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

EDUCATION AND TRAINING COMMITTEE

Inquiry into promotion of maths and science education

Clayton — 10 June 2005

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Professor R. Gunstone, director of the Centre for Science, Mathematics and Technology Education; Faculty of Education, Monash University and

Dr D. Corrigan, senior lecturer, science and technology education, Monash University.

The DEPUTY CHAIR — I declare open this hearing of the Education and Training Committee. This committee is an all-party joint investigative committee of the Parliament of Victoria. It is hearing evidence today in relation to the inquiry into the promotion of maths and science education. I wish to advise those present that all evidence taken by the committee, including submissions, is subject to parliamentary privilege and is granted immunity from judicial review pursuant to the Constitution Act and the Parliamentary Committees Act. In other words, you can say what you want and you will not be sued.

Prof. GUNSTONE — I am Dick Gunstone and I am professor of science and technology education at Monash University. I coordinated the rather brief submission that we made to the inquiry from the centre for science, mathematics and technology education. My colleague is Dr Debbie Corrigan.

Dr CORRIGAN — I am a senior lecturer in science and chemistry and the associate dean, teaching.

The DEPUTY CHAIR — I will ask you to present to us and then after that we will ask some questions if we may.

Prof. GUNSTONE — Certainly. I was assuming that you might want to explore a little the things to do with the science high school. I have a little I want to say. A number of people wanted to come but could not. I formally apologise for our dean, Professor Sue Willis, who as well as being dean has been a significant mathematics educator in this country for a long time, and has particular concerns with gender. Sue was very anxious to be here but she is away on a university planning retreat, so her boss said, 'Go there'. So it was a bit difficult for Sue to come, and she seriously regrets not being able to be here.

I will begin by saying that although we have made comments in our very brief submission about the very large number of state and federal government inquiries relevant to maths and science teaching, we think there are some significant issues embedded in the consequences of those inquiries over the last 10 years. There is a really important point in the particular focus that this inquiry is taking which has not been sufficiently present in some other inquiries. I have a fairly strong view — and I am known for strong views — that even if one takes a very narrow pragmatic view of science and maths education, it is a very narrow view that this is important and that its place in schools is because of the economic future of the state. Even if you take that view, which I would argue against very strongly, but even with that very narrow view, the most single important outcome you would want from teaching maths and science in schools is that students want to do it again next year. I have a particular problem with people who argue from the position of a direct linkage between school science and mathematics and economic future, but then not to take that to mean that we should fill maths and science courses full of interminable amounts of content and try to turn them all into Einsteins by the time they are 10 years old, and the consequence of that is that none of them want to do it past the age of 5 years.

I remain bemused how people — who I would pejoratively call economic rationalists who say that schooling is only of any use if it produces this sort of consequence — totally disregard the importance of providing science and mathematics education at school which engages kids and has them wanting to learn their stuff and learn more of it. Certainly everything you hear from the group of science and maths educators here, if you were to stay here for the next two weeks, would have at its heart concern with engaging students with science and mathematics. It seems to us that in the absence of that, the rest is fairly pointless. It is a very easy matter to structure an education system in which 1 per cent of students learn a lot and the other 99 per cent leave it at the earliest opportunity. We are actually far too good at that. We are rather pleased that the focus of this inquiry is much more central than some have been on making maths and science more engaging, more appealing to students at school because that is at the heart even of a really narrow economic and distorted view of the purposes of education. Beyond that I am not sure that I want to elaborate on the things that are in our submission. We did make some very brief summary comments and tried to provide some further written material. If it is helpful to you I would be very happy to react to your questions.

Debbie wants to say something specific about issues of gender, as a message from someone else. The one weakness in our *Readers Digest* submission is that our person most familiar with issues of gender, Sue and then Helen Forgasz, were both overseas for an extended period at the time we put the submission together. The weakness there is my fault.

Dr CORRIGAN — In terms of gender I suppose both Helen and Sue would suggest that it still needs to remain on the agenda, that currently there is a lot of talk about boys' performance, but if you look at the data for maths and science it is still an issue for girls as well, because you have a very select group of girls participating in

maths and science. They participate and achieve very well but they also tend to be very intelligent, very academically-orientated girls, so they are not really representative samples of girls in secondary education. For that purpose alone girls still remain an issue in terms of maths and science. It is not just about boys or girls, depending on what time in the last 30 years or 30 years into the future you are looking at, but it is also the fact that you have a very skewed group of girls participating in maths and science. It is not representative.

Prof. GUNSTONE — To be anecdotal, about six years ago I reviewed a paper for an academic journal — you know the sort of game academics play, where you write for other academics. This was an Australian study for an international journal which laid out data to show that in this Australian state we have solved the problem of girls in physics because — look at our data; the girls in our year 12 physics cohort perform just as well as the boys. The data in fact showed that. The sad problem — which meant this study was never published — was that they had not addressed the issue that only 25 per cent of the cohort was girls. There was still an overwhelming majority of boys. Even with that, when you might expect that the girls would outperform the boys when there was so much more selected selective in choosing to do the subject, but even with that, doing as well, no better.

That tends to be the way we collectively as a society have let the issue of gender fall off the back of the truck, by seeing a sort of vague equity of performance with girls doing better in some subjects, so I am supposed to believed there is some natural justice in boys doing better in others. It misses the point that there is no biological reason why either gender should be doing better in either. There are lessons in the teaching of literature for the low performance of boys and there are lessons to be learnt in the teaching of maths and science in the continued low engagement and performance of girls. We should not forget that. The public media tends now to present it in ways which give me the sense that there is something natural about: boys do better at this and girls do better at that. There is nothing natural in that at all.

Dr CORRIGAN — I suppose the only other thing I was going to say was probably about industry and business links, but I assume that you will probably ask us some questions about that so I am happy to wait until the questions come.

The DEPUTY CHAIR — You can.

Dr CORRIGAN — A lot of my research has been into industry and technology links with science curriculum. What it has to say is the fact that industry links and those sorts of experiences are not going to make sense to students unless they also make sense to their teachers. So it is really then fundamental that there are opportunities for teachers to have meaningful experiences in settings outside of schools. We do that a little bit in terms of schools because you have people coming in through grad. Dip.Eds who have been in industry before but the real problem is keeping them updated, giving them those experiences in a continuing way, because if that does not happen then the teachers become significant barriers for learning in those sorts of contexts.

Ms MUNT — You talk about making the content more interesting for students. How exactly would you do that? What would you put in there?

Prof. GUNSTONE — The issue is not content itself; the issue is content and how it is taught. Can I give you an example? Every single physics textbook you choose to look at will present this rather strange logic that you are supposed to believe about tables pushing upwards on things that sit on them. The jargon is 'the normal reaction force'. There is nothing in any physics textbook — and frequently nothing in a physics classroom — which will give a student any notion as to why they should accept that a force is pushing up. This is solely to do with how it is taught. The fact of the matter is that when you put that microphone on the table, the table bends, and because the table bends it is trying to spring back up — there is the force. There is actually a logic to this. That would normally take me an hour and a half with year 11. I am sorry — —

Ms MUNT — You would probably have to take 3 hours with us.

The DEPUTY CHAIR — Is it the universities that are to blame, the teacher training?

Prof. GUNSTONE — No. There are two things there: you said 'universities' and 'teacher training'. It is really important to be clear about this.

The DEPUTY CHAIR — Teacher training providers?

Prof. GUNSTONE — No, because teacher training providers do not teach the science; the science is learnt in science faculties. That is really important. We get a lot of bad press because teachers do not understand the science and maths. It has nothing to do with us, Your Worship — it has to do with what and how it is taught beyond that. It is a much more fundamental issue than that. In our view it is tied up with the set of expectations and past practices in school and undergraduate university. It is tied up with the notion that somehow or other teaching this stuff is teaching people who are going to be experts and the rest are just hanging on at the edge. The more fundamental question to ask is: why would you teach about normal reaction? If you have a good answer, then teach it, but otherwise maybe we do not need me to play my tricks about bending tables and showing you how they bend and all that sort of stuff.

The fault is in both the ways we conceptualise school education and the conceptualising and practice of university undergraduate education. I have to say — this is a personal position but I think most of my colleagues would agree — I think there is a great step forward in moving away from some of the fundamental dimensions of the CSFs in maths and science education. As an example, with the first edition of the curriculum and standards framework for science there was a legitimate case to say we are not teaching the concept of energy in this curriculum. There were little, subdivided microgoals for potential energy, kinetic energy and heat energy. There was actually nothing in the curriculum that said you needed to put these together to get a broad concept of this thing called energy, which is about as central to an understanding of this society as anything you can imagine.

In real terms we were not teaching energy because of the way we chose to structure the curriculum, in that case as a set of — I cannot be certain of this; it is a sort of low-level accountant's view of curriculum: let's lay out a whole lot of fairly trivial and trivially testable objectives; we will shape the curriculum by what we think is easy to test, rather than what is important to learn. It is a very complex issue, in part tied up with what we think science and maths are. They are meant to be hard; they are meant to be this. Like hell they are! We choose to make them that way. That unfortunately is not the sort of answer you are looking for, I know.

Universities certainly are culpable here. Science and maths teaching sometimes is at its worst at undergraduate level. As an example, here is a party trick you can play with science and maths teachers. Ask them to put up their hands if they ever did a university subject where the most important thing was not going to lectures, having lecture notes, doing problems. It was doing the last 10 years exam papers. Because if you did that you would have done half of this year's exam paper. Hands sort of creep up around the room. Then ask them: what subject? And it is always: undergraduate maths. It does not require any imagination to see how the approaches to learning, what students are trying to do as they grapple with these things, are shaped by that approach to assessment. So mathematics gets reduced to a form of rote learning — no understanding at all. It is sadly still common in undergraduate mathematics.

I could even be so bold as to say I thought I saw a flicker of recognition on the other side of the table! That is an appallingly bad teaching practice, I would argue. That approach to assessment totally distorts everything else you might have in mind by way of an educational purpose in the teaching. It is a context where you would actually be silly to try to understand because the time you spent or tried to understand is going to diminish your prospects of getting a good grade; you did not spend it on ploughing endlessly through old exam papers.

Ms ECKSTEIN — Sounds like what we did in year 12 actually!

Prof. GUNSTONE — That is another story, too. I am always intrigued at how one Australian state has managed to survive with no external exams since 1972 and the world has not gone to hell in a hand-basket yet. That is another interesting dimension about that approach to assessment, too, I have to say, if we are talking about undergraduate teaching. The strongest advocates of external examinations, in my experience, are university academics, particularly in maths and science. I find it wonderful to look them in the eye, smile sweetly and say, 'So that means, I assume, you would be in favour of an Australia-wide external examination for, say, physics 1?'. They are horrified and all of the arguments they will lay out about why this would be a terrible thing are in fact why our approach to assessment year 12 is not terrific either.

Dr CORRIGAN — I suppose it comes back to Dick's original comment about what are we engaging the students in science and maths for? We think it is a valuable academic pursuit and that it has relevance to their lives. That is the thing that is really important — that it should be relevant and they should be able to use it. My experience of chemistry graduates coming in to do method in chemistry, for example, is that if I take them to the supermarket they are struggling to identify chemistry. There are some significant challenges for me in taking that

group of academic chemistry students and preparing them to teach in schools, because that is what is relevant to kids.

Mrs BUCKINGHAM — Monash was one of the first universities to get rid of science prerequisites for their undergraduate science degree. It said you do not need any prerequisites. Are you seeing anyone coming into teacher education — I cannot remember how long ago that was, it could be about four or five years — so you should have had people come through your methods classes that perhaps went into an undergraduate science degree with no science at school.

Dr CORRIGAN — It is just a delayed prerequisite though — their first year is a multidisciplinary year in their science degree and so they have to actually do two of biology, physics, chemistry and maths.

Mrs BUCKINGHAM — So they catch it up, do they?

Dr CORRIGAN — That sort of background is actually in the first year of their degree.

Mrs BUCKINGHAM — My question was going to be: could you tell any difference between those who had done science at school and those who had picked it up at university?

Prof. GUNSTONE — In simple terms, no.

Dr CORRIGAN — The reality is that many first-year subjects would get people that have not come in with the subject anyway from year 12 and so often the practice has been in first-year university that you will do the VCE stuff in the first six months and then move on. It is dealt with again in first year, regardless of whether you have done it in year 12 or not.

Ms MUNT — Is there a high drop-out rate though, if they have not done any of that and they have to do it in the first year and cannot cope?

Prof. GUNSTONE — What evidence there is — and this is not my area of expertise and I think the evidence is more anecdotal than we would like — suggests that drop-out at university is more related to issues of the profoundly different social environment, the senses of isolation, particularly for rural kids who can turn up on this campus and are the only person from their year 12 anywhere on this campus of 24 000 people and they are lost. It is those broader issues of, 'Who am I, what am I doing here, who can I turn to for help?' that seem to be the more profound.

Ms ECKSTEIN — 'There is no-one to tell me what to do'.

Prof. GUNSTONE — That is a bigger problem from some categories of schools than others on average.

Ms ECKSTEIN — Indeed it is.

Prof. GUNSTONE — There is data to support that position — there really is. That data which has been recently publicised also exists through the 1980s across year and across faculty that if you were wanting to select in the first year to give equal chance of success at the end of first year you would be selecting government school students with lower entrance scores then Catholic, then independent.

Ms MUNT — Spoon-fed versus struggle?

Ms ECKSTEIN — And it has ever been thus.

Prof. GUNSTONE — Exactly, whilst recognising that the most spoon-feeding school I have been aware of in the last decade is a government school not more than 5 kilometres from here which quite happily acknowledged that its year 12 coordinator should physically go to the house of the student who was late with a CAT and get it from them. You do not get much more spoon-feeding than that, but on average, yes. The real issue in all that, of course, is that the variation between schools is much bigger than the variation across the school system, but it is the school system one that we tend to think of.

I am going to make a couple of comments about the science high school if I could, since I do not have much longer. I am not quite sure how much you know about it? There are things that I do not know about it that I would like to

know, to do with this year's budget. We have a meeting with the eastern region next Wednesday when the detail will become obvious. The one thing I did want to say that for us is very important is that this idea has been seriously discussed and debated in this university for over four years now. The reason that there is not yet a science high school on this campus is the university's overwhelming and complete commitment to making it a government school rather than a private school, both for reasons of principle that there is then not a financial selection into this school and for pragmatic reasons of a lesser level that we actually thought that people would misunderstand it if we had it as a private school. We could have had it up and running last year with students paying, I guess, $14 000 a year, in which case people would say, 'You are only doing it for the money' and that would have been a real problem. But the principle of it being a government school was quite substantial to us.

It has some relationship to the Flinders school, but the idea is not initiated by the presence of Flinders. We started thinking about this not too far from the same time that Flinders did. We have very strong desires to have this as a school for all Victorians. Being a first-generation boy from the country I have a particular concern that if we are able to generate this school it will have very reasonable and usable ways of engaging country students, both in their school and through attendance here during university schools vacations, because we actually have a lot of spare beds around the place. So we have a structure in our proposal that has been with DET in time for the budget review process this year. We have a proposal for associate schools, which will include country schools and metropolitan schools.

We want the place to be a lighthouse for science and maths teaching, and science and maths curriculum. There would be a very strong focus in this school, assuming it eventuates, on forms of learning that tend to get summarised with labels like 'project-based learning'. It will not be a regimented curriculum and so more learning will occur. We want it to be a lighthouse school for teacher development and pre-service through the involvement of this faculty and ongoing professional development through the involvement of the science teachers association, as a very powerful and active professional body that runs across all systems. We want it to be a lighthouse school for industry engagement as well because it will be physically located on the Monash STRIP, on this campus surrounded by trivial things like the $50 million federal government centre for excellence in stem cell research and so on. So to the extent the commercial-in-confidence problems allow, the kids will be directly engaged with both researchers and with the commercial developments that are a consequence of the research. The physical location is really quite crucial.

We are particularly committed to the school being one for students interested in science and my involvement with the school would cease instantly if we had a form of — I use it only as an example — the Melbourne High School entrance test, because a very knowledge-rich entrance test is not what we are after. We are not after a hot-house for people who have already learnt two encyclopaedias so they can learn a third one; we are after a place to foster interest both within the student cohort and running more broadly. It is not a selective school, but if it is at all successful it will have to select. We will be wanting to try to find ways — assuming the ministry will agree with us — to select on what involves interest, not performance, on the sorts of nasty tests that I was being cruel about before.

Dr CORRIGAN — It goes back to that original statement. It is not the content, but how that content is taught. That is really critical in engaging kids in science and maths.

The DEPUTY CHAIR — What age group are you looking at?

Prof GUNSTONE — The proposal that we have — for which there is some money in the present budget, and I am not quite sure what the purpose of that money is yet until we have this meeting with the eastern region, which has been the focus of our joint work; I say that because we have a fully developed and fully costed proposal that has gone to the minister, so I am struggling a little to see what a small amount of money will do for us, but I am sure there is a good reason — is years 10 to 12.

The DEPUTY CHAIR — What are the numbers like?

Prof GUNSTONE — We are looking in general terms at around — —

I mean, all of this I will talk of very generally because our commitment to it being a government school is such that if DET wants to do something different, and that does not fundamentally compromise us, we do that. The thinking we have had is about 150 each year level, and the equivalent of another 150 through the forms of staffing and

resource allocation that would allow these associate school involvements, and a maximum of 50 international students, because we do not want the thing to be drowned by people who think they are buying their way — —

The DEPUTY CHAIR — Are they paying full fee, the international ones?

Prof GUNSTONE — Yes, as is happening now in so many government schools. That is a way of trying find another income.

The DEPUTY CHAIR — Can I ask you what the recurrent costs are?

Prof GUNSTONE — What we have costed, in what has gone to the ministry, is a building which was down to about $19.5 million, I think, which caused some twitches. But yes, okay; it is a multistorey building.

Ms ECKSTEIN — I just know how the department works. I am not surprised.

Prof GUNSTONE — Its thinking does not seem to have quite got around the notion that the land came free, thank you. We provided the land. But it is a multistorey building with large open spaces, so there are much more construction costs, and it is electronically very rich, so there are much more network costs and all that sort of thing.

The DEPUTY CHAIR — Tell me, as I need to understand this: how would a science class in that particular school be different to a science class at Balwyn High School or Ivanhoe Grammar School? How will the classes be different?

Prof GUNSTONE — They will be much more variable in structure and focus. Sometimes the class would involve kids working in groups of two or three; sometimes the class would involve maybe the whole year level. If we have a passing Nobel Prize winner and we can wheel them in to talk to the kids, sometimes it will involve the kids in smaller or larger groups out of the classroom and in the synchrotron, or in one of the laboratories in the STRIP, or in one of the laboratories in science, engineering or medicine. The curriculum will be focused by being multidisciplinary in ways which run across the whole curriculum. It means that for the next three weeks, for example, everything which is going on here relates to water and water conservation, water purification and better water usage. That is English, maths, social studies, science et cetera, so the curriculum is the fundamental difference.

Mrs BUCKINGHAM — Are these modelled on the sorts of specialist schools that operate in Britain through the Specialist Schools Trust? There are specialist science schools that operate in London and outside.

Prof GUNSTONE — Not so much there. The model is a little bit stronger with contexts like the Bronx High School of Science in New York. We have got fairly good linkages with a lot of these places in this faculty. There is a specialist science high school called HEMDA in Tel Aviv. There is some relationship to Flinders in its general structure. There is less relationship to those English schools because we envisage this school as being, with all of the responsibilities as well as privileges that go with it, probably the only one quite like this in Victoria. We do not see this as one of a network; we see this as being singular because we do not see that it is possible to have another school with that location, with that set of direct physical and staff linkages with researchers, developers and technicians. So the location makes it different. Therefore we do not see it as the beginning of a network of things. What we do envisage is that it will influence other schools and provide opportunities for other schools, both through other schools coming in and through the staff moving out of the school and off again. One of my very strong beliefs is that there needs to be a five-year sunset clause on anyone teaching in this school. The last thing you want are teachers who find themselves there and stay for 30 years, because the school will be so different. Some of my colleagues are not quite as strong about that.

Mrs BUCKINGHAM — There is a movement philosophically in education to make education more broad, not more narrow. English is a prerequisite and, of course, they have to do English as part of their course at a special science school. But the International Baccalaureate is gathering recognition in Victoria and has recognition worldwide, of course. Within IB you must do a language, you have a choice of art or music, and you do science, and some of the sciences at high level are indeed first-year level university, and you can gain credit for them in most universities in the world, and here at Monash, too. Having said that, there is movement to broaden people's education so that they are literate, they know English, and they have a little bit of economics. You are narrowing it right down again.

Prof GUNSTONE — I am really pleased you asked the question, because I believe we are broadening.

Dr CORRIGAN — You only have a little bit of time, okay?

Prof GUNSTONE — It is a really important issue. The curriculum structure that we have proposed and we have worked through with people in the eastern region is a full curriculum in the traditional sense. The kids are here and they are doing English and social studies and they have access to languages, access to music and access to art and so on. It is broadening, because it is placing the science much more strongly on context.

Now here is a one-line argument that is another really important issue that is relevant to this school — it has nothing to do with your committee, I think, which I need two days for. One of the things we have really mistakenly done in the 20th century in science and maths ed. is to see the education of experts as needing to necessarily be specific and focused and demanding, where demanding means narrow and you do what you might have done next year this year instead. What we do, then, is produce experts who are dislocated from the society they are supposed to advise; and we are paying simply profound prices for too many experts being dislocated from the society that they are expert in. Now education of scientists right through university needs to recognise that. We will be much better served in research and development and a whole raft of other things if we have a broader education for our experts — where 'broader' means placing it in context. This is true of all areas. You cannot understand history if you do not know enough about technology to know the technology-driven dimensions of why the Europeans suddenly got very acquisitive and ran all over the world colonising. It did not happen by accident, and it was not something in the water; it was that the technology allowed the navigation. You turn the whole thing around on its head. A scientist who does not understand a really relevant broader set of issues that have shaped their thinking is in real trouble in all sorts of ways — including, for example, in giving advice to a committee like this, which is concerned with broader public good. This is much broader and more substantive.

Dr CORRIGAN — I suppose even when you think about the IB, it does require all those fields, with the argument of making it broader. But I am constantly disappointed that the links between those silos are not made. While you are broadening the number of things that students are undertaking, you are not broadening the education, because they still remain in their silos.

Prof GUNSTONE — It is another problem with education at all levels. The only people able to provide help to students to integrate are teachers. We always assume students will do the integrating. If they know enough to do the integrating across the silos, they do not need to be in the bloody silos in the first place; they can be in them next year. The responsibility is with the teacher of the curriculum.

Dr CORRIGAN — I am sure if somebody taught me chemistry and French I might be a lot better at languages than I currently am.

Prof GUNSTONE — Oh yes, when — —

Dr CORRIGAN — That is a very simple — —

Ms ECKSTEIN — That can be done.

Prof GUNSTONE — Bilingual societies like Canada and New Zealand in fact — —

Ms ECKSTEIN — Go down to Bayswater South Primary School. They are teaching science in German.

Dr CORRIGAN — And maths in French at schools that have 25 French teachers. I suppose you can make that argument about the IB, but still it is reproducing the same thing. You do chemistry here, you do French there, you do English there and they do not cross over.

Prof. GUNSTONE — The point at which it really is most obvious is that philosophy set separately from physics. There was a time in its life when physics was called natural philosophy — for fairly good reasons. It is a fundamentally philosophic subject if taught well. Those two are a marriage made in heaven and the only time the marriage occurs in IB is when the philosophy teacher is also the physics teacher, which has only happened in one case that I am aware of. That certainly transforms both of them. I am glad you asked that question.

Mrs BUCKINGHAM — Can I come back to one other question. The deans of science have just released a report which had some frightening statistics in it about the amount of physics or chemistry that physics and

chemistry teachers had done in their undergraduate degree. How much do you think a science teacher needs to have done in their undergraduate degree to be able to competently teach?

Dr CORRIGAN — He is physics and I am chemistry, so this is a bit biased.

Prof. GUNSTONE — I think the working rule — and it is obviously very variable — of two years of undergraduate to teach year 12 is a very reasonable beginning point. The deans of science are right, particularly in the context that the real problem is that most of years 7 to 10 general science is taught by biology graduates because we have so — —

Mrs BUCKINGHAM — We have been told us that.

Prof. GUNSTONE — We have so few chemistry and physics graduates. That can be a problem in the way that chemistry and physics are taught.

Dr CORRIGAN — And it is not unreasonable to think about having a really sound content, an academic background in the subject, because what you have to do when you are teaching is use that and reconfigure it in so many different ways. But if you are actually going to do that you have to know it really well. So if you do not know your content really well you are challenged to reconfigure it so that it actually makes sense to kids.

Prof. GUNSTONE — If you do not know the content well you cannot teach it; you can only be a technical transmitter of a particular way of looking at the content with kids. You cannot rethink it, you cannot use analogies, you cannot look at in a different way, you cannot link it with other things.

The DEPUTY CHAIR — So is that the problem in the primary schools. We have heard evidence that primary school teachers are very uncomfortable teaching science or mathematics. The main reason is that their content knowledge is very minimal.

Dr CORRIGAN — They think it is hard.

The DEPUTY CHAIR — Students do not face science or maths to the level they should be facing it at primary school until they get to year 7, 8 or 9, and maybe then they are taught by biology teachers and it just gets worse. Could that be a reason and what should be done at primary school level with the teachers coming in?

Prof. GUNSTONE — There is a serious case — that is an intractable problem, that problem with primary teachers. It exists in every country in the world and it is logical. How can you give the sort of knowledge base we are inferring across seven or eight distinctly different content areas? It is just not reasonable to assume you can do that. It will always be the case, as it is in almost every country in the world, that primary teachers tend to come out of the school leavers who rejected physics, science and mathematics. There are two responses. Firstly, there is in some contexts some value in having specialist science teachers, but you have to be really careful about how they are engaged with the school as a whole. The other response — which is not fashionable, but it is my position — is that we actually place too much importance on the teaching of science at primary school. I think it is too much.

The DEPUTY CHAIR — If they teach 1 hour a week it is too much?

Dr CORRIGAN — Some are doing that.

Ms ECKSTEIN — It is what you do with it that matters.

Prof. GUNSTONE — The history is that it is very hard to teach a formal, detailed curriculum of the nature of CSF and it is very hard to find ways in which that can even be vaguely, competently taught in all primary schools. One serious response is to question whether we want a formal, detailed curriculum of the CSF type at primary school. What is it achieving? It is a really important question to ask. It is certainly highly appropriate to have primary schools providing the experiences for kids to help them start to work out some of the more interesting complexities between cause and affect and data and conclusions.

Dr CORRIGAN — Natural curiosity.

Prof. GUNSTONE — Yes, but I remain increasingly uncertain about how wise it is to have a formal content-based curriculum for primary science. No country in the world has seriously managed to do that well. The

countries that have come closest have done so by having specialist science teachers, and there I include Japan and Korea, but that has some downsides to it as well. It comes back to the point I was making right at the beginning: we over-emphasise the significance of content.

Dr CORRIGAN — A perfect example is that the federal government is into a series of science books, investigating primary science.

Prof. GUNSTONE — Primary investigations — that was the Academy of Science.

Dr CORRIGAN — They are quite good science books but it became obvious to me that you had to have a science background to be able to use them, but that is not obvious to people who write those sorts of books because they do have a science background. I have a science background and I can use them, but when I take them to primary schools and watch them use them, they do not have a science background and they struggle. They are fine with all the pedagogy and the way you go about teaching it, but it is the content that lets them down all the time and they find them really difficult to use. If you had freed them up a little bit and said, 'Explore, collect evidence, explore things that are interesting to kids' — they are probably participating in science anyway.

Ms ECKSTEIN — Find out how the world works.

Dr CORRIGAN — Yes, that is what science is: an explanation of the natural world. Why don't we let them explain?

Prof. GUNSTONE — To reinforce that, people tend to want to use Japan as an example in lots of ways because of international tests and their high performance. The primary investigation books Debbie is talking about sit on my shelf and they probably measure about 15 centimetres from the beginning of the first volume to the end. Sitting beside them is a set of very popular Japanese science text books for grades 1 to 6 primary school students — they are in Japanese so I cannot read them. They are selling very widely. They have been written by an eminent science educator who used to be a professor of science education at the University of Hiroshima. In total they measure about 2 centimetres, or a bit less. Each book is, perhaps, 30 pages — and that is a student text book. Each page is 20 per cent text and the rest is illustration. This is an example of dramatically non-content-rich curriculum. One of the really under-recognised lessons from these international tests we keep having — TIMSS and PISA — is that the more detailed the prescribed curriculum in the school system, the tendency for that country to perform lower. I find that very explicable because the education gets focused on factual trivia because that is what the curriculum is.

Dr CORRIGAN — I have an example of that. I have just been involved in a symposium around the redevelopment of VCE chemistry and I had to focus on the assessment. I actually took one of the PISA items and put it up to this very learned symposium attended by chemistry teachers, industry personnel, all with a chemistry background. Because the item talked about bugs, suddenly the whole group turned off and said, 'This is not chemistry'. In fact it was very relevant chemistry this item was testing, but the context for it was seen to be bugs so it was biology — which is a nonsense.

Prof. GUNSTONE — Pathetic.

Dr CORRIGAN — It was predictable and I am glad they did that because it would have wrecked my talk. But that is the reality; it is not about what is important about it and we focus too much on the content

Ms ECKSTEIN — Can we go on a different tangent related to the content. You talked about your research with industry. What is industry saying about what they want, both in terms of content and in terms of skills?

Dr CORRIGAN — When I was doing this research I asked them exactly that question. They said, 'We want them to have VCE chemistry or year 12 chemistry'.

Ms ECKSTEIN — Yes.

Dr CORRIGAN — But what did that mean? Why do you want them to have that? What are they going to use out of it? It took quite some probing, but none of them actually wanted the content. They actually wanted the skills that come out of it. The content did become irrelevant, because when I pushed them quite significantly they actually did say, 'No, it is all the skills you actually get when you participate in learning a science'. We will teach

them the content they need to know because the content in lots of instances is specific to the context, so if you are looking at ACI Pilkington and they have one chemist for the whole country, you know obviously it is a really specific content area that you are looking at. But in terms of that chemist then relating and working as part of a team with a whole lot of other people on how they collect data and provide evidence and produce reports, that is the important part. It is the skills they were really focusing on when you pushed them, and it is the thinking skills that also come from participating in particularly the physical sciences and that.

Ms ECKSTEIN — The analytical stuff and the logical processes and that sort of stuff?

Dr CORRIGAN — Yes. They will say, unless you push them, they want year 12 chemistry or physics or whatever — —

Ms ECKSTEIN — But they do not say they want them to know this bit of — —

Prof GUNSTONE — Yes.

Dr CORRIGAN — That is an automatic response, though.

Prof GUNSTONE — They never say we want to know about normal reactions.

Ms ECKSTEIN — So they do not say that sort of stuff?

Dr CORRIGAN — The reason they want it is that they want those sorts of skills that they have had in learning that subject.

The DEPUTY CHAIR — Thank you very much for coming. We appreciate it.

Witnesses withdrew.

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

EDUCATION AND TRAINING COMMITTEE

Inquiry into promotion of maths and science education

Clayton — 10 June 2005

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Dr I. Mitchell, co-founder; and

Mr D. Lumb, Project for Enhancing Effective Learning.

The DEPUTY CHAIR — Thank you for coming. I look forward to your giving us a presentation and then we can ask questions.

Dr MITCHELL — I am Ian Mitchell and assisting me with the slides is David Lumb. Andrew asked me to prepare a presentation. When I looked at your terms of reference, because Project for Enhancing Effective Learning (PEEL) is a very multifaceted endeavour, I realised that I really did need to give a presentation first to make sense.

The DEPUTY CHAIR — Is that part of the silent teaching?

Dr MITCHELL — No, it is not part of the silent teaching. Silent teaching is something I will get you to have a look at. I bring in voices from the classroom into any presentation that I give, which is why I have got something here for you. Okay, so when I thought about this, I thought actually I would start with a very brief critique of a major trend in the USA where Congress, for a number of years, has expressed serious dissatisfaction with education over the 20th century, that it has not achieved the revolutions that happened in medicine and agriculture. There is no educational equivalent of penicillin, and Congress has been very critical of that. For the last few years they have been only giving research funds for what they call P programs that have definitive solutions: they can be fully specified and documented in ways that can be implemented, replicated and scientifically tested in controlled programs versus non-programmed schools. From my perspective, everything about that is wrong. I put that up to contrast with what I am going to say about what has been happening at PEEL.

I will comment that it is partly that we learnt in the late 1970s when after a decade of rich funding that we will never see again for educational programs, about the time the money ran out people started to realise why they were not very successful. One was that just because someone — a school or a teacher — is adopting something, it does not actually say anything about whether they are implementing it in ways that bear any fidelity to what the designers intended. You see a group of schools that are using a program and the variation within that is just absolutely enormous. So you have got problems with your so-called scientific testing because the people in the treatment group are all over the block. This is not just because teachers are bolshie but you cannot specify all aspects of the new teaching approaches. P programs tend to focus on the kind of tasks that you will get kids to do which can be specified and leave out a whole lot of other things that are in fact more important about what is going on in the classroom. Related to that is that you cannot mandate change in the things that really matter in terms of teachers' practice. Let me give an example of this. This is a story from the classroom of Rod Greer. He decided to make a change in his practice. So he says that in the past he conducted his class by first showing a series of slides with different types of coastlines. Then he says:

> During the slides I would have given the students information about the different type of coastlines. For this lesson however I stood aside a little and simply wrote the heading 'Coastlines' on the board. I then asked students to describe different coastlines and put their ideas on the board.
>
> The students' early response was fairly typical, 'What do you want us to say, sir?' After 15 minutes waiting and thinking time however I filled the board with their responses.
>
> When this was finished I showed the slides and was pleased with the lively discussion during and after. In fact I was thrilled when at the end of the lesson I was talking to the class about estuaries and fjords, and the students, not me, had taken the class there. The lesson ended where I would normally want to but not necessarily be.

Now Rod did not adopt any major new task here. He just made one important change to his teaching practice. He shut up and let the students fill the vacuum. I would assert that no-one could have forced Rod to make that kind of change; he had to come to make that himself. I will also say that his account is silent about what he did in here, in this 15 minutes, to get the board full of their responses. Having done that sort of thing, there were some important teaching skills in there that are often tacit and will not be documented in programs. The other comment I would make about programs is that they assume that teachers will just start teaching differently and students will start teaching differently, with a sort of instantaneous change, you know, that changes can occur in a revolutionary way when in fact it is evolution, not revolution. Finally, the critique I have made is that the programs position teachers as compliant adopters, receivers of other people's ideas. Not only do teachers put their own stamp on things but I will argue that we want them to be doing that. I will argue that that is the type of system that we ought to be trying to set up.

So let me then go back and talk about the project for enhancing effective learning, a title we very casually chose 20 years ago, and began with teachers who were concerned that students were very passive in their learning. These

are the sorts of concerns, and the full list is not at all important, that tend to drive people into confusion, with concerns about passive, dependent, unreflective learning, kids not really having an intellectual go.

Mrs BUCKINGHAM — With the question, 'Will it be on the test, sir?'.

Dr MITCHELL — 'Yes, will it be on the test' — that is exactly right. There are several things I want to say about that. One is that we frame those as habits that are learnt as a result of schooling. We think from the PEEL primary collective by about the end of grade 2. So it is not that kids cannot link one lesson with another or make a link to their outside life, it is just that they do not see that as part of the game. So that was the optimistic part of what we had because if you asked the question, 'Why is David doing badly?' one reason is that he is not bright enough and nothing can be done about this, but we took a more optimistic view, that these poor learning tendencies are learnt habits and because they are learned, they can be unlearnt. We set out to try and tackle these. The third point I want to make about this sort of thing, which is not the list we originally began with, but it was like that, is that it breaks learning up into bits. I do not know how to get kids thinking but I will tell you I am pretty good now at getting them to link one lesson with another, and I have different approaches for getting them to make links to their personal life. They were targets of about the right size.

Overheads shown.

Dr MITCