broadened the VCE, the senior years, to include VCAL and to get more diverse offerings for young people, particularly in those apprenticeship and trades skills areas. But what we are hearing here is that there is still a lacking in the way the subject mix is occurring and the skill mix in those subjects to meet the aim of more apprenticeships in the skilled areas. I think there is no doubt that what you say is true — —

Cr JONES — I was not going to talk too much today, but seeing that I do have experience at Bendigo Senior and I have taught the crucial years 11 and 12 — and I have taught the VET kids and all that — what I think is happening is that you have that cohort who want to be builders, plumbers, electricians and mechanics. Traditionally they would have left school at 13, 14 or 15. Now they are leaving school at 18. I can assure you it is very hard — the point you made is exactly right — to have someone who wants to be a mechanic and you have to try to convince them that the subject you are teaching is relevant. That is the greatest challenge. Traditionally they would have been on the job and would have learned on the job. Maybe we expect that cohort. A lot of these students are very practical and there is a role for them and a place for them in the work force to be hands-on practical people. We are expecting them now to come into the work force and to start sprinting rather than to start walking, where 15, 30 years ago the apprenticeships would have started off at a lower base.

The CHAIR — I understand that. I just do not know how that helps us solve the problem, that is all.

Cr JONES — I think that point of relevancy and that point of linkage, and the fact that industry is becoming far more interested — not more interested, but far more involved, and it has been encouraged to be more involved — is absolutely crucial. And the linkages that we are having through the VET are sort of — —

Mr KOTSIRAS — Is there a coordinated approach from industry, or is it VECCI on its own or Bendigo on its own?

Cr JONES — I think it is coordinated in the sense that it is almost like when you speak to people from different groups; the issues will invariably be the same. I mean, there are different and specific areas and different things, but industry as a voice is telling us loud and clear basically what is being said today.

Mr BOTHE — Career teachers have a very difficult job. There is a Bendigo and district careers teachers association in Bendigo. Each secondary school, to my understanding, has either a part or a full careers teacher designated to do that particular role. But when you look at the complexity of the jobs now that are out there, you cannot expect one person or a limited resource to be able to provide a comprehensive coverage of what individuals need to do at the age of 14 or 15. It is just impossible to do. And it should not rely on the one person. But industry — and Alan, you might cut in over me on this one — really is working hard to maintain industry. Businesses are working on their businesses to sustain themselves and grow. Their ability to go and provide dedicated resources to work outside their businesses on a very time-consuming basis, which it can be, is just not there, unless, I guess, they are a bigger business. Most small businesses need to spend their time in the business to do it. Asking industry to be involved with maybe linking more relevance into the curriculum to their particular side, is a big ask. That is part of the problem.

Another part of the problem, I think, is that there is a lot of part-time work around now. I think Maxine will comment on this one. When kids go through their secondary education and they get to 15, in Bendigo there is a lot of part-time work and they can earn reasonably good money for a 15-year-old or a 16-year-old. First year apprentice wages are a pittance compared to what people working part time are earning. So where is the incentive? You immediately get people looking at, 'Okay, I have got cash in my pocket; I can go out and do things', but they are not looking long term. I think that is probably where the issue really lies. How do you get young kids to look long term, when life for a young person is then and now?

Mr HALL — They are broad philosophical issues.

Mr BOTHE — Yes.

Mr HALL — Can I just pose this question, for anybody who wants to make a comment, to try to define a little better the problem that we need to address in our report as a committee. In your opinion is there a difference in the preparation of students through the secondary system for different vocational areas — for example, like retail, banking and finance? I think you mentioned before, Tony, that your bank was able to secure suitable people with qualifications. I would be interested to know if we are talking more about a lack of preparation in the truly practical vocational areas as opposed to a preparation for careers in areas like retail, banking and finance. Is there a difference?

Cr JONES — I might have misunderstood your question here, but with the cohort that tends to go into apprenticeships, it is very hard to get them to do maths, physics and chemistry — almost impossible. And at that senior level there are three or four different maths streams, and they will be doing the fourth stream, if you want to talk in that regard. They are an incredibly different cohort, a difficult cohort, and maybe they need to be looked at on their own, because I think they can be tweaked.

One thing I was going to say today is that my experience up there was that when I first started teaching there was a cohort who were sitting at the corner of the room and really not going anywhere. What happened with computers is that they were that type of person who liked computers. And there was a distinct group of them. At the start it was quite interesting to watch. They all went into computers and are now driving around in fantastic cars and have great jobs, because their moment came. Does that make sense? They were engaged, and with their personality type or the people they were, they just loved it. I saw kids who one year were really struggling and the next year were still struggling at maths and English but were just A-plus at computers. So they found their niche.

What we have with what we are discussing today are people who really need to have mathematical skills, they need to have geometry and all those sorts of issues we discussed, but it is about how you engage them, because they

cannot see the relevance. It comes back to relevance and motivation. We can take them to the water but we cannot make them drink.

Mr HALL — That is what I am trying to get at. Perhaps Sandy or Maxine, in your areas if you have somebody who wants to do a traineeship — in retail, for example, or perhaps even hospitality or banking or finance — are their maths skills that they are taking from their secondary education sufficient to get them into those vocational areas?

Ms ROBERTS — It depends on the level of technology that the respective employer requires or has in place. If it is very highly computerised and those individuals, those trainees, are able to adapt or take the computer skills they got in their secondary environment into that workplace, then they are fine and they survive. Where they actually have to do a lot of manual calculations, no. Retail requires a fair degree of accuracy. Even with simple little things like change they have difficulty, unless the computer machine tells them how much change they have to give. It is even that basic. So somewhere along the line the preparation is missing. They are not bringing the skills — and maybe it is back as far as the primary sector.

Certainly the way that maths is being delivered in the primary sector is different to the way that it was done 30, 40 years ago. There is less reliance on rote learning and there is a lot more reliance on the visualisation, the memory side. I am not an expert in that field, but I do know that the absence of not being able to calculate even simple things like change, when they are a 15 or a 16-year-old, is a real issue. However, technology has probably encouraged that, too, because a machine will tell them how much change to give. They still have to recognise what they are giving, but it is that basic. I think it is quite sad that we have kids of that age who really struggle with those basic fundamentals that we would have assumed, 30 years ago maybe, a seven or eight-year-old could have done quite competently. I think that is rather sad. We are kind of deskilling in this area.

Mr HALL — Is that your experience too, Maxine?

Ms SEMPLE — Yes, it is. I agree with everything Sandy said. What I also find is that employers, unless they are set up to actually test for maths skills, and the bank would be, they do not find out that the apprentice or trainee is lacking in these skills until further down the track, until they suddenly realise that — the small retail business — the till is way out because things just did not work out that day.

The CHAIR — Have you got any comments, Tony?

Mr BRENAN — I think in terms of the sorts of people you are talking about as a wide spectrum, we only see a very small part of those people who would apply to work for us. So whether we see that depth and breadth of people not being able to calculate using mental arithmetic or able to deal with providing correct change is perhaps much smaller for us — we do not see that. Certainly in terms of when we are looking for people to work, especially in our retail network, we look for a diverse range of people across a wide range of ages, experiences and backgrounds, so in terms of the people we do get, coming in at an entry-level role, we probably get an opportunity to see some who are not necessarily better but more attuned to those particular areas. We are really focusing on a service ethic as opposed to the mathematical skills and so on, because we believe that with the training that we can provide we are able to upskill them with that. What we are looking for in people who are coming into an entry-level role from school potentially is more an investigative mind and a problem-solving approach and a willingness to learn. That is where I see, I suppose, the importance of maths and science as being able to promote that eagerness to learn, apply those skills and continually to challenge themselves, and that is probably a different mindset to what you are talking about.

Ms SEMPLE — There was something else that Sandy said that I was thinking of too. We have been talking about secondary school education. Maybe we need to go back to the primary school education and look at how maths in particular is taught at primary school and the emphasis on it.

Mr WALKER — I agree.

The CHAIR — It will be interesting to see what happens with maths recovery and the intensive stuff that has just started in schools because it could be an issue that students who are poorer at maths in primary school are the ones who are having trouble at secondary school, and it is a cyclic thing. They are the ones that tend to go for the trade option, I imagine. But taking that aside, one of the problems I am having difficulty here coming to grips with is when we say ‘maths’, because we have maths up until VCE, then at VCE we have fundamental maths,

basic maths, maths methods and more applied science kinds of maths with more quadratic equations in basic maths, and then we have the top line specialist maths which is often those who are going on to scientific courses in university.

I assume that most of those doing apprenticeships at that level, will have done VCE; is that pretty much right nowadays?

Ms SEMPLE — No.

Ms ROBERTS — Pretty much.

The CHAIR — A fair few. Is there an issue here with the maths content curriculum as much as students electing to drop out of maths early, because we have got figures that show that something like 85 per cent of young people do maths at VCE, so they are doing maths? I do not know there is evidence that shows that they are actually dropping out of maths at an early age. They seem to be doing it; the figures will show that, certainly at year 11 level. Maybe the type of maths they do is inappropriate to business or to the industry jobs they want. Maths methods and specialist maths, I gather, tend to be a more pure form of maths that link to physics and chemistry and a sequential type of maths. Maybe it is the other sort of maths that is not practical enough in terms of what is needed by industry. Would anyone like to comment on that? Does that make any sense to you?

Mr BOTHE — One of the recovery methods these days being used for kids who have dropped out is more adult learning principles. That is, you do apply it to everyday activities. Whilst I cannot categorically say it is successful or otherwise, clearly the outcomes from those courses indicate a high take-up of employment following those adult courses. Funding is tied to a certain level of outcome, and if they do not get outcomes the providers do not get fully funded. What you see in results seems to suggest that if learning is around everyday occurrences, then the results are better. Taking that a step further for secondary school students, how do you engage businesses to have those everyday activities included in curriculum? That is a difficult one. It would challenge anyone to get that one right.

We have such a diverse industry base in Bendigo, and I guess most other regional centres are the same, I am not sure how you would do it. Maybe our Australian technical college that is coming in 18 months time is going to be part of the answer, because the curriculum has to be developed for those particular apprenticeship areas that get taken up by that. Maybe that is where our future will go through more of those technical-type training areas.

The CHAIR — Is there not a specialist maths that has been developed for students doing VCAL, the vocational courses at VCE? They have more specialist maths located with that.

Ms ROBERTS — VCAL has a maths component but it is very, very basic.

The CHAIR — You think it is too late, do you?

Ms ROBERTS — The point you made earlier was about doing all these maths, and yes, the apprentices that we engage post-VCE, most of them for the traditional trades area have finished their VCE, have done a maths. It is not the top maths; it will be mostly the easier maths, the more fundamental maths. I am not going to make a judgment about the assessment criteria or about their ability to be achieving or non-achieving. Most of them have passes in that subject or in the subjects they have done over their two-year VCE, yet most of them are not quick enough — and a lot of it is speed — or do not demonstrate sufficient problem solving in a mathematical sense to actually achieve in their apprenticeship. They struggle with the study at trades school; they struggle with basic calculations. Maybe it is not the actual method that they do, but it is how they are going about it and the speed at which they are doing it. It is also about the ability to apply the particular method in a range of contexts which they are not able to do beyond the schoolroom. They are just not able to do it.

How do you mesh the industry need, the employer need, which they cannot experience until they are actually in an employment situation, into a traditional classroom? That is a real challenge. Until you can give them the real live thing with their supervisor or employer saying, 'I want you to do this calculation; I want you to cut or work out this particular thing; I want you to design this and tell me what the dimensions are', they cannot experience it. They would not know how to respond in that particular setting. Certainly they are slow. I am not generalising. This is in most cases. They are slow and it is frustrating for the employer. A lot of our hosts want to hand them back.

They talk about gumption and initiative, two interesting words — lack of gumption and lack of initiative. It comes back to their having to spoon-feed, and it comes back to that problem solving, to the speed with which they cannot automatically generate a response, a solution. It is in that calculation, that mathematical sense. There is a dilemma. They are passing maths, but it is not something they are able to achieve and apply it directly in an employable situation. It is a whole process of going right through in maths that is failing them in their ability to then draw upon those skills when they are working.

Employers do expect a lot more. Maybe we are totally out of synch with employer expectations and what is being delivered during those last few years at school. Maybe what is being delivered during those last few years of school is a result of what is not being delivered in the earlier years; I do not know.

The CHAIR — There is a question of whether what we have now is maths geared towards better entry scores. It has been put to the committee that students doing maths methods and more advanced maths are doing it for the points they will pick up to get into a university course in law or medicine or whatever, as opposed to those who want to go on to engineering. If that is what is happening then that really gears the way teachers teach courses and a whole range of factors that happen in schools. That has been put to us at other times.

Mr HALL — A common point that has been made in a lot of the presentations is the need to engage kids and teach them relevant maths and science in their early years and to get them motivated. It seems that a lack of motivation to learn and therefore have the skills to apply is one of the detriments to a successful graduation from secondary school with the skills required.

In that regard would be it be practical or advantageous, for example, Jeff, to get the building industry to put together a course in building maths or maths for building or something like that, and run it through some of the lower level secondary and even the upper higher primary schools so the kids are actually seeing some practical application of learning maths skills to a particular industry? Or it could be mining maths, for example. I know that in the mining industry there are environmental courses that have actually gone out, and I think you said you deliver that in schools as well. What about maths for miners or something like that that could be developed by particular industry groups and actually taught in schools so that kids are seeing the relevance of the skills they are being taught in those particular maths areas — and it could be applied to science as well.

Mr WALKER — It sounds to me that what you are getting at is whether there is some way we can get a meeting of minds at a, shall we say, later level, a higher level in the process. I am wondering whether that can be achieved closer to the foundation in the sense that if the process you were talking about was actually happening at a deeper level so that the people who develop curriculum, or the people who write textbooks, were in contact with the people who need the end result. People can go out and write maths textbooks when they have never set foot inside the door of a factory in their life. People who develop curriculum may also never have set foot in a real-world workplace. I wonder if some sort of awareness raising might be needed there so that the people who design course materials, textbooks and decide the curriculum had a greater knowledge of what the industry needed, then maybe some of the things you are talking about might then be easier to achieve.

Mr KOTSIRAS — But each region might be different. Each region has its own needs. Something may be wrong in a particular region, there might be a shortage.

Mr WALKER — Is that what you are finding?

Mr KOTSIRAS — I am just saying that if you put it into a textbook, you are saying every Victorian child has to learn maths in mining or maths in building. I think what Peter is saying is it should be made more relevant to the student; to make the student understand by learning maths how maths can be used in mining or building; and perhaps they can go on and do maths at years 11 and 12 as well.

The CHAIR — It is an interesting point — for instance, in maths methods you will be able to use CAS calculators in exams in the next few years. CAS calculators are basically mini-computers for doing quadratic equations. To do the equations you just press a button. That will undoubtedly change the nature of maths courses, just as normal calculators have. I wonder whether the industry has been consulted on that. Certainly Texas Instruments have put money into new textbooks et cetera, and I wonder if there has been much discussion within the industry on issues such as that to make them relevant. Your point was that there need to be greater linkages but the world is moving pretty rapidly and I do not know that it is happening.

Mr BOTHE — Can I say to that, and we experience it in our offices, when systems go down you are still expected to work. What is the backup? If you rely on a calculator or an advanced computer or an iPod or whatever, you have to have the skills to be able to do what you have to do.

Mr KOTSIRAS — You need to understand what is happening. All that equipment does is let you do it quicker, but you should be able to understand the theory behind why you are pressing in those numbers.

Mr BOTHE — That is right. In respect of your question, Peter, the practicalities of having more applied maths learning or examples can be attained. It does not matter what region you are in, you can make it relevant by having a cross-section of examples within the curriculum to give you that. Mining was not an industry in Bendigo three or four years ago, so we might not have had anything relevant to mining. But now with Perseverance Mining, Bendigo Mining and now AGD down at Costerfield we are probably going to have 500 or 600 jobs we did not have four or five years ago. That is why anything we teach has to be responsive to change that takes place. You cannot go down a single line; you have to have flexibility.

Mr HALL — I suppose I was thinking more along the lines of utilising someone like the minerals and energy council, the overarching body for mining. It develops a lot of good programs in environmental areas for delivery in schools and to sell its message on environmental issues in the mining industry, but it probably does not tackle the maths and science. I am not sure whether it has a recruitment program, for example, that it can run through schools. I suppose my suggestion related to whether through industry bodies there could be development of the curriculum in the maths-science area that would help engage students and ultimately better prepare them for a career in that industry at the end of the day. It might be the Building Commission that develops it, or it might be VECCI. I think VECCI has been involved in developing some programs for schools in the past.

Mr WALKER — I think it would be very valuable if there was some process that ensured that industry groups had some input into developing the learning materials that are used in schools, the textbooks, the exercise students have to solve and the design of the curriculum. By the time a teacher gets in front of a class it is too late because the job is overwhelming. How do you go off and look for an example? No maths teacher is going to ring up Bendigo Mining and say, 'What do you need?'. It has to be already there in the materials they have to use — for example, the mining council, all sorts of things. It can be embedded into the curriculum material so that in a sense it almost becomes natural; it is not something you are grafting on and saying, 'Today we are going to do some stuff that is relevant to the mining industry'. It is just there. Are we on the same wave length?

Mr HALL — Absolutely. I am a former maths teacher. I know, for example, when there is a link to the Commonwealth Games you develop a theme for teaching around that. But I did not develop any themes around particular industry groups. You teach Pythagoras theorem and then there is application in the building sector or the roof trusses you were talking about before, Jeff, that could well be applied. But as a teacher in a classroom I agree with your comment, Alan, that you do not have the time to construct the learning units around a theme which might lead to better outcomes towards a particular vocational orientation.

Ms BOWYER — I think more in the primary sector there is a big emphasis on all that hands-on learning. That is the big push now, to do it that way. The Olympic Games or how to build a house or let's build a paddock and put fences around it, that is the real push. But once they get to secondary it is all over. It is year 7, get out your book and let's do it exercise by exercise. I do not think they have the time to sit and get that good stuff in, which boys love — and primary boys love building fences and paddocks and working out the area and whatever they need to know. Once they get to secondary school that all changes; it becomes very bookish and, like you say, they have to get the marks to get their VCE. If they do not want to do VCE or go on to university they ask, 'Why do I want to do this? It is not even interesting. Why do I want to get that mark?'

The CHAIR — I represented the Premier on an R class 707 steam train which had an engine of 198 tons, plus seven tons of coal. It went from Melbourne to Bacchus Marsh. Of course, at Bacchus Marsh the old steam engines needed to turn round, and most country towns have a turntable. Two people turned that engine. There were about 30 tons on the turntable, plus the 198 tons, so you are talking about 240 tons of machine turned by two people. It is not something that I had really thought about, although I did applied science. It is all about how fulcrum works. Those platforms work on the fulcrum principle. The train has to be absolutely level. When the track starts rising at either end, it is balanced and they just swing it round.

I have always thought that they worked on some sort of pulley system, or just normal weight, but they all work on the fulcrum system. It struck me that if you were trying to teach how a fulcrum works, you could never think of anything better than having the 200 tons-worth of machinery in a steam train being swung around by two people, even if it is once a year. That was quite powerful for me. It really shows how something works and adds relevance to it. I guess that is the sort of thing that you are talking about.

Ms ROBERTS — Orbost Secondary College had a brilliant model of that kind of thing; they had a foundry. They had some year 9 and 10 kids who really struggled with maths and science and the whole curriculum. They brought in a foundry in which they were designing an ancient bell. They had to use some pretty sophisticated mathematics to get the right calculations for the bell. It was a foundry and they were doing it hands on, but the kids were doing the calculations for the bell — and it was brilliant. That was about two years ago, and those kids got really engrossed with mathematics. It was a brilliant model. That would be the type of thing I could see really assisting in that re-engagement — because it is about the re-engagement of these kids. They might be still doing maths, but they are not passing it, or they are barely getting through and not really understanding. But that was a really good model that you could look at.

The CHAIR — We will have a look at that. I will now call Neville Davies, the science project officer from the education department.

Mr DAVIES — The reason why I have made my way to the table is that when you were discussing the issue of relevance, the gentleman who was up here, but who has left, was pushing it as well. It is really fundamental. One of my roles is to provide opportunities for professional development for teachers. The partnership links component of getting teachers to see the relevance of what they are teaching in relation to the industry is the sort of thing the professional development that I am trying to encourage is aimed at. The sort of thing that Bendigo Mining does is an example of trying to get this industrial experience into schools and making it relevant.

In the next four or five weeks groups such as minerals education, the department that Peter was talking about, CSIRO, Swinburne University in relation to its space program, will be running professional development for teachers in Bendigo. Obviously the idea is that the stuff that the outside groups provide is put into a context that teachers can bring into the classroom. Of course one of the problems with that is that while it is really entertaining and relevant to teachers, you do not get all the teachers there. Also, while it is relevant to what is being taught, it is not necessarily relevant at the time when teachers are teaching a particular topic. So we really need to get larger numbers of industrial groups to create the opportunity for this sort of professional development, but we also need to be able to get teachers to the forums where this professional development is being provided.

One of the problems is getting the teachers there because it is generally run after school and teachers cannot make it for all sorts of reasons — they are tired and it is the end of the day. If you try to run it during the day teachers are teaching and they do not have time to experience anything other than what they are doing in the classroom.

The point I am trying to make is that there are industrial groups which have very appropriate course materials that teachers are taking up, and the minerals ed department is one that has great stuff. But we need to have a system with greater partnerships between the education department and industry. I imagine that the way to do it is to provide some sort of funding to encourage it. Businesses do not have the funds to give their workers time to work with education groups. Funding has to come from somewhere, so maybe there should be an investigation of where that funding could come from to allow that liaison to occur.

The CHAIR — That is a whole issue in itself, that is for sure, Neville.

Ms BOWYER — Can I tell you how we run it through minerals ed? We are connected with minerals education which gets a bunch of teachers — only 30 from all over Victoria, so it is a handful — and they go to all the mines. They to Stawell and Perseverance and they get an afternoon with us to look around. But even that is fairly valuable for them, and they are able to take away resources. But you still only get a tiny group. They come in the school holidays; we had them a few weeks ago.

Mr HALL — So that is teachers?

Ms BOWYER — Mostly secondary teachers.

Mr HALL — Do kids get the opportunity to look at Bendigo Mining?

Ms BOWYER — We are just putting in a processing plant so we are not letting anyone in at the moment, but normally the answer is yes. They catch a bus up, come in and have a look from a platform. We take them around and that sort of thing. Our other problem is that there are huge safety issues. They are all given hard hats. I am terrified the whole time they are there, but it is the only way to get them in. I have a bit of a thing about boys, and in the upper end of primary and early secondary, if you do not give them some idea of why science and maths are important, you are going to lose them.

Mr HALL — I went underground through your mine 12 months ago and I thought, 'If you take any young kid down here and show him what you are doing underneath, they would be absolutely rapped and you would have them for life'. They would go back to the classroom and think, 'I want a career doing that'. So the exposure to the industry — —

Ms BOWYER — They do science awards up here as well, and we take the top 9 or 10 science students for an underground tour. But still it is only that small batch. It would be fantastic to take a bigger group, but it is not really practical. That is why we go out to schools with a lot of our stuff.

The CHAIR — Can I just go into a completely different area. The world has changed rapidly. We keep going back to the past when kids left school at year 9 to do an apprenticeship to learn the skills on the job. In many ways that is part of the point that Neville was making. Then employers took a greater responsibility for the more generalist training of young people because they started a lot earlier. They now come in at an older age and perhaps there is not quite the same ethos running through. That might be wrong, but that is not my point. My point is: are the apprenticeships in traditional trades in electrical, mechanical and engineering at higher skill levels now than they used to be? Has technology had an input? Has industry changed so that you need higher skills than in the past when kids might have been more genuinely hands on? Has there been a change in the nature of apprenticeships, and the sorts of skills covered by the trades?

Ms ROBERTS — The automotive industry has seen the biggest change. It is a lot more highly technical now. The mechanical side is a lot more complicated. Computerisation is really abreast the whole automotive spectrum.

That is one that has had probably the most phenomenal change. The engineering and metal fabrication fitting and turning machining is highly computerised, but the basic apprenticeship skills are not that much different to what they were 50 or 60 years ago. The principles are all the same. When they move beyond their apprenticeship, the industry is also very diverse. You have your small SMEs that have older types of lathes and other tooling equipment, and then you have your ADIs that have the absolute state-of-the-art highly computerised equipment. A lot of industries are like that. The printing industry is also like that. You have one end of the spectrum to the other. Nevertheless the apprenticeship component and the trades school component that they go through teaches the basic skills, and then they move into and learn the computerisation beyond their apprenticeship, or in their fourth year and beyond. The skill level and the trades school level has not changed dramatically. It is more highly skilled to some extent with computerisation.

The CHAIR — I was just wondering about the point that was made earlier that the kids who are going into apprenticeships are the traditional kids that dropped out of school earlier but who tend not to be academically motivated, to say the very least, whether there is not now a case that part of the problem is that you need students who have a higher level of education because of the nature of apprenticeships, or that the industry has changed. I was just trying to tease that out.

Ms ROBERTS — I think the demands of industry have changed. It is much quicker; it is just in time. So the output and productivity has increased. The expectations and demands on the individual apprentice are much greater, I believe. Stress levels are much higher than they were a few years ago, and it is getting tougher. So they might be two or three years older — I do not believe they are any more mature — than what they were 30 years ago when they were finishing form 4, which was kind of like the benchmark then, not year 12 now. But what has happened is that because of the demands and pressure, there is absolutely no tolerance for error. Margins are at the thinnest of business. There is no acceptance of even a first year or a second year being involved, and that is another aspect. Because the tolerance and margin for error is so much slimmer, small businesses cannot afford to have a huge amount of scrap and waste, so therefore they often do not give the exposure until the third and fourth years,

and sometimes their trades schools often are misaligned with the kind of work they are doing. That is another issue that I think is beyond your brief.

The CHAIR — Is it fair to say when we hear industry here today say that there are students who do not get the skills or the practical understanding or the approach, that there has been a bit of a change in terms of the workplace and that employers' expectations have risen a bit to what they were probably 20 or 30 years ago because of the nature of the business nowadays?

Ms ROBERTS — Yes.

The CHAIR — Is that a fair thing to say, or do you think that is wrong?

Ms ROBERTS — It is, but you are still taking a cross-section of employers.

The CHAIR — Do you think it is true?

Ms SEMPLE — Taking a cross-section of employers, you will still find a lot of employers who are quite happy to take a 15 or 16-year-old if they can get them, but the push is for 15 and 16-year-olds to continue on at school, to attempt VCE, quite often fail, unfortunately, and then go into the work force, by which time a lot of employers feel they are too old to start them off on the basic training. They really want them at 15 and 16. They are happy to teach them. They are a bit like the bank. As long as they have the right attitude and they want to learn, they are happy to teach them. But as far as the skills in a lot of industries are concerned, once again from talking to different people, fro example, in the electrical industry a lot of it now, apart from the house stuff, is pulling a part out and replacing it; it is not repairing.

I work a bit with railway signalling. The old railway signalling apprenticeship used to be a part of a fitting and turning apprenticeship, so they actually made the components that they were using. Nowadays it is nothing like that. It is all electrical. If something goes wrong, you pull the part out, you mark it as faulty.

It is actually fault-finding more than an electrical apprenticeship, and this is happening in so many more industries. Plumbing is still pretty much the same, but I know also a lot of employers that are happy to take people who have done a pre-apprenticeship course. They really like the kids leaving school doing a pre-apprenticeship course. They get a bit of knowledge and then go into the industry, but sometimes the TAFEs do not have the places for them.

Mr HALL — That is an important point you make because sometimes if you look at a specialisation in industry nowadays, it is virtually impossible for a classroom teacher, teaching a class of 25 kids, to identify the exact skills that those persons need. I look at, for example, Australian Paper, a major paper manufacturer in my area, and the skills that the operators require now to operate those paper machines. They are very particular people, but they are fault identifiers, essentially. They go and address things. You cannot possibly teach those sorts of skills in a classroom, but you need to teach the basics so that they have those essentially basic skills to go out and further learn in the workplace. I think your point about encouraging kids to stay on and complete year 12 is a very valid one. I know when I was teaching I would much prefer to ensure that a kid got a successful job; that was more important than actually completing year 12.

Ms SEMPLE — I agree very much.

The CHAIR — I agree with David's point, though, that you have six or seven careers nowadays.

Ms SEMPLE — But there is nothing to stop kids. They go into an industry; they may do an apprenticeship — and we see this with a lot — and when they have done the apprenticeship, completed it, they have worked in the industry for a number of years and decided to move on, and they go possibly into another apprenticeship or back to school. The TAFE motto is lifelong learning.

Ms BOWYER — But if you are 16 and you hate school, why stay? There is no point being there. They should get a job.

Mr BOTHE — A lot of our business leaders have done apprenticeships as a first basis, and they have had a change of career and gone on to other things.

Ms SEMPLE — There is research being done at the moment — just on Jeff's point there — when the bureau of statistics asks what qualifications people have got, and it is usually the highest level. They do not ask what is underneath it. There is some research being funded at the moment through the Australian Research Council to find out what qualification is under those high level qualifications, which really comes back to a lot of small and medium-business owners who have done their bachelor of business, or whatever, or up to that level. What other qualifications have they got? It is turning out that a lot of those have actually done apprenticeships. They have dropped out of school; they have done apprenticeships. They have thought, 'I love this industry', moved through it, started their own business. They went and did higher qualifications so they knew how to run their business, but their basis is an apprenticeship.

Mr HALL — I was going to ask, in light of some of the discussions we have just had, is there any view about the Australian technical college that is proposed to be developed here in Bendigo, and whether that will lead to some better outcomes in terms of industry preparation for people in the Bendigo region?

Mr BOTHE — As long as the curriculum is appropriately developed for those particular streams that they are aiming at. That is a key. Industry has to be the leader in that.

Mr DAVIES — Absolutely.

Mr BOTHE — I was trying to see what reaction I would get from education. Industry, to do that, really has to change its thinking and be able to commit time. What I said before is they are working very much within their business to help their businesses survive, and I guess that is a challenge for manufacturing — to get people involved in those sorts of initiatives. It is being led by probably one of our strongest industrialists in Bendigo now anyway — the local technical college — so we have a good start, but we have to get other businesses in behind it. It is critical and it will make a difference because as soon as you get credibility in a particular line of education, it is leading somewhere. It will take a while to build. It will not happen overnight. It will become a strong pathway.

Let us give credit where credit is due. I think the VET programs at Bendigo Senior Secondary College and the support from the junior secondary colleges by introducing year 10s to some of the VET programs that lead into the secondary college, is a fantastic achievement in an arena that has been very difficult to get change, and they need to be given credit for helping start that push, too, and now the Australian technical college initiative will happen in this area as well.

Ms ROBERTS — Can I just add to that that Bendigo Senior Secondary College is probably one of the most proactive secondary schools in vocational education across the state in terms of what we are trying to achieve, and exploring those cross-sectoral links. We have 60 skills-based new apprentices, the majority of whom are doing their schooling in a combination of integrated and non-integrated as part of the VCE at the moment. They are very good in releasing them from school in a creative, innovative way. They are very, very good at trying to integrate in a generalist versus specialist, and that is a real challenge because they are trying to teach a generalist VCE curriculum, but you have kids who are doing a range of skills-based new apprenticeships in a variety of vocations. We are trying to push traditional trades in that area as well, which is a better way of trying to ease the transition of getting kids from school into an apprenticeship. They are very proactive there.

The ATC is probably just going to enhance that model even further for this region, and it will benefit and move on from that. Whether or not we are going to get talented kids, which was the policy statement by the federal government — to get 300 talented kids into that — there is a good question about what is talent. It is really about trying to actually get that better model; of trying to actually make it more realistic about what they are doing as part of their study versus what they can achieve as their first vocation.

That is another issue as well, that we do not give kids the career transition education — I think is the best term I can call it — because careers are going to change. Forty years ago it was a career for life. Those of us around this table, I suspect, have all taken on many different careers. We do not teach that to our kids, about how to move from one to the other without having large chunks of unemployment in between. It is those skills as much as anything that we are not delivering, but that goes beyond maths and science. It is all part of that total packaging about how you the mix the generalist versus specialisation.

The SBNA structure is a brilliant structure, but again they still do their trades school quite distinct from their VCE studies, and it is all done in chunks and blocks. They get released to do certain things. There is no real cross-meshing going on because the various trainers, whether it be VET, secondary or the employer, do not have

the mechanism to develop an individual curriculum to meet that individual need and employer need as they move through their two years of VCE. That is a real challenge. That is probably the closest model you have got to try to integrate and promote that cross-sectoral learning.

The CHAIR — On the moving through careers, if someone does an apprenticeship in the electrical or engineering area, how do those knowledge and skill levels at the end of the apprenticeship compare to say a first-year university course in engineering or electrical engineering, that sort of thing? Are there comparisons there? It has always surprised me that there is not more RPL going on or more credit from apprenticeships directly into tertiary. Sometimes there is at the TAFE, like a diploma, but there is never any into tertiary. Are there any similarities there that you are aware of, or has no-one ever really mapped it?

Ms ROBERTS — There is no mapping and there are no real stepping stones. It is kind of like you come to the end of the barrier. I guess that is why a lot of the successful business people who have done an apprenticeship have then done a business or masters degree later on in life, but there is no stepping stone at all. In some vocations they will move into a diploma and that may give them credits into a degree.

Ms SEMPLE — But that is not in the traditional trades. The traditional trades, the certificate III is the apprenticeship. Once you have that you are fully qualified, and what you do after that is up to you.

The CHAIR — Given what you say about the nature of change of industry apprenticeships, diplomas and degrees, it would be an interesting exercise to do a mapping exercise of knowledge levels.

Ms SEMPLE — This research that is going on, when the results come out from that it will be very interesting.

The CHAIR — What research is that again, sorry?

Ms SEMPLE — It is through RMIT and, I think, AIG. It is from a grant from the Australian Research Council. It is just looking at the underpinning qualifications that business people have. That is part of it. What they are doing is studying a group of university graduates and apprentices graduates who have left RMIT, and I think they are doing it over a 10-year period, to see exactly where these people are now, and also what income they are bringing in. Apparently the early research is showing that the people who have done apprenticeships are now bringing in more money than university graduates; they are on a higher wage. They are also looking at where the apprentices have gone and where the university graduates have gone. I think there is a study group of about 100 of each. It was in June when I heard about it.

The CHAIR — It sounds interesting. I know my cousin, who is a multimillionaire, was kicked out of school in year 9. He did an apprenticeship; he was kicked out of his apprenticeship as well; that is not a good example. Jeff, you were talking before about wage levels and the impact of people starting an apprenticeship at 18 — notwithstanding what has been said — who are getting much less salary than those doing part time. Is there a case for either governments to re-look at the subsidy scheme and perhaps look at subsidised wages? We subsidise training, employer incentives and a whole range of things, but if there were an issue of salary or wage level at that key impact time of where people decide what they want to do, maybe there is a case to look at.

Mr BOTHE — Certainly, for first-year level apprentices there is a time to review that commencing wage structure. That was set up for 15 and 16-year-olds, now we have 18 to 19-year-olds; it is just out of date. The line of argument that we use to try to convince young people to take apprenticeships is, 'Just imagine you were doing first year at university on Austudy; it is the same sort of thing. You are working and studying; they are studying at university; it is equivalent to that. It is starting to form the base from which you can do a career'. But it is really difficult to get the really good young people into apprenticeships with such a low incentive.

The CHAIR — I guess that is my point. There are two ways you can do it. You can do it through industrial negotiation, but it is pretty hard to raise salaries substantially for apprentices. Many employers who would say that they do not get much productivity out of them and that is why the salary is based so low. That is why I just asked whether there is a case to have a look at, in key specialist and shortage areas, wage subsidies for apprentices.

Ms SEMPLE — Centrelink has brought in access to the youth allowance as a top-up for any low-paid apprentice or tradesman, no matter what age. If someone goes onto an apprenticeship in their thirties and they are

still only paid first-year apprentice wages, they can apply to Centrelink for a wage top-up through the youth allowance.

The CHAIR — Does that take it to a substantive level? How does that compare.

Ms SEMPLE — I do not know; that only came in a month ago.

Ms BOWYER — You certainly cannot expect employers to pay a lot of money for first-years. We pay to go to university, do we not? They do not pay us.

The CHAIR — That is not really part of the terms of our inquiry. I was thinking that if you have a problem it is better to try to look at the solutions.

Ms BOWYER — You will get so many people who will not take them on if you do that.

Mr BOTHE — In essence when you look at the apprenticeship system it has not had an overhaul from many years, to try to pick up some of these issues.. The technology that has now come on board has made training much different and their respective of what trade you refer to, I think you will find that a first-year apprentice is not a liability. They do in actual fact produce a lot for the employer in a whole range of different ways. I guess if you are asking them to stay at school for an extra couple of years and if they have invested in themselves to do that, but there is no reward or my recognition of that by either party in taking on board and 18 or 20 year old as against what was happening when we had basically no technology and basic equipment, who started their apprenticeships by sweeping the floors. There are not too many who start these days on that basis.

But from day one you expect a young person to be not a liability. You expect them to start learning and be productive in a short time.

Mr WALKER — Yes, and it's not just about trying to make a buck because we have to look at the long-term now, particularly in business, but it is also about motivating a new person. If they go home at the end of their first day of a new job and think, ' I've done something useful' that is tremendous motivation. That is one of the reasons we do it although we do not have apprentices at all.

Mr HALL — It seems to me that when we talk about skills to move into industry employment, in some of the areas — particularly in your area, Alan, where you have high-tech manufacturing — I sometimes think that now kids for many years have had access to such things as Lego, Lego-technic and Lego-robotic, and I have had access to computers for probably 20 years or thereabouts, all the electronic devices that kids are so clever at, in doing programs and things like that, doesn't that help in terms of their development of skills to come into a vocational areas such as yours and in other trades as well? I would have thought the analytical skills required to solve some of those Lego problems would help?

Mr WALKER — I think there is a peculiar type of mismatch, that you get people who are extraordinarily good at some things and extraordinarily bad at others. It is half the joke but it is also half serious to say it is easier to hire somebody who can program a robot to do up a bolt that it is to hire somebody who can do up a bolt.

Mr HALL — One of your opening comments was that the kids that you have access to often have good research skills, not do not know their 12 times tables.

Mr WALKER — Exactly.

Mr HALL — Is that your sort of experience, that it goes back to that basic fundamental point about giving change to a customer, making an estimation or doing basic maths tables?

Mr WALKER — Yes, and that is an example of what I am saying. It is a peculiar mismatch of people being very good at some things but being very bad at other things. The really basic, boring skills are often inadequate and often with the glamorous stuff, they are often way beyond what I have ever hoped for. I had the case of somebody who had done two years of tertiary education. I asked him to calculate a 1 per cent change in a 1000 gram batch of material, and he reached for his calculator; he just could not do it.

The CHAIR — I somehow think we have got more questions than answers from this session, but we will keep pondering the issue. Thank you for your attendance.

Witnesses withdrew.

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

EDUCATION AND TRAINING COMMITTEE

Maths and Science Evidence Committee

Inquiry into promotion of maths and science education

Bendigo — 1 August 2005

Members

Mr S. R. Herbert
Mr N. Kotsiras
Mr P. R. Hall

Chair: Mr S. R. Herbert

Staff

Executive Officer: Ms K. Ellingford
Research Officer: Mr A. Butler

Witnesses

Associate Professor V. Prain, interim head;

Dr S. Tobias, lecturer; and

Dr B. Tadich, lecturer and course coordinator, School of Education, La Trobe University.

The CHAIR — The committee welcomes La Trobe University to the public hearings of our inquiry into maths and science education. In particular we welcome Vaughan Prain, the head of the school of education, Steve Tobias, the deputy head, school of education, and Barbara Tadich, the bachelor of education coordinator LTU. Welcome and thank you very much for giving up your time to discuss maths and science education with us. We understand what a terrific job La Trobe is doing here. We also understand that the Bendigo education community has a multifaceted approach to education, but also has vastly different cohorts of students and socioeconomic backgrounds, so the whole issue of maths and science education and how you meet the needs of quite a diverse range of students is critical to this area. Vaughan, you might like to start off with a presentation and then we will open up discussions.

Assoc. Prof. PRAIN — I will give just a very quick overview and then Steve and Barb will expand on points or answer questions. This has been a issue for a long time, has it not — science and maths in our schools? It is as though we have had 20 years of inquiries looking at the problem, the challenge. The problem has been to have meaningful and powerful learning experiences for students in primary and secondary schools so that they want to continue with the study and go on and do tertiary study, or even want then to teach it, so that we have a pool of repeated expertise in terms of positive science and maths experiences.

The problem in primary schools is that the teachers have very good pedagogy but they do not have much science knowledge; and in secondary school that gets reversed where there is a strong content understanding by the teachers but perhaps a reductive pedagogy. We think at La Trobe that in a whole range of ways we have come up with some productive ways of addressing the challenge. It is a challenge for all states, and it is probably a challenge for the western world, to have a meaningful and effective science and maths curriculum, but we think we have come up with a whole range of strategies and approaches. We have lots of expertise in terms of teacher preparation and teacher professional development. If I could just briefly talk about one thing I know about, and then we can consider some other areas.

I am currently involved in a national project that seeks to link primary teachers involved in teaching literacy and science — 100 teachers; 50 schools across the country. What we know is if this professional development program is to be effective, we need a strong focus on the teacher knowledge required; timely support for the teachers in learning about these particular topics; and they need time for professional support in the introduction to the program and in follow-up. What we have found in the year of trial this year is that there has been a significant increase in the participant teachers' perception of competence and confidence in teaching science in primary school. It is possible to have a significant science primary experience if you provide sufficient support. We are not building on long, strong traditions, as we all know from 20 years of reading the reports, but if we have programs where there are clearly devised guidelines and support for teachers, including curriculum materials, then you can have very strong positive effects. This is just one example where I would say it is possible to influence the quality of the science learning experience in primary school for the children and also for the teachers.

Devising a national program is a challenge because you have to have something that is meaningful to Aboriginal kids right through the spectrum of different learner groups. When we were trying to have a program for preps to learn about the weather. We know some schools have got a weather station on top of the school and 4-year-olds can produce their own CDs, versus context, where the weather is cloudless every day and there is not much opportunity to experience a wider range of understandings of the weather. We are well aware that learner diversity is a challenge in having effective programs but it is possible to produce material that works. That is just meant to be an overly positive view about things that can happen, but it requires planning and strong teacher support.

The CHAIR — Thank you. Dr Tobias or Dr Tadich, would either of you like to add to that?

Dr TOBIAS — I think one of the challenges that we face is that of the students who enter primary teaching at the university, one of the concerns is that often they are from an arts-humanities type of background, as opposed to a maths-science type of background. Generally speaking about 75 per cent are female, and generally speaking most of them fear mathematics or have some sort of anxiety about mathematics.

In primary teaching it is not so bad. We have got four years in a four-year degree to actually influence their content knowledge, develop a pedagogical knowledge and also address some of the effective things like the fears and anxieties about mathematics. I think we do that in a very proactive and positive way to the point where they do leave and become engaged in actually teaching mathematics because the last thing we want is for them to leave the university and avoid teaching mathematics, or avoid teaching the hard bits about mathematics like fractions, long

division, algebra or those sorts of things. It is easier to teach small bits of mathematics, but it is another thing to engage in the more difficult parts of mathematics.

In secondary teaching it is a different kettle of fish in lots of ways because we have got, as Vaughan said, experts or so-called experts with a content knowledge well founded — it may be in a bachelor of science or associate sort of degree. Then we have got one year — and in fact it is not really one year, it is about 26 weeks — to really influence their thinking. These student teachers that we have coming into the university have never generally struggled with learning maths and science. They do not know what it is like to find it hard. They are generally algorithmic thinkers, people who can think in patterns and regurgitate knowledge and understandings in tests and then — like me because I was one of them — forget it, and we know that that is the case. They were not learning to understand, they were learning to pass a test. This is a flaw in the system, we believe. We have got 26 weeks with the secondary school teachers to influence their view of mathematics and science and hopefully broaden their view to see that there are other types of learners — people who do not actually find it easy to learn mathematics.

That is a challenge for us and often. One final point is that they do not really understand the mathematics themselves. They are good rote or memory learners who can regurgitate this knowledge, but when you scratch the surface, you do not have to dig very deeply, as I have proven many times, you find their understanding of mathematics or science is at a very slight level.

Assoc. Prof. PRAIN — Which probably has the immediate corollary that giving them more of that experience will not address the problem, because there is often perhaps a view that if we just give them more top-up in a particular content, understanding that somehow will translate to more effective learning and engagement in those subjects.

Dr TADICH — In support of what Steve said in science, I think they are even more phobic with science. Our first approach is to open up their beliefs about their understanding of science and how they feel about science, to get them interested in science. We approach it from that and we bring in the content through a more negotiated curriculum to start off with. In many ways we had already started to respond to VELS through an integrated approach. We have a school-based project which we do in the very beginning. They do not start science education until second year, but the very second week they start that they actually go into schools and teach science. That has had a very positive result both from the schools and from the students. The students come back — I would say 99 per cent of them — thoroughly enjoying science and the schools would like more of it because when we get into the primary schools, the primary schools are not actually teaching science.

That is a really positive outcome because they begin to understand you do not need to know chemistry, physics, biology and geology in depth, and they come back and understand young students absolutely adore science. So we do it from an inquiry base and we bring in a theme, and then we go and research the content to give them a basis of confidence. We bring in the discovery centre and use it when we can. Last year we used an assignment. We have a developmental aspect to our assessment across the four years and last year we used an integrated approach with the discovery centre to allow them to see what it was like to use a science centre so when they go into schools they are prepared to use the science centre and know how to follow up with it.

My own research, if I could bring it in here, which I have just completed, was looking at middle years mathematics, researching and collecting data about middle years maths teachers in the schools in this region as far as Echuca. Something like 68 per cent of them had no maths training at all. They had not done any maths since their own secondary school, even though there is an assumption in the schools they do a bachelor of science and therefore they can teach maths. This a two-pronged thing — they go into the schools thinking they are going to do science and they finish up with maths. They resent that to begin with and then they feel absolutely lacking in confidence. Steve and I are working hard at that. We have volunteered our time. Some of that is through grants that schools have got and some of it is just because we care. We go out and help these non-maths teachers. Last Thursday we covered the topic of fractions — we connected the theory to practice and we did it from a maths ed approach.

My other research is with middle years — what students want and what teachers want and the mismatch there. We are trying to connect the gap. With students particularly, the more you introduce them to how they learn, the more they want to learn and the greater their achievement. We are covering the effective and cognitive domain; we are looking at the beliefs of students and teachers and are trying to fix the mismatch there.

The dip. ed. is a difficult one because they come in and there is a sense they know how to teach. I support Steve fully there because when they get into the schools they are just textbook driven. If you look at the students' beliefs, that turns them right off.

The CHAIR — Thank you. That was very good and on behalf of the committee I thank you for your submission. It was a very good submission in terms of what is happening. There seem to be exciting things happening in your faculty.

I was pleased to hear that you think maths content is important. I know of a faculty of one of your competitors, I guess you would say, which teaches its primary school student teachers that you do not need to understand maths, you just need to know how to teach it.

Dr TADICH — We do not support that.

The CHAIR — That is a strange approach, I must say, and one hopefully after this inquiry they might change. One of the things that begs the question, and I will just deal with maths first off, is how what students are learning is appropriate to them later on. We have had a number of industry groups here earlier that said one of the major problems is with maths as opposed to science. In maths a number of students do not appear to have basic content knowledge particularly in the junior level, or a practical understanding of what happens in terms of doing maths in school.

That can be summarised into they seem to be good at inquiry learning and researching but in maths you still need basic content. They do not know their times tables — I guess that is one approach. The other thing they would say, or what seemed to be coming through, is that they get turned off maths because they cannot see any practical application to it. What do you think of the relevance of those comments and how do you address those issues in your teacher education?

Dr TOBIAS — It is an interesting dilemma and it is one mathematicians have with maths educators, and there is a difference. You can have a pure mathematician whereas a maths educator is a person I would define as someone who knows the content but more broadly understands the pedagogical strategies you could use to teach that content and an acute awareness of how kids learn — the psychology of learning. The packages of a mathematics teacher educator, or any other curriculum area, would be centred on those three things. Barb and I often use this sort of model. Actually when you make that model explicit with experienced classroom teachers who have been teaching for years and years and who forget the game is about understanding the learner, and that is where your starting point often is — the psychology of learning — they are set back. When we point out some of the issues of the psychology of learning and identifying kids' needs and things like that, they do not actually understand it.

The CHAIR — Because they are caught up in the content of the curriculum?

Dr TOBIAS — They are just focused on the content. Our firm belief, and I think you have identified it, is that nothing succeeds like success in mathematics. We can all enjoy mathematics if we only do the easy bits, but it is when we do the hard bits and get through algebra or fractions or whatever, and learn and understand, that it is real empowerment. That is how I approach maths education with my students — to not avoid it, to face up at the university to their own personal issues in teaching it, address any concerns they might have and through that build on the strategies and understanding. Often I find that then they want to go and learn the stuff. It is not me teaching it. They are coming to me and asking questions, 'How do you do this, Steve; how do you do long multiplication?' They are not frightened. Do not forget a lot of these people are anxious about maths. All of a sudden when they have that sort of orientation they want to address their inadequacies. They understand teaching is a profession and they need to be able to go out and do their job as best as they possibly can. I illustrate this a lot — there is nothing more humiliating than being pulled up by a grade three student when you cannot answer a question. You cannot just fob it off, can you? These little kids just keep coming back. You have to know your stuff and treat it like a profession.

Assoc. Prof. PRAIN — When you are doing that work with teachers, it is not just teacher preparation, it is professional development of an ongoing need.

Dr TADICH — Can I offer something here? Steve and I do a lot of work with rich tasks and problem solving. If you go into the junior and middle years, there is not a good understanding of what a rich task and

problem solving is where you can bring in the basics. There is a lack of knowledge in the schools of how you can engage maths — you do not have to have it textbook driven. That is one of the templates we put together — what is a good rich task? How do you teach it? How can you bring in the basics through engagement?

The CHAIR — How do you do that, though, at the more senior levels? In reality, how do you blend VCE curriculum, or year 10 leading into it, and the demands and textbook kind of approach with more creative education?

Dr TADICH — Can I say I have taught maths from grade 5 to year 13 and you can do it by open-ended questions. I will give you an example. You can teach quadratics by going through the textbook. You do factorisation and expansion and the kid cannot connect the bits. Or you can say, 'Here is a quadratic. What do I need to know to be able to draw it? If I turn my back on you and you do your quadratic, what do you need to know to tell me how to draw it?' That is an open-ended approach rather than just telling them to do an exercise. There is no connection in the child's mind as to what part of that exercise is connected and all of a sudden they are asked to draw a quadratic. You turn it around.

The CHAIR — Is there any quantifiable information or analysis of which approach is best or what gets the best outcomes? Has any research been done in this area that you are aware of, in terms of what the best approach is for young people?

Dr TADICH — You want to quantify it.

Dr TOBIAS — Just adding to the position that Barb has identified, we know from even way back to Piaget — and this is one of the flaws in maths ed — that you have concrete stages, where we have different ways of representing mathematics. We have a concrete model, and primary school teachers are very good at doing the concrete pictorial sorts of models so the kids can actually see, feel and touch and move things around. I think this is where we are losing it. We actually want the kids, by year 10 say, to be very good algorithmic practitioners in mathematics. We want them to think abstractly in mathematics. That is the goal, that they can do these. When they see a quadratic, as Barb has just said, they understand it by going back to a concrete picture. They can see where you would use a quadratic and they know exactly what a quadratic looks like. It is actually an area problem. We talk about calculus, and most students — including my son, who is in year 12 — do not understand what calculus is all about. He has been working on it very hard; he has never had explained to him what calculus actually is and what it does. When you contextualise the learning, the mathematics, the kids understand that and say, 'Oh gosh', and can then actually see where it might be used and start thinking and understanding what is behind the mathematics. I think this is where it — —

Dr TADICH — It comes back to my research. I am steeped in mathematics, trained in mathematics and am now a maths educator, and can connect the theory to practice. But it goes back to my research, and when I interview the teachers — with a science background, not maths — and say, 'What is your approach?', they say, 'I am usually a chapter ahead'. Therefore it is content — do this, do this exercise 1, and do part A — and that is their approach.

The CHAIR — On the same issue, are teachers making it relevant to students in an easily understood and practical approach — which is much of what industry was saying to us earlier, that they need to be able to see where you use it and how you use it? What is happening here with that? You are teaching new graduates. Is that being passed on through the teaching work force, or are they rapidly changing their ways when they get into the schools?

Dr TADICH — Can I answer this one, please? I am not that long out of schools, and by teaching science ed and maths we are the big change agents. Now when they came back to us from practicum or their first year out teaching they said, 'It is very hard to maintain it' because the atmosphere, the culture they have gone into is different to what we are doing. They need long-term mentoring. They need people like Steve or me to be on call. I am not saying Steve and me as such, but do you know what I mean?

The CHAIR — There is a problem with the existing work force. How do you change habits and patterns there so that the relatively small percentage of new teachers coming in do not get swamped by it?

Dr TOBIAS — One thing, Steve, with what we have been doing with a lot of in-service work where schools have invited us in, we have actually built those models and said that you have to have an understanding of

the content as well as the strategies and the psychology of learning. You can have a group of teachers comfortable in saying — these experienced people saying — 'I do not know some of this mathematics', as it was the other day. We had a whole day of in-service on teaching fractions to secondary school teachers who identified that as an area that they did not understand. These are experienced maths teachers. We thought it was fantastic that they actually came out and said that, 'How do you teach this, and what is it behind the fractions?', and were identifying that as an issue.

The CHAIR — With the university doing that sort of partnership model — which I note from what you have said is very important to the La Trobe University education faculty — how do you charge? Do you charge? Or is that part of the schools taking your student teachers? How do the dynamics occur in terms of the partnership and in working with maths or science faculties?

Assoc. Prof. PRAIN — With a lot of the professional development money now devolved to schools, it is a matter of a contract relationship with schools. So they are seeking ongoing support through their budgets.

Dr TADICH — I am sorry to come in here. Because we are a partnership we do not charge as much as some of the consultants out there, so they will tend to get us for four days rather than a one-off. We want to maintain that partnership because basically we care about education. So it is a different approach.

Dr TOBIAS — There is another level, too, in that the schools in this area now really look forward to having our students coming in, on teaching rounds or any other alternative sort of practicum. We often do alternate practicums, not just three-week blocks, because they are often artificial and judgemental. The teachers have to sit up the back and tick the boxes and give them an A or a B or something and give a critique at the end. Whereas the alternative practicums are about getting in, making mistakes, having a go, trying ideas, reflecting on the ideas and redoing it. It is a more normal way of teaching. So the alternative practicums are where we are putting a lot of energy, into this type of collaboration, and the teachers are responding very enthusiastically because they are actually learning from the students. There are students who are coming out with, hopefully, the latest knowledge about good activities and good ideas and how to teach things, and the teachers are soaking it all up. With that sort of model we do not actually pay for a practicum, which costs us a lot of money — like about $300 per student.

Assoc. Prof. PRAIN — Per subject per three weeks.

The CHAIR — So you do it more in-service?

Dr TOBIAS — So we can actually say, 'Right, we will do this', and we waive the practicum. We do not pay them for that.

The CHAIR — Are you ramping that up? Is that in the early stages; is it starting to develop stronger, or are you way down the track?

Dr TOBIAS — I think there will be a middle point where it will get to and it will not go any further. But the finances of running this are a thorn in the side.

The CHAIR — Yes, but in terms of those sorts of in-services, have you been doing that for a long time at a lot of schools, or are you ramping that approach up?

Dr TOBIAS — We have been doing that for at least 10 years. In mathematics we have been doing that for 10 years. It is quite well known in the Bendigo area, and we have no trouble in teachers wanting our students and not being paid, if you know what I mean.

Assoc. Prof. PRAIN — There is probably an increased reputation. There is scope for more, but we are limited by resources.

Dr TADICH — I think we are ramping it up, because we have got a new fourth year, have we not?

Dr TOBIAS — Yes. Just on one final point, from the research that I have done, in that sort of experience we can change a pre-service teacher's view of teaching mathematics and we can change the classroom teacher's view of teaching mathematics too. But when the pre-service teachers leave and become beginning teachers, on the research that I have done, straightaway it drops off. They go straight back if they are not supported in that sort of a structure; if they move into a textbook-type of school, they will revert. They are bombarded in that culture, and it

brings them back to more of a textbook-sort of approach. So the first few years of teaching are really critical. Unless they are a strong teacher and can argue with very experienced teachers, they will revert — and you can see it drop back straightaway.

The CHAIR — That is a good point.

Mr HALL — One of the comments you made, Steve, was that the majority of the BEd students who come in come from an arts-humanities background rather than a science-maths background, and that therefore you have to work on them to overcome their fears of teaching maths and science. At the end of the four years, after you have worked them over good and proper, how do they shape up, compared to those people from a maths-science background, as a classroom teacher of maths and science? Have you done any follow-up work?

Dr TOBIAS — Yes, we have, and it is comparable — if not, they do better. I think the critical thing is that they know what it is like for those kids not to do well in mathematics from their own experiences in primary school. In fact, by the middle of first year they are very angry about the learning they had or the teaching experiences they had as children in primary schools. It is, 'Why were we not told this? Why were we not taught this way?' or that sort of thing — they are quite judgemental about it all.

I was doing the statistics last night and with the cohort of 102 third years that I went through and surveyed last week, about 14 of them. and these are primary teachers, are doing a maths minor at least — that is, university calculus. In the dip. ed. class that I had in first semester this year there were about 40 students and at least 20 of those students were primary. They began the course as primary teachers but are going to leave it as dual-trained secondary teachers with at least a minor in mathematics. I think it is astonishing. They are going into university and we can turn their orientation around and address their anger and say, 'Look, maybe it was not your fault.'. Largely that is their belief — that there is something wrong with them, that there is a maths learner, a science learner and an arts-type learner and they were not a maths learner. We can change that to the point where they want to go and do things like calculus at university and then go on to a secondary school and teach it. It is possible.

Mr HALL — It is interesting. Preconceived ideas and knowledge are often a detriment to becoming an effective teacher — that is, you can create more than a blank sheet, I suppose, in many respects.

Dr TOBIAS — I think you are right. You can get more than you think out of a situation like that through self-motivation.

Mr HALL — What is La Trobe University's relationship with local industry and meeting their needs for skilled graduates? Is there is any sort of formal structure through which you relate with local industry?

Dr TOBIAS — We were very instrumental in establishing the Discovery Science and Technology Centre — I hope you have been up there — near the railway station. That was developed about 10 years ago. I was given the job in the early 1990s, and some money. It was only some seeding money — it was about $30 000. From that we established the industry and education consortium. That has become something else which is much bigger than that now, but the whole goal of that was to establish a link between the local industry, schools and the university on maths and science issues. For about five years we did a lot of interactive things — such as the milk factory — and we wrote classroom books for teachers where they could look at them, do preset sorts of activities, go to that industry and come back and do reflective sorts of activities. It culminated in about 1995 with the establishment of the Discovery Centre — $1.5 million went into that.

The key to that was essentially establishing that industry and education consortium. What is probably more important is the community owns it. It has to own it because it struggles to get financial support. We have busloads of kids who can go for nothing. The state government will pay for students from local schools to go all the way to Scienceworks in Melbourne but we struggle here with a similar sort of concept.

We are trying to bring local rural issues to the fore in local schools. In fact, that is a way of addressing some of the issues in maths and science in primary schools here. If the expertise is not in the school, places like the university or the Discovery Science and Technology Centre can act as a buffer and provide the expertise. If it was appropriately funded, they could have extension programs which they ran from the Discovery Centre into the schools. From that there are these beaut links between local industry so we work as a network. In the country we are used to doing that. You have to wear many hats and be adaptable, and you always know somebody who might be able to help out. We are good at doing that. Discovery became a focal point for that development in this area.

Mr HALL — Maybe I can ask Barbara this question: you mentioned the middle years research work you were doing, what teachers want and what students want. Do you look at the other end — what employers want out of middle school?

Dr TADICH — At the middle years it was more about engagement. It was improving the learning and teaching culture of the classroom. There has been work done on employment, but the particular research I was talking about was the alienation and disengagement of the middle years, and the relationship between the developmental needs, teacher efficacy and classroom environment. But there has been research done on that.

Mr KOTSIRAS — Going back to science, do you think students should have picked up a science course at years 11 and 12 before they come into primary teaching? Should it be compulsory? If so, instead of doing physics, chemistry or biology, should there be a general science course at years 11 and 12 in your opinion?

Dr TADICH — Are you asking me for primary whether they should have a minimum of year 11 science?

Mr KOTSIRAS — Or of year 12 science.

Dr TADICH — I have a tension with that because I think if we went down that path we might not get enough primaries. Their intrapersonal intelligence is very high and they see maths and science as not in that arts thing. However, when I face a lecture with science or maths teachers I wish they had year 11 science and maths. I have a tension with it; I really do not know the answer.

Mr KOTSIRAS — How about having a general science subject at year 11 or 12 where students could pick up some background knowledge of science before they get into the university and they have done no chemistry, no biology and no physics, just year 10 science. You are saying you have great programs, but it would help if they had a background in science or some science subjects.

Dr TADICH — It would definitely help but it is not the only solution. I think the universities can sometimes have an intake. I have a tension with it; I cannot answer it. I can jump either way. It would be ideal as a lecturer to face students who have a year 11 and 12 background.

Mr KOTSIRAS — The fact is our primary teachers avoid teaching maths and science. It is a fact. The reason is they think they do not have the content knowledge. I am just trying to think of ways to improve or increase their knowledge in science and mathematics. It is a problem.

Dr TADICH — It is a problem, I do not deny that.

The CHAIR — I will finish off with a couple of questions. I have been doing a little experiment with the Double Helix books that the CSIRO produces. I have given them to a lot of young people and they love them. Do you have much experience with that? It seems to me that there are so many resources at a primary level — the CSIRO's Double Helix club and magazine — and vibrant kinds of things that capture a lot of people's interest.

Dr TADICH — I do not think there is any shortage of resources. We work with Neville Davies in the science and schools area and there are a lot of resources. I do not think we lack resources, if that is what your question is.

The CHAIR — No, the question is: are teachers in schools picking them up as much as they could to make their classrooms more vibrant and create enthusiasm about science?

Dr TADICH — The primary teachers are not.

The CHAIR — Not in primary? That is why I use the Double Helix — it seems to be a great resource. It is just one example, and why would you not use it if you were a primary teacher?— For $20 you get 12 issues and you are online. Every primary school now has computers in the classroom and access.

Dr TADICH — Can I just go back and answer Mr Hall's question to Steve about community partnerships. I have just been involved in a grant that has come through. We are working with the industry around the Tongala district and the schools in the Kyabram cluster. We are always doing things like that. Schools have come to us to help with the grant or have been told we have it. We do things like that constantly.

Assoc. Prof. PRAIN — We certainly can let teachers know about all of these powerful resources like concept cartoons. There are all sorts of things that are powerful ways of making science more effective, but that is only part of the picture of altering the orientation from just thinking, 'It is a task, I will do the work'.

Dr TADICH — We try to give little tips and tricks but we take it further — you have to know how to use them.

The CHAIR — Of course. Thank you very much. Good luck with what you are doing, it sounds very exciting. We look forward to speaking further to you. Andrew may follow up on some of that middle years research with you, Barbara, if that is okay.

Dr TADICH — It would be a pleasure.

The CHAIR — 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

Maths and Science Evidence Committee

Inquiry into promotion of maths and science education

Bendigo — 1 August 2005

Members

Mr S. R. Herbert
Mr P. R. Hall
Mr N. Kotsiras

Chair: Mr S. R. Herbert

Staff

Executive Officer: Ms K. Ellingford
Research Officer: Mr A. Butler

Witnesses

Ms S. Shanahan, mathematics coordinator, Eaglehawk Primary School;

Mr C. Nielsen, mathematics teacher and coordinator, and

Ms L. Armstrong, science teacher, Kangaroo Flat Secondary College;

Ms A. Kloft, innovations and excellence, Kangaroo Flat cluster;

Mr B. Carpenter, science coordinator, Bendigo Senior Secondary College;

Ms S. Cuming, head of science; and

Mr R. Algreen-Ussing, head of maths, Girton Grammar School;

Ms L. McKerrow, middle years coordinator and maths KLA leader, Kangaroo Flat Primary School;

Ms K. Freer, integrated studies coordinator, Strathfieldsaye Primary School; and

Ms D. Cammerford, teacher, Camp Hill Primary School.

The CHAIR — I declare this meeting of the 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. The subcommittee is giving evidence today in relation to the inquiry into the promotion of maths and science education. I wish to advise all present at this meeting that all evidence taken by the subcommittee, including submissions, is subject to parliamentary privilege and is granted immunity from judicial review pursuant to the Constitution Act and the Parliamentary Committees Act. Welcome to this education forum in Bendigo.

The committee has been investigating maths and science education for some time. We have a reference from the Parliament and are due to report back later in the year. It is an extremely important reference, to which of course, once tabled, the government has six months to respond. It is important in that maths and science education in Victoria, and in Australia for that matter, is absolutely crucial to our state's ongoing economic viability and to the development of our industries and to the general education of our population. We are in an increasingly competitive environment internationally with other countries spending a lot of money in maths and science education, and getting it right is pretty important. It is particularly important to Victoria which is a small state with quite an industrial base. Places such as Bendigo have large manufacturing industries and other mining industries to which the maths-science capacity of the population is crucial to their ongoing viability. In that context education, particularly schools education, whether it be primary or secondary, is crucial, and we are very much appreciative of the input people will have here today.

We have four presenters who will present briefly from various levels of education. I will then ask anyone from the gallery if they would like to contribute something, and then we will open it up to discussion and questions. If you have something to contribute from the gallery, I would ask you to use the small microphones on the podium, and state your name and where you are from for Hansard's purposes.

The transcript of this hearing will be available probably in a couple of weeks and those who contribute will be sent a copy. Having said that, welcome and thank you for participating. I will hand it over to our presenters.. Sharon, I think you are starting off first.

Ms SHANAHAN — I am representing Eaglehawk Primary School.

When I talk about maths and science I tend to put the two together because the way we approach maths is very similar to the way we approach science. When I am talking about one I am usually talking about the other as well.

Eaglehawk Primary School is still on the road, I think, to really creating effective teaching and learning, but at this stage what we are really trying to do is establish an effective classroom environment in an effort to improve our teaching and learning. We are focusing on the development of four main elements within that environment. Our initial priority was to establish a supportive environment which encourages all students to have a go and feel confident about taking risks in their learning. This is not specific to maths and science but it really contributes to the success of our programs.

We try to create this supportive environment by building up a positive team spirit within classrooms. We have done this through a number of different strategies: things such as promoting values such as respect, perseverance and resilience; establishing class rules and consequences and routines; encouraging interaction and cooperation between students through learning activities. We have encouraged students to share what they are doing and incorporate share times into our learning activities so that they can share their understandings with others, which encourages them to clarify their ideas and helps them learn further from one another. We also involve students in shared experiences, such as creating maths trails through the school so that other students can follow them and having theme days based around a science topic.

After that we have aimed to develop a stimulating environment that engages and challenges all students. We have tried to create this environment by basing our maths and science teaching around constructivist principles, which means that our maths and science lessons are very active, usually quite noisy and most times pretty messy with lots of hands-on activities. We use a huge variety of concrete materials and equipment. Most of our lessons begin with a tuning-in activity which is led by the teacher, and that focuses on the concept of strategies that are being developed. The students generally then break into small groups or independently and they work on a related problem or they play a connected game. At the end the students come back and share what they have done and explore further issues.

Where possible we try to use open-ended problem solving to cater for different levels of ability and interest, and also where possible students are involved in real-life activities that have some relevance to them. Why I say 'where possible', at times it is just not possible to make them open-ended or relevant, and you do not want them to become to artificial. Students are also given the opportunity to become involved in their own personal inquiries related to the topic being studied or the concept that is being developed.

We have also tried to develop a stimulating environment by encouraging students to develop deeper levels of thinking and to become more critical, creative and caring thinkers. VELS in particular has encouraged the focus in this area. We have tried to do this by embedding strategies for promoting higher-order thinking into our programs. Blooms Taxonomy is our guiding principle and that is supported by various strategies such as de Bono's thinking hats, thinker's keys, graphic organisers and questions and reflection prompts. It is up to the staff to decide which of these they prefer to use.

In conjunction with developing a stimulating environment we aim to develop a reflective environment that supports students to clarify their understandings to make learning more meaningful and to enable teachers to better assess student achievement. This is an area involved with the principles of learning and teaching (POLT) program, and we have identified it as the area we need to do a lot more work on, so what I am talking about here is really just beginning. At this stage, we are trying to encourage whole class and individual reflection and assessment through the use of strategies such as reflection prompts, T-charts, class learning journals and individual learning journals and rubrics. Students are encouraged and supported to set long-term and short-term goals for their learning in both their maths and their science, and teachers are encouraged to use a range of assessment tools as a means of both monitoring students learning and ascertaining their achievement levels.

The final element we have been working on is developing a collaborative environment that builds a connection between members of the school community and between school and home. Some of the strategies we have used involve students in shared experiences through excursions and theme days. We have lunchtime programs running. In particular, we have a science club which just recently has been working on the engquest competition. That has enabled like-minded students to get together and work on shared projects. We have had activity nights, such as a maths games night and science activity nights. We have had open classrooms, and information sessions have been organised so we can share with parents what we are doing in the school. We have also tried to feature displays of children's work around the school to share with members of the school community some of the activities that are happening, and also students regularly take home maths activity bags or maths treasure boxes, as they are known in the junior school, and the activities and games in there are shared with the families.

That is what we are aiming to have happening in our school. To assist us with the development of these elements we have had to consider and address two main areas. First, we have needed to address access to quality professional development to develop our knowledge and understanding about teaching and learning in maths and science, and also to increase the emphasis of those areas in schools, because up until now, English has really been the major emphasis, and we were trying to shift the focus. To do that we have trained coordinators in early numeracy, middle years numeracy and the schools innovation in science program (which has been excellent). We have also had a consultant mathematician in residence who has worked regularly with the staff and students on issues of maths learning and teaching (Michael Reddin). He has been a wonderful resource to have.

We have had a regional consultant who has worked with the staff through the schools innovations in science professional development program, and that has really lifted the profile of science in the school. We have had two teams of staff who have been involved in the recent program of teacher professional leave. That has provided the best opportunity to get out and visit schools and spend time talking with colleagues and reading and learning, because it is difficult to get the time to do that in your normal day-to-day teaching. We also have a member of staff involved in postgraduate studies in early numeracy which has really helped lift the profile of maths.

The other area we really need to consider is building our schools resources — both human and physical. Our numeracy coordinator and our science coordinator have been allocated time away from their classrooms, which has been really important, as it has given them a chance to provide support to staff. Otherwise it is really impossible if you are trying to teach the whole time. We have made a continuing commitment in both the maths and science budgets to really build the resources in the school. We have developed and collected themed science tubs, robotic Lego, meccano sets, lots of reference books and core classroom maths equipment sets.

The issues that we still need to consider at the moment are continued opportunities for professional development on current issues in teaching and learning, which is quite difficult at times in regional areas. You see a lot of really good things being offered in Melbourne, but they are at 4 'clock, and it is almost impossible to get down to Melbourne in time to be a part of that. We still need to find ways to continue to build on our maths and science resources, so that is a budgeting issue. We also need to find lots of time for teams of teachers to get together and be able to share what they are doing and to plan together. Again, they are difficult through time and money. Finally, we are really aware that we need to build more links with the wider community and to maybe have some more big picture authentic projects developed with the community around maths and science to further develop the concepts of meaning and relevance. That is a snapshot of what is happening in our school, and I would say it is pretty much what is happening across schools in Bendigo.

The CHAIR — Maybe we can ask just one question each before we move on. I have a simple question: how many students are at the school?

Ms SHANAHAN — We have 170, so we are a fairly small school. We have seven classes this year and also a couple of specialists.

Mr HALL — You identified a need for a change of focus, particularly to concentrate on creating an effective maths and science classroom environment. Why did you decide to do that? What were the things that made you identify that area?

Ms SHANAHAN — We were involved in a triennial review which highlighted that we had put a lot of energy and resources into our English and we were performing well in that area, but we were not performing quite as well in maths and also in science.

Mr HALL — When is your next review so that you can evaluate that?

Ms SHANAHAN — Next year.

Mr HALL — Have you done any interim evaluation?

Ms SHANAHAN — Yes, we have. We have a very transient population and it is really hard to keep a track of cohorts going through the school, but I think what we have put into it is really helping. If nothing else, it is lifting the profile of those areas, if not the achievement levels at the moment, but the children are really engaged in what they are doing.

The CHAIR — Who do we have next?

Ms ARMSTRONG — I, with Angie Kloft and Chris Nielsen, are the line-up from Kangaroo Flat Secondary College. I am really aware of time constraints, so I will say a bit on behalf of the science faculty. I am a science teacher, Chris is maths and Angie is our cluster coordinator, so we have three different perspectives. I will begin with science. To be honest I felt a bit daunted about representing secondary science teachers in rural Victoria, because I think a lot of schools are doing a lot of fantastic stuff, and we are a small part of that. I see a lot of other science teachers in the room, and I think that I can represent our school, but I feel reluctant to represent Victorian science teachers.

We are a 7–10 school, as the state schools in Bendigo are, and we teach core science to years 7 to 10 in three periods per week and have electives at years 9 and 10 in biology, physics and chemistry. I have structured my notes today basically giving an overview of what special projects we are involved in, but also going on to address each of the different areas that you wanted to focus on today as part of the forum. To begin with our current projects and initiatives, we are involved in the SIT project and have been in this project over the last three years. Our focus this year is investigating Kahootz as a digital resource and looking at other digital resources that have filtered through to us from the department. We have also been able to get an interactive whiteboard, so we are currently investigating the different forms of software that come with that and ways to implement that in the classroom effectively.

We are also involved with a La Trobe University study which looks at enhancing science through a focus on multiple and multimodal representations of concepts which, when I first read it, was an incredibly big mouthful, but we have managed to work together with some people at La Trobe Uni, as well as the coordinator of that who works with us at Golden Square and Flora Hill, to look at ways that we can represent to students concepts that are both

engaging and also effective in transferring understanding and engaging their misunderstandings and understandings. That involves a lot of observations by the people that are running that project in our classes and a lot of reflection and discussion of them afterwards: looking at what we did, how it worked well, what we could do differently next time, and actually getting PD on different ways to do science in the classroom and to convey concepts. That has just really begun this year and it is very effective. We have four teachers involved and we are looking forward to PD that will be coming out of that which hopefully we will find beneficial, and it also gives us a conduit to other schools to increase our communication about what is happening in those schools and what is working for them, and therefore we can trial them. It is a PD session which is ongoing really for two years and which has started off well.

We are also part of the physical sciences partnership with Melbourne University, and so far we have had a day of PD with PhD students and also lecturers from university who have given us really helpful hands-on ways to demonstrate scientific theories, to investigate concepts, and have also given us access to a mentor, who is a PhD student who we have access to by email.

We can also phone him. He is available to help us with anything that comes up where we might need equipment or assistance or clarification or any sort of educational support material, and all the staff can contact him whenever they need to which is really valuable.

Time is one of the biggest tyrannies of teaching, and I think everyone has that problem. You have lots of good ideas and projects et cetera, but it is getting the time to get them happening. So we have developed a teaching and learning team at the school which is linked to our professional review. Rather than sitting down with the principal and going through questions and saying, 'Yes, you are ticked off to get your increment', we do projects. We are allocated a project evening or meeting time after school about every three weeks, and each group chooses a project that they want to work on. Their time is devoted to that and it becomes their review. You keep a diary as you go through. This is our third year of running it, and it is improving. There were a few teething problems but we are getting there. A lot of the time for doing those other things can come through our project. An example is our SIT project, which would have been impossible in any other situation. As we have heard, the teaching load is enough. Doing other things around it can be really difficult. Having teaching and learning teams to do the SIT project has been a good way to kill two birds with one stone.

As part of the Leading Schools fund we also have coaches or mentors. We have implemented four positions where staff take on the role of a coach, which means their workload, or their teaching contact hours, have been reduced to 10 periods a week, and I am a coach. The rest of the time is made up working with staff in the school who want to improve their ICT skills, or who have information they are trying to source about higher thinking skills, or they want some assistance with running programs or projects in their classroom. We are available; we have been freed up. We have the time to go in and assist other teachers. This is the first year it has been run: we started at the beginning of term two. I suppose there have been a few hurdles, but it is starting to become part of the culture of the school; we are being utilised more. Some really good things are happening, so it has worked well with the time issue.

We have also just received a grant through the hard work of our cluster coordinator to fund a project working with our feeder schools — our primary schools. It has a few goals. One is engaging boys, which in turn tends to engage most students because it involves hands-on activities. Angie will say more in a minute, but another project is looking at working with the community and getting involved with Parks Victoria, Coliban Water and with all the primary schools that feed into our school, creating loops and giving an opportunity to network.

We have made a few changes. One is VELS, and planning its implementation means that we are looking at different ways to structure our lessons. We visited Eaglehawk Secondary College to get an idea of what they are doing there. As I said, we also have our coaches and mentors and the Leading Schools fund, which has not only provided us with time in the form of coaches but also resources in the form of changing rooms. We have adjusted some existing buildings to make them good, mixed learning spaces. We can use them with computers, for activities and for using data projectors, whiteboards and the like. I am really aware of the time. I am sorry Chris, I think I have stolen your thunder.

Mr NIELSEN — That is okay.

Ms ARMSTRONG — We will distribute a few more notes, but I would now like to hand over to Angie or Chris.

Mr NIELSEN — My name is Chris Nielsen and I am the maths coordinator at Kangaroo Flat Secondary College. I have been teaching for the last seven years and like Lucy, coming from my point of view as a teacher, my teaching is mainly in years 7 to 9 in maths. The way I approached your terms of reference was to split them up into resources as well as the other factors affecting high-quality learning. I will go through them fairly quickly.

There are some things which might sound like basic ideas, but which are very important — for example, physical resources are essential for teaching maths. We use a lot of hands-on materials. Things like photocopied sheets, some of which we can re-use. We have activities like directed number bingo. We have what we call the silent card shuffle, which uses photocopied cards which are matched. We use these in a range of different ways. We also use materials which are used once and then replaced. These are resources which might sound basic but which are quite important to what we do in maths teaching. We use the traditional maths manipulatives like rulers, protractors, compasses and dice. We use lots of specialised manipulatives such as large dice for probability. We have had some perspex protractors made so we can hold them up against the whiteboard and the kids can see how to use a protractor. We use things like M&Ms for probability, which again you can only use once before they disappear! We could use lots of different things for units like fractions and decimals. There are some fantastic materials for geometry, but our physical resources are limited by budget. It is one thing to recognise they are there; it is another thing to be able to access them — and that is a concern that I have.

We find that these resources are really important for placing mathematical concepts into context for the kids and that is a really important part of maths learning. It encourages students to work mathematically. Often it is when you are manipulating materials that students start to understand how something up on the board might relate to something in the real world.

Again hands-on activities are also very important in numeracy resources. We have found with numeracy that we also need to locate resources that address low literacy levels. Often the students who need assistance with numeracy also need assistance with literacy. At the moment we are trialling a program called the JUMP program in a couple of classes. It has been developed by a fellow called John Mighton in Canada. He has developed a number of booklets for low literacy students. They are designed to work on building confidence in easily set out steps. From a subjective point of view, so far we have found them to be very effective with students who are low in confidence. They have been able to approach the subject in a different way and achieve success. Of course there is a cost factor, but that is the sort of thing we are looking for; materials that we can use for a wide range of students.

Other resources that are important at Kangaroo Flat include information and communications technology resources. We use graphics calculators extensively in year 10 and are looking at using the CAS computer-algebra system calculators in the near future. We have just spent a lot of time in planning the upgrade of our ICT resources and redesigning classrooms because the use of computer software will be a big thing in the future. As a cluster we have subscribed to a resource called maths 300, which is run by the Curriculum Corporation. It contains lots of interactive material that students can use on the computer, and there are also lots of lesson plans that teachers can use. I suppose I am trying to emphasise that there is a huge range of resources. Budgeting and effectiveness in choosing those resources is very important.

Other important resources, apart from physical ones, include staffing. Finding qualified and experienced teachers who are willing to adopt new processes is very important. A lot of changes have happened in the last 10 years. There are more changes to come in education and trends in education, and it is important that we find teachers who are able to go along with those changes — for example, at Kangaroo Flat we have incorporated double classrooms for years 7 and 8 in maths, English and SOSE classes, and I will talk about that later. With staffing we also find that aides for numeracy support are really essential. We have found that a lot of students work best one-on-one, and we often find that we are stretched for staff to work with those students. Time resources are also important. Teachers need time to plan units and incorporate new ideas. So that is another thing to think about.

I just want to skip down now to factors supporting high-quality learning and go through a few of your other terms of reference as well. Basically, at Kangaroo Flat we follow pretty closely the principles of learning and teaching that have been developed by the education department. I have a list of them in front of me but I will not read them out. I will just talk about the double classrooms. In the double classrooms we have two classrooms with two teachers, and students arranged in table groups of four around a table.

We have found that this has been very beneficial for teaching maths in a number of ways. It has been beneficial just from the point of view of the transition from primary school into secondary school. We have tried to minimise the number of teachers who students come into contact with as a result of our familiarity program — for example, the students I teach as a maths teacher I also teach science. We find that the students tend to develop ownership of a room, which we encourage so the students feel comfortable within that classroom environment. We find the students work well when there are two teachers in the classroom because they have two different people they can relate to. It is also more effective for teaching in that one person can be giving some instruction for the whole class while another person works with individual students.

We have found that table groups work well for peer learning. If they are chosen carefully, the students at the tables can work well together. We also find that it is conducive to the activities we run in the classroom. So at times we do group work and at other times we do individual work. Basically we have found that to be very effective in a certain way, provided the teams of teachers work well together. That is an issue, but that is the approach Kangaroo Flat has taken.

I want to talk about student engagement. I have found that when students are studying maths it is important that they find value in what they do, so we also look to try to place maths learning into some sort of context. We have found that, generally speaking, students need to achieve success and develop self-confidence. They need to find challenges for an appreciation of thinking mathematically. We try to concentrate on more than textbook learning, so we use things like open-ended tasks, theme-based tasks and problem solving in the classroom.

A lot of that has come out of work with Peter Sullivan of La Trobe University, and a lot of that has been developed within the school. I just want to talk a little bit about some of the initiatives we have. I notice the terms of reference refers to gender and peer influence. This is my opinion — I have no data to support this — I feel that boys more often tend to be under-achievers compared to girls. I think that is because often boys perceive themselves as being uncool if they are good at mathematics. I have come across students who have come into the school from primary school where that is not an issue, but when they are in the mix of kids from other schools and see the kids who are supposed to be very cool, they say, 'They are not doing maths so I will not do maths'. That is a concern that needs to be addressed in some way. It needs to be looked into. The way we look at it is by encouraging effort and perseverance and looking at work practices rather than just saying that this is the way you can be cool. It is really a matter of addressing boys thinking — how they perceive themselves and how they can be more positive about what they do.

I want to mention very briefly what Sharon has already mentioned about rural schools and the professional development occurring in Melbourne. That is a bit of an issue so far as travel is concerned. Also with excursions, it is extremely difficult to organise something from Bendigo down to Melbourne. We have found one way around that — for the last two years we have had Rod Quantock come up to the school and do a presentation on the history of maths. So if we can get people to the school, that is what we will do instead. But that is an issue about being out here.

I will finish by very briefly talking about two initiatives. One has involved Michael Redden. We have had Michael come into the classroom and work with teachers and through that develop the fraction unit. Another one involved Peter Sullivan from La Trobe University, who has done similar sort of work on open-ended tasks. Both those initiatives have been extremely helpful in getting teachers to look at their own teaching and students' learning and developing new ideas. We would really like to focus on those sorts of things over the next couple of years. I will hand over to Angie for that, because as cluster coordinator she has been involved a fair bit with the things that are happening at Kangaroo Flat.

Ms KLOFT — I am extremely aware of time now. I will make this very quick by going through it in dot points. Kangaroo Flat cluster consists of eight schools: one secondary school and seven primary schools — I will not name them all. From the start of innovations and excellence we have looked at student tracking, and with maths we have tracked students through the transition process as well. To best do that we looked at PAT maths and implementing it from grade 3 right through to year 10. That was a huge aim for us, but we successfully started it for grades 3, 4, 5, 6, 7 and 8, and we are working towards years 9 and 10. We looked at the data and used it as tool to further plan some lessons.

We also looked at the data to formulate applications, grants and direction within our cluster. Obviously our data indicated to us that boys engagement levels in maths were very low, and academically in year 7 it was a concern.

We were tracking the students coming in from grade 6 and using their data in year 7 to actually continue to track their progress in areas. It has been quite successful to be able to identify the areas that were low. We identified a number as a whole-of-cluster focus, and with our data we have been working with Peter Sullivan to further plan open-ended maths activities.

Peter worked with the cluster to do two things: firstly, to help us work on the engagement of students, especially the boys, and secondly, to help our teachers pedagogically with planning and developing units of work that are going to be successful and help these students. He looked at six steps of planning. We then started putting together a task folder so that teachers had something to refer to. They could divide them up into their topic areas, and they were practical and hands on. We also supplied the schools with Peter Sullivan's book, which is broken up into year levels. That is a resource that schools can use. If a teacher is running down a corridor and needs to get a lesson organised, it is there. Hopefully that will reinforce it. Along with that we have got the Australian Government Quality Teachers program (AGQTP) funding, and we resource schools with a task box, and within that task box there are things that assist with opened-ended maths tasks. There are eight of them and they are distributed around the cluster. Last week we were awarded more money for our program to further resource the schools.

Peter has done four planning sessions with our teachers. We have after-school sessions which I advertise their availability to all of the cluster. The teachers come in and plan with Peter. He sits down with them and asks, 'What is the topic? Can I help you? What can we do? How are we going to make it engaging?'. So we work on it from there. We purchased maths 300 to try to support this engagement and support teachers as well in their planning. Just last week we were successful in getting an ASISTM grant, which is the Australian School Innovations in Science, Technology and Mathematics grant. We have not been given the money yet, but it is quite a substantial amount. We aim to support teachers financially in their planning with outside organisations and to give schools the money to give them CRT release time to then go and plan with organisations such as Parks Victoria and Cleanaway, the waste management group. All the schools have identified an outside community link to plan the science units of work that they would like to do within their schools.

A big push at the moment is for Waterwatch and for a lot of the water reduction and recycle programs as well. We would like to further support the teachers in each one of the eight schools by giving them the time to plan together. The aim is for them to plan with not just their team within their school, but also with the seven or eight other schools that are involved in our cluster. It is the whole idea of sharing and continuing the wheel of resources and programs that we have developed. We have done a big push on VELS and have just finished a PD session which updated teachers on what that is. We are now moving onto assessment and reporting. Hopefully that will support the maths and science links as well.

Mr HALL — Generally are new teachers to your school well prepared to teach maths and science?

Mr NIELSEN — That is a good question. It depends on their qualifications. All the teachers who come to the school are prepared to teach, but sometimes they do not necessarily have the knowledge if they are not qualified in a particular subject area. In the years 7 and 8 area we do not have everyone teaching who has a maths teaching method. That is the situation at the moment. It is difficult to find teachers who have a maths teaching method. Whether or not they are prepared to teach maths is another thing. I am currently working with a person, for example, who is not maths qualified yet is a fantastic teacher and comes up with lots of new ideas. Certainly the enthusiasm is there; the preparedness to give things a go is there. I think the difficulty is finding teachers who are maths qualified.

Mr HALL — Knowledge deficiencies rather than teaching skills?

Mr NIELSEN — Yes, I would say so.

Ms KLOFT — Barb Tadich from La Trobe Uni has done research with Kangaroo Flat Secondary College. She researched the qualifications of teachers within secondary schools and the outcomes of that, and then moving on to whether that has an impact on students and learning within the schools. She started the process and has got the data, but where she is with that we are not quite sure yet.

Ms ARMSTRONG — In the science faculty the majority of science teachers have qualifications — a degree — and there is probably one I could name who does not. What we found in that situation was it was me changing from being in the classroom as much to becoming a coach or mentor, which meant that someone was coming in to fill in a position that involved a PE vacancy as well as a science vacancy. When a school is in a

position with an awkward combination that it needs to fill, it is extremely hard to get someone qualified in both areas. It means that you compromise, and the compromise is in the science area. Like Chris was saying, you do not have to be qualified to be able to still be a good teacher but having that knowledge base is invaluable; you need it, and especially in the higher levels — for example, I teach year 7 maths; I do not have a maths qualification but I am comfortable teaching it at year 7. But I would not teach above year 7. I have expressed quite clearly that I do not feel qualified and I do not think I would be doing the kids justice. I am confident in my skills but not my knowledge.

Mr KOTSIRAS — Are you involving the parents in trying to encourage students to enjoy maths?

Mr NIELSEN — It is something I would like to look into. Things like family maths days, I think, are really useful. I would say probably not as much as we could. We certainly have an open night where we have the parents through the school and we show them what we are doing in the double classrooms. We have parent-teacher interviews in the double classrooms. The parents are welcome to come into the school.

Mr KOTSIRAS — But to work in partnership with the parents, so when the child goes home the parent can involve the child — for example, with cooking and ingredients.

Mr NIELSEN — We probably have a more traditional approach in that the students have a homework sheet they bring home every week. Actually that was one of the things I wanted to mention about parents and involvement. One of the difficulties — and I think it is something we need to address — is the parents who say: 'I cannot do maths and I cannot help my child'. That comes up from time to time. It is an important issue, and I think we need to do more to address it.

Mr KOTSIRAS — But the father might be a carpenter or a chef and uses maths every single day. He might not know it but he does use maths every day. So there is no partnership in terms of PD for parents?

Mr NIELSEN — Not as such at the moment. We have a bit of a partnership with the community house in Bendigo, where we have students who go out on a modified program and also go through a literacy and numeracy program at the community house, but no, we have not gone that way.

The CHAIR — I welcome Bruce Carpenter who is the science coordinator from Bendigo Senior Secondary College.

Mr CARPENTER — The school setting in Bendigo is very important for you to be aware of — I guess you are — but we are a years 11 and 12 college only, so we only teach VCE, and there are five 7–10 colleges that feed into our school. It is a fairly unusual setting in Victoria. There is Mildura and perhaps one other similar. We teach the VCE subjects, so in terms of science that is biology, chemistry, physics, psychology, environmental science and, at our school, agriculture, horticulture, and the complete range of maths subjects. What I am going to present here is a result of a brainstorm of ideas from maths and science department meetings. I guess the other context too is that our particular school is quite well resourced in terms of its facilities and so on. We are actually quite happy with it. We do not have too many complaints. At times here I am going to be speaking from what I know or have learned maybe from going to science conferences and talking to other people around Victoria. I hope that is of use to you as well.

We have focused on those four questions that you have suggested. The first of those was: what resources are required for effective maths and/or science teaching at primary and secondary school levels. I will not volunteer for primary; it is not my area. But certainly at secondary level people have identified student attitude, motivation and engagement as the key factors for supporting high-quality science education. The way to do that: enthusiastic teachers who have an excellent depth of knowledge in their specific teaching area are absolutely crucial, especially at senior levels. You certainly need to be a good teacher and have all the strategies, but the better the depth of knowledge, the better the delivery. You need high-quality resources and equipment. We have got students walking around our classes with iPods, digital cameras, computer gaming consoles at home, mobile phones, PDAs — they have got the works — and we find sometimes the equipment used in teaching science is a little bit dated in comparison. Yes, maybe that is where an image problem comes in for science and maths.

In doing electronics sometimes I will get out an old bakelite ammeter. To me it doesn't look that dated, but I do not know what the kids make of it. Bakelite went out in the 1940s I think. It predates plastic. I think there is an image

problem in terms of science equipment. The kids come in with certain expectations of science and I think fairly often they are disappointed in terms of the whizzbang stuff.

Also the science laboratories and maths classrooms need to be of a higher standard. I think that basically comes back to marketing. If you walk into a supermarket or you walk into a new home, the surroundings are usually really nice, with everything laid on. If you walk into our school, I am quite happy, it is really good. But if you walk into a lot of schools around the state you do not get that impression: old buildings, old equipment. That really tells the kids, 'We do not value you', and, 'Science is not that important', or, 'You are not that important'. I think that is a very important concept. I really think we need to urgently benchmark our buildings and resources to bring us up to world best practice. That is something that needs to happen fairly soon.

Regarding the use of display technologies, if you look at the explosion in high-quality display technology — plasma screens, digital projectors for the mass entertainment market — schools really need to be similarly equipped if they are teaching science. If you are just presenting videos on a little TV screen at a distance of about 20 metres, it is not particularly engaging. A lot of the stuff that we have to go through in senior college is fairly involved. You cannot really get the concept out of a book. You need to see things moving; you need to interact with it a little bit, and once again that feeds into how valued the kids feel. They need to feel this is something new and vibrant they are doing in science and maths as well.

Class sizes need to be optimal. When they are too small — and you find this in small, country schools around the state and some in Melbourne as well — students lack educational interaction; when they are too large they lack teacher-student interaction, so there is an optimum size. My guess is it is something between 15 and probably 23 in an ideal world, but you certainly need to keep an eye on the class sizes.

The next question was: what factors support high-quality learning and teaching of maths and science in rural and regional areas and the specific challenges for those communities? I have dot-pointed these, so I will go through them quickly. Our proximity to the natural environment is an asset, as is our ability to network and share resources through the Internet and email. We are forced to do that because of distance. A culture of sharing expertise and specialised resources amongst clusters of schools comes and goes, but generally that is a good thing, in particular when you get away from Bendigo and up north. Professional development must be provided locally and in Melbourne. You also have teachers who are more likely to live in their communities and be closely involved, and that is a plus. They also need to be involved in maths and science conferences to share their experiences and innovation.

There is also, at least in Bendigo, a large body of retired maths-science teachers in the region who could be used to mentor beginning teachers and take up some mentoring of students as well, even on a voluntary basis. I was talking to Rod Fyffe, the mayor of Bendigo, and he picked up on that this morning and said that there would be a great pool of people in Bendigo. Perhaps they are retired but they do not want to be cut off from the educational community, and they could be used in schools to tutor and mentor students. Highly-trained and enthusiastic laboratory assistants could assist in the preparation of practical classes. Teachers just do not have the time to prepare the practical side of practical classes. Also — this is from a maths perspective — a significant trend in Melbourne is the move to symbolic manipulation technology. They are calculator-aided systems. We were a pilot school for the maths methods CAS, which can be introduced to all schools next year. I guess I am a bit short on the maths side of things; I am a science coordinator. I teach a bit of maths but I am not quite all over that.

There are specific challenges facing rural and regional students. There is the lack of high-tech companies operating in country areas and a subsequent lack of career choice for those wishing to return to the country to live after completing tertiary education in maths and science. It is a common trend for students to leave Bendigo, do their 10 or 15 years in Melbourne and then tend to drift back to the country to their families and whatever. It is a problem for career paths in science that we do not have companies in Bendigo that require a lot of high-tech staff.

Another challenge is the difficulty of obtaining work experience in such companies because the high-tech ones are not here in a big way. There is also the lack of choice in the science courses available to students locally at La Trobe University, particularly in the physical sciences. I hope I am not speaking out of turn but it is a fairly cut-down offering in science at La Trobe, so the kids know from the outset that if they really want to follow through with physical sciences, they need to be thinking of going elsewhere. Perhaps that puts a dampener on their enthusiasm for doing science subjects. I must say, though, that engineering is great at La Trobe.

Another challenge is the lack of equity in regard to education resources. It is a full-day excursion for us to go to the Melbourne Museum or the aquarium and those great places in Melbourne,. For senior colleges this takes them away from their school studies and then they have to go back and catch up. From our point of view it would be great if some lateral thinking was taking place to make those resources equally accessible to country students in, maybe, regional centres. We do have the Discovery Centre up here which does a great job, but if we could build on that it would be great.

There is also the fact that when the students are getting towards the end of years 11 and 12 they are thinking about the next step. We have a record number of kids deferring and it is basically a cost issue for them. We find that they need to go away for a year and earn some money so that they can get on Austudy to keep them going for the next four years. Unfortunately there is a big loss of students. The percentage that actually do return is fairly low and that is an issue that needs to be looked at seriously. City students who live in Melbourne can go to, say, Melbourne University and live at home. They have not got that perhaps $20 000 cost added in to each year they attend university. It is a powerful disincentive for kids to go to Melbourne.

There is another little thing. Occupational health and safety regulations have impacted on our ability to work with local groups on environmental science projects — tree planting and that sort of thing. Where it occurs in the workplace setting there is just that little legal problem that they need to have done occupational health and safety training courses. If you put that in front of every excursion, that is a big problem. In fact, not only do you need to do the basic one to plant trees, but you really need to do the farm one as well. The red tape starts to get really out of hand.

The next question related to giving examples of where business industry or research applications have been successfully integrated into the school curricula. I will list them. They are the ones we use at Bendigo Senior Secondary College.

Coliban Water is fantastic in terms of environmental science, agriculture and horticulture; Bendigo Mining in environmental science; the Discovery Centre particularly in physics and astronomy. There is also Swinburne University — we started off with one of those innovations grants from the government to get them up to run genetics workshops for year 12 biology students. That funding finished about two or three years ago but we continue that process.

Teachers are also invited to attend Melbourne University each year to see innovative research in maths and science and engineering. The Australian Institute of Physics youth lecturers are fantastic; they visit Bendigo every two years. We also have good working relationships with the maths staff and Professor Peter Jones from Swinburne University. The astrophysics department at Swinburne come up and give us talks as well. The Bendigo La Trobe University materials and structures workshops for physics used to be great. They discontinued those three years ago because of a lack of funding, which we thought was a very unfortunate step. Bendigo Astronomical Society has been fantastic with astronomy. Bendigo Mining and Sandhurst Dairies are very generous with their time in respect of maths.

You talked about VELS and multidisciplinary things that involve teamwork. One example we had at Bendigo Senior Secondary College in the past was a thing called triple science. We got biology, physics and chemistry classes working together for three weeks to research a topic. We looked at global warming, ozone depletion and nuclear power — which has actually become more current as an issue now. That project won a *Herald Sun* teaching team of the year award. But to us it seems to be a precursor to the thinking on VELS — talking about issues-based education. It is very difficult to do in a VCE setting because of the constraints of the course. We have recently discontinued that because there just was no time in the year when the topics basically aligned themselves sufficiently. That is one thing we have done and there is certainly a willingness to do that wherever possible.

The last question related to opportunities for greater cross-sectoral links to improve maths and science education. We were not sure how to interpret cross-sectoral but we have had a go. We found that the most successful partnerships really arise out of meeting mutual needs. They are the ones that last the longest and are the best value. At the VCE level we have formed partnerships between ourselves and tertiary institutions via visiting lecturers and combined coverage of topics in VCE science courses with information about tertiary courses and potential career paths, which also ties back into their motivation. More specifically, a senior academic in a tertiary institution may be linked as a mentor to individual secondary schools; maybe something like the artists in schools program. Other

partnerships have been built between university education faculties and schools via student teachers on teaching rounds.

With respect to the last one, and we have the Kangaroo Flat people here, there is a great need in the Bendigo region for science and maths teacher from 7–10 colleges to collaborate more closely with their VCE counterparts in the preparation and delivery of curriculum. There is certainly a willingness to do that, but the logistics are very difficult in terms of time.

The other issue was the gender issue. People from our school have done some research: Mary Nash and Peter Cox. Peter Cox is now a lecturer at the university. He did some PhD research looking into VCE results and gender issues over the past few years. He is just releasing his results, virtually now. What emerges is a very complex picture. Basically it is not what you would think it would be. When you see that boys are not doing as well as girls, that would appear to be not quite correct when you take into account all the variables. I contacted Peter and he said he was putting a separate submission in, so you will have that information. I might just leave it that.

The CHAIR — Was there anyone from the gallery who would like to make a comment and then we will open it up to questions?

Ms CUMING — I am the head of the science department at Girton Grammar School. At the end of last term we were lucky to be involved — I do not know if any of the other schools were — in the University of Newcastle's science and engineering challenge. I was also on the committee that helped organise that and it was a great roadshow almost. The kids really were heavily engaged in higher-order thinking; they were involved in group work; it was really challenging, rewarding and it was wonderful for them to work not just competitively but to see other students of their age in year 10, girls and boys, working on short-term problem-solving tasks. The students absolutely loved it, they got a huge amount out of it and year 9 is already excited about next year.

It was the first year that it came to Bendigo. It would be great to see more of that type of thing coming to the country because it costs a fortune to get a bus — from here to Melbourne and back can cost about $800, and if you have 25 students, it is very expensive to take kids to Melbourne. I took another group to Melbourne University and it cost them nearly $50 to be there for 2 hours, and for a lot of parents it is very limiting. If there could be something to help country schools access those things that would be a really big benefit.

The CHAIR — Thank you. Now we will open up to general questions and general comments.

Mr HALL — Can I go back to Angie and ask a question. You spoke about the tracking you are doing from year 3 right through to year 10 students and you also spoke about at times the disengagement of students from maths and science. Does your tracking show where that disengagement occurs?

Ms KLOFT — Honestly the tracking would show disengagement as in performance levels and outcomes. Then we were looking at the academic level in grade 5 and then comparing it to where they should be in grade 6, and then dropping off in year 7. We were trying to see the trend happening there and we were comparing them to the AIM results as well as the teacher-moderated levels.

Mr NIELSEN — This is PAT maths?

Ms KLOFT — Yes.

Mr NIELSEN — PAT maths is a diagnostic test which really gives us a snapshot of where the kids are at a particular time. We started using it in year 7 to compare that to the data we were getting from grade 6 teachers, just to see how that was matching up. It gave us an idea of where the students strengths and weaknesses were as they came into the school. What we have found is that we have been able to feed back that data to primary schools and discuss about where their strengths and weaknesses are. We have found some primary schools are particularly strong in certain areas. What it does not tell us is about engagement, but it does give us an idea of some students who come out low on the diagnostic test, and that means we can address that straightaway at the beginning of the year and look at those students further.

Ms KLOFT — But we then used Peter Sullivan who came into the classroom and did open-ended questioning and monitoring when we would ask the first question, stepping to the second and third when we would lose the engagement level. We have been trying to track if we do three steps, at what step are we loosing these

students? Are we losing the boys first? Are we losing a general stream of kids? Are they academic wise? We have been trying to track. We are finding a variable result, but the boys are dropping off in the secondary level when we are applying the open-ended tasks. We have got to keep them more engaged.

Mr HALL — At the early secondary level or through some of the middle years?

Ms KLOFT — Yes.

Mr HALL — Sharon, with some of the work that you are doing, can you identify an area at a primary level where students tend to be disengaged?

Ms SHANAHAN — Listening to what was being said, I agree with boys and often with open-ended tasks you will get a small percentage who will be extremely engaged, but a fair majority of the boys can not be bothered thinking, particularly at grades 5 and 6 level; they just want to be spoon-fed.

Ms McKERROW — I have been listening to everything you have been saying and it is absolutely true. I am from Kangaroo Flat Primary School. I am a passionate maths teacher; I do not necessarily believe I am good at maths. Speaking from my perspective, I think I speak for children because what I do when I go into a classroom is turn it into as much fun as possible. If you can engage children with maths as a fun subject I think you are well on the way to keeping children engaged in that area. I will leave it at that at that stage. I may have other things to say as we go along, though.

Mr NIELSEN — Can I just add — this is just purely subjective again — we use open-ended tasks in our 7 and 8 classrooms a fair bit, and I have seen boys who take to it a lot and really enjoy the challenge. I think part of the key is finding different strategies which are seen as a challenge. There is no one single answer with one strategy. I think it is important that we keep looking for different strategies and keep putting the mix in there so that there is something there that both boys and girls see as challenging and of value.

Ms SHANAHAN — It is really hard work coming up constantly with these relevant, open-ended, engaging but challenging activities.

Ms KLOFT — They are open ended because we are saying you need to engage them, so we have decided that open-ended questioning is the best way to engage but also get a reward from it, because they feel they are succeeding — not a yes or no answer.

Mr HALL — I would like to ask this question and I would appreciate it if anyone wants to comment. How important is the Discovery Centre to the schools around Bendigo in particular? How effective is it, and how could it be more effective?

Ms ARMSTRONG — We have used the Discovery Centre. It had a nanotechnology exhibition last year which we used with year 10s, and that was valuable. The thing that struck me is that the funding meant that the price — even though it was local and it is cheaper than going down to Melbourne with buses — there was an issue there where we could not take as many students as we wanted to, and its funding stopped at the point when I asked, 'Do you have any educational support material that goes with this exhibition?'. Sally, who I spoke to, was saying, 'I am really sorry but we do not'. I went in and did my own activity sheet that went with all the exhibits. With the Discovery Centre you have either got to go the whole hog and make it have an educational support facility where it does activities and supports things like the Bendigo science and engineering challenge that we spoke about earlier, which we attended and which was fantastic, or you do not do it at all.

At the moment I feel it is at a position where it is just enough to be tantalising enough to want to go and get a bit out of it, but it does not follow through. I see that it is teetering on the brink of issues with funding when it could be amazing — it could be really valuable, and I think Bendigo really needs it because we are in a hub here and we are aware, by our position, that we are in a really good spot to make something like that work really well. When you go down to Scienceworks in Melbourne, which is mind-blowing, you think that it can be done. I think looking at it in terms of why we are not getting enough people through the Discovery Centre and therefore it is not working, is the wrong way to look at it. It needs to be given a bit more of a boost because I believe it can work really well.

Mr HALL — I see lots of nodding of heads.

The CHAIR — Would you prioritise it over, say, innovation excellence staffing?

Ms ARMSTRONG — No, because it should not be that you cut off one thing to get another thing.

The CHAIR — In fairness, if you have a fixed budget, whether it is your house or anywhere, it is hard. If you ask anybody, 'Would you like more funding for X?', everyone will say yes. We are trying to get an idea of how important it is in terms of the overall maths-science programs that are happening in schools.

Ms KLOFT — Specific science and maths based could be great, but innovations and excellence would do a spread of lots of other issues that schools may put in their action plan individually and then work on as a whole cluster with everyone.

Ms ARMSTRONG — It is a mean question to ask.

The CHAIR — It is a fair question, whether there should be more money for science labs or for equipment in science labs. Everything is always a balancing act and it is hard to get a picture in terms of what is really crucial for lifting the next step in maths and science.

Ms ARMSTRONG — You could put all that money into the Discovery Centre and people might only use it once a year, whereas a cluster coordinator gets used day-to-day.

Mr NIELSEN — You could just look at this money allocated to resources. If you have one essential area where X amount of dollars are going in, but its resources are going to be used by all the schools within the area, that might be more valuable than saying this school and this school gets a little bit of that.

That could work for maths as well. It may be great to have a maths resource here. The Maths Association of Victoria has got maths trials constructed for Melbourne, and it would be great to be able to say we could do one for Bendigo, we could use the Discovery Centre in some way, we could go in there to do different activities, that sort of thing. I think if you look at a centre resource which every school is going to use, that is certainly of value.

The CHAIR — They could change the nature of it so that you could actually have some science experiments there and equipment so you could take your class there and use some science equipment that perhaps every school does not have?

Ms ARMSTRONG — Yes. That happens on a small level at the regional office, so for example there is a great weather kit that we have access to through Neville Davies, which is fantastic because it is really up to date. It looks pretty swish and it looks legit. Kids can spot a dodgy piece of equipment a mile off, and they tend to treat it that way. I like the comment that was made earlier — that kids get insulted with poor resources and treat them accordingly, whereas if the Discovery Centre could be set up where it becomes like a library of resources for science schools in Bendigo and the surrounding area, it could be great. If that is managed well and funded well, then you are killing a lot of birds with one stone because you would be sharing a lot of expensive equipment.

Ms McKERROW — Basically from the point of view again of primary schools you have got to get the kids engaged. I come back to what I was saying before, and the person who has had a great influence on us at Kangaroo Flat has been a chap called Andrew Fuller. I do not know what his title would be other than a reader of society, but he came to us to help us learn about the way children are thinking these days. As with what was called the X generation or the Y generation, he says this generation is called the click-and-go generation. They want something, they want it done, they want it done quickly and they want to get it over and done with.

That has influenced maths teaching at our place in the sense that children like variety. We try to provide variety for the click-and-go society that he has influenced us to think about. So you really have to think about your people, the children that you are working with, and how they are going to be affected by the decisions we are making today, because they are the ones that you have to draw along with you.

One of the things we have done to help draw children along with us is to give them greater ownership of what they are doing. I owe a lot of this year to rubrics. If a child is on board with you, in that they are creating their expectations as they go along, they are more willing to put in. They feel like they have ownership of it, they belong with it, they are working with the teacher, and I think they make greater progress when they are working along rubric evaluative expectation.

Ms SHANAHAN — I am actually doing a research project on that at the moment which I will get the results of towards the end of the year. That is talking about getting them engaged in their learning in most cases through this self-assessment.

Mr KOTSIRAS — Could I ask each of the schools, if you had 5 minutes to corner the minister and you knew that one demand would be agreed to by the minister — it does not matter about the cost — perhaps something about resources or infrastructure to improve the teaching of maths and science in your school, what would that be?

Ms McKERROW — Does it have to be realistic?

Mr KOTSIRAS — Yes, it has to be true.

Mr NIELSEN — I think we should do a professional development program for teachers so that there is on-going professional development, so it is keeping up with developments and so on. I think that is really important.

Ms KLOFT — In school?

Mr NIELSEN — In school.

Ms KLOFT — That is, in-school people coming within the schools, not taking these people out to a Melbourne course or a Bendigo uni or Latrobe course or something like that, actually coming in and working with the teachers and the students at the same time.

Mr NIELSEN — That could be very useful.

Ms SHANAHAN — Taking it further that that, I would just like the money to enable us to have the time as a staff to work together. Once you have had that initial PD it has then got to come back into the school and you have got to have the time to be able to try things out, come back, share, try things out again. So to have time to have CRTs come in would be the thing I would really want.

Mr KOTSIRAS — For Bendigo, I know you are funded enough and perhaps you want to give some out, but — —

Mr CARPENTER — There are a couple of ifs there, but I will try to stick to one idea. The quality of the teaching is paramount, but I think most teachers will tell you they are pressed for time. If money is time, then that is where the pressure needs to be relieved, to get people together, to put curriculum materials together and mentor kids. It is just that pressure of time and that really feeds back into the quality of the education that you can give the students.

Ms FREER — Strathfieldsaye has quite a strong environmental science focus as well as the maths which is actually part of our charter. With all of this it seems to go back right, to also currently look at re-evaluating and restructuring our integrated studies or spiralling curriculum so that it actually flows properly from P to 6 as we have found that at the moment it is segmented all over the place.

A lot of the topics might touch them once in Prep and then a couple of concepts are missed and then they are touched again maybe when the kids get to grade 5 or slightly earlier, but it has really been quite patchy. A lot of the conversations say teachers are very confident in teaching SOSE subjects — history, geography and the rest of it — but when it comes down to the nitty-gritty knowledge about science concepts, why things happen the way they do, explaining them to the children, they are quite happy to run the lessons but they do not actually have that basic knowledge to back it up, which is particularly true in primary schools as well. I think it has been addressed reasonably well with the early numeracy project over the past few years, but I think science is the next step in that.

Ms CAMMERFORD — I agree with Bruce. His introduction does not just apply to Bendigo senior school, it applies basically to how we operate in the school system, through primary and secondary. I actually have written down that engagement does not have to be a problem. I think it is all about being authentic. The science and maths we are teaching at the primary and secondary schools need to be authentic and, 'Can we give an authentic application? Can students see where that application is and make the connections?' is the key to engagement because people have spent years working on this.

The other thing we have lost touch with is, 'Are we curious?'. We have to engender that. That has to come from us as professionals and parents. When kids get to year 4 they start to lose that. I have a few other key words: relevance, consistency, accuracy, independent investigation skills, rigour and the ability to associate and connect. I think that is the key to turning kids around on how they view mathematics and science. You do not have to be a mathematician to be passionate about teaching mathematics and science.

Mr KOTSIRAS — When you do your PD days, and I assume each school chooses the day that they want to do their PD, when the students do not come to school, do you coordinate that with other schools in the area? Do you have combined PD days with primary and secondary?

Ms ARMSTRONG — It depends, actually. If it is a PD day, for example, at our school, it will involve the whole school. for example, for my school the PD is with Eric Frankenheim who is looking at higher-order thinking skills, so that PD day was designed for the whole school, but I think there are other PDs for example, there are quite a few that come up at the Discovery Centre, that is a good venue for PDs, and then all schools are invited and you can go and see teachers from other schools but I would like to be able to sit down with other teachers and say, 'Well, what do you do that works really well in this unit at this year level?'.

Mr KOTSIRAS — If you have student-free days, or whatever you call it these days?

Ms ARMSTRONG — We call it PD.

Mr KOTSIRAS — You do not coordinate it with other schools, to sit down together?

Mr NIELSEN — We do with maths.

Ms SHANAHAN — We can and have done, but it took a lot of organising and a lot of work from other schools; we only have four days. If they have individual school projects that they want to do and I approach them and say, 'We need a VELS day', they say, 'Hang on a minute, we will have to prioritise what we think is important. It is very difficult to try and make the mix of planning together. Four days are not a lot. If you really want to get into an actual area, one day is not enough to do it in. I hate using one-off sessions because they do not lead to anything — it's not sufficient to achieve any real change.

The CHAIR — In fairness, we have met teachers. I know schools that are constantly doing in-service and planning faculties during the meetings you have after school. I imagine that within schools you are spending probably more time than you would like to working on your curriculum and faculties; that is a constant thing, so you would think at least one of the four days could be allocated.

Ms SHANAHAN — The innovation and excellence clusters have been good in encouraging schools to work more as a team. That has been good.

Mr NIELSEN — I would say in the school we spend more time in administrative work when we have time available. As a follow-up of working with Peter Sullivan, a group of teachers got together for about an hour and put together a unit of work on angles. It was an hour very well spent but it was an hour that we had to organise somehow together, and it was fairly hard to get the teachers to have that hour available at that time. It sounds ridiculous but that is the situation. That is the sort of thing we are saying. I feel it is important to get that coordination time together — that teachers work on certain things together.

The CHAIR — We had industry reps here this morning at our industry forum and universally they said students going into apprenticeship areas particularly — as well as other areas — showed a lack of practical knowledge about how you apply mathematics in a workplace setting or just in life, as some were saying, like the shop assistant counting out change. They are coming out of the schools.

Ms ARMSTRONG — At what year level?

The CHAIR — They were saying it runs right through to VCE. As a general comment from industry — and it was consistent right around — there was concern about what was being studied in mathematics from primary levels that would result in students not being able to quickly do basic mathematics and apply the mathematics knowledge they had to real life situations. We heard just before and we seem to be hearing here that that is a fair aim of the schools — to make what you are doing more practical. Do we have a lag period happening here? Is that what is going on? Is this something schools are increasingly looking at?

Mr KOTSIRAS — The example they gave was that you teach students how to use the calculator — CAS — but when you ask them out in the work force to work out 1 per cent of something, they cannot do it unless they pulled out the calculator. They were saying, 'Yes, we know that times are changing, computers are in', but surely the kids should be able to understand what they are actually putting into the computer or into the calculator.

The CHAIR — So we have two questions: is that an issue and has the change in thinking been occurring recently as opposed to 10 years ago?

Ms SHANAHAN — There has been a swell. It is definitely happening in the primary schools now — I cannot speak for secondary. It is moving through, isn't it?

Mr NIELSEN — It is, though I also think there is an issue there. We come across students in year 7, for example, who do not know how to use a ruler. They will measure from the wrong point; they will measure from the end of the ruler rather than from the zero mark — that sort of thing. Because we have so much in the curriculum to cover, the tendency is towards dividing up the topics. We want to integrate these topics where possible but we also find that the students might go along and do something of the topic and be successful at it then, but they are not practising it further throughout the year.

We impress that in different ways through homework sheets and things which look at the topics all the way through. That is an issue, however, and it may be an issue of redesigning the curriculum, integrating the topics more — that sort of thing.

The other side of it is that the curriculum is structured towards the VCE and academic success, and with the disbanding of the technical schools and so on there seems to be less of an avenue for the practical aspect of maths. I know it is there in the VCE for foundation maths and general maths — mostly in foundation maths. General maths units are more academic but there is certainly scope to put that in there. It comes down to teachers as a group agreeing that this is how they would like to approach it. Individual teachers also treat things differently. You need some coordination there and I think this is an issue that needs to be considered.

Ms McKERROW — It opens up a broader issue. This is coming from a person who is in her final years of teaching — that is, the sequential nature of mathematics. The young people who come into our school from the universities have a broad overview and think, 'Yes, this is mathematics', but what has developed with the teachers over time is that we have an understanding of the sequential development of the concepts of mathematics. The perfect example was just given by Nicholas — they do not know how to do the 1 per cent unless they have a calculator in their hands.

You have to go back five steps in mathematics teaching to be able to do that and if they have not had that sequential teaching, and then had the opportunity to put it into use, they forget. So it is very important to keep that going.

From the overview that you are losing quality teachers with the ageing teaching population, there is the chance that that sequential knowledge that experienced teachers have to put into use could be lost, so we have to be really careful to make sure that that is kept, that the nature of mathematics as a science of patterns is kept and also that we are losing such knowledge. I get passionate about this subject.

It is all to do with sequential; it is to do with making sure that these young people are getting the idea that a lot of teaching is required to go into the concepts that are required by society.

The CHAIR — Generally speaking, would you say to industry that it is an issue, that you are trying to address it but there is still a long way to go?

Ms McKERROW — I am a little bit worried that we may lose it even more if we are not careful.

Mr ALGREEN-USSING — On the issue of students going to apprenticeships, you have to be careful that you are not tailoring the whole curriculum to students who are essentially dropping out at year 10 level. Students who go into apprenticeships are traditionally those who have dropped maths at years 10, 11 and 12 so perhaps you need a different course for those students rather than saying the whole course has to be focused around these students.

The CHAIR — The comment on the percentage was in fact from a bachelor of science student.

Mr KOTSIRAS — I can guarantee you that those kids will go onto university and do mathematics and some of them will not be able to understand why they have been asked 'to factorise' or why they have been asked to look at a square and what is behind it. They can put the numbers in the calculator and out comes the answer.

The CHAIR — Or do a quadratic equation and not be able to apply it. Your point is taken, though, that there are different types of maths expectations.

Mr CARPENTER — There certainly are. I have been teaching for 27½ years and that same comment has been made to me; 25 years ago I heard the same story Being realistic about it I have had students doing, say, maths methods and physics. You try to teach them a concept in physics and apply some maths to that, and even if they have covered the course that week, they will walk into physics. That is something that does not occur easily at that age level.

When they go into a trade where someone wants them to be a painter, they would be required to work out volumes, areas and so on for the painting; if you ask the person cold, 'How many people in here could calculate fractions, for example?', once they get going, usually they are okay. I think it is probably unrealistic for people — tradespeople or whoever — to expect people who are up to speed with maths to walk into those trades and be ready and off running. I do not think you could ever have expected that at any time in the past.

There is an issue to do with calculators. It is being addressed. At Melbourne University they do not allow calculators at all in maths and science in the early years. As of next year at VCE level, one maths subject will be calculator based, and the other will not. That will have to be addressed. There is an issue with the use of calculators. They thought calculators would improve maths education by taking kids to a higher level so you could do a lot of 'What if?' scenarios, you could put a straight-line graph in or a quadratic and change A, B and C and get that better cognition of high levels of maths.

At the same time as doing that you risk the basic skill, drill-and-kill type of understanding of this basic maths manipulation. When I went to school every morning in primary school we had a sheet of 100 subtractions, divisions or whatever, and you came out pretty well thoroughly indoctrinated in that. We are talking about engagement — I do not know how you would go if you tried that now with kids, particularly in junior secondary. I do not think it would be a way to engage them.

The CHAIR — It would be wasting a lot of paper.

Mr CARPENTER — We do have tools, we have calculators. They are widespread. I would not appreciate someone asking me to divide two big numbers together or work out a percentage necessarily in my head — I could do it but I do not think it is that important. We should be using modern technology. It is a cheap shot so I think it needs to be kept in perspective.

Mr KOTSIRAS — Do you feel the same way about mixing two chemicals together which might cause an explosion? Should the kids know that or do they have to check how two chemicals react?

Mr CARPENTER — If I was an employer mixing chemicals that could explode, I would certainly want my apprentice to do a bit of training for occupational health and safety. We can get kids to a certain platform with their education and sometimes when you ask them cold how to do this, that or the other they will tell you. I get it all the time from year 10 — you would think they had not learnt anything in years 7 to 10. I know they do but they get to a certain level, they go away on holidays and it slips back a bit. However, you get to a certain platform level where it is easy enough to pick that up and run with it.

Ms CUMING — I wanted to make a quick comment. My view of education is that we teach the ability to solve a problem. I am a science teacher and a senior biology teacher. There are things I do not know but I have the knowledge to solve a problem. That is my philosophy on education — that it is not of major concern that not every student comes out and knowing how to mix chemical A and chemical B but I would like to think that students I have taught would know that if they did not know X, Y, Z, they could go to A, B, C to solve the problem.

I think it would be unrealistic to think that everyone who comes out of year 10 and goes into a trade or anyone who finishes year 12 has a level of knowledge. That is unrealistic but if we can provide the scaffolds, the skills and the confidence that they can solve problems, that is what I think education should be about.

The CHAIR — Thank you. I thank all participants for participating in this forum. I wish you well in your cluster. I gather you are doing some pretty good things there and we look forward to reading the outcomes from that. Once again, thank you for participating. I declare this hearing closed.

Committee adjourned.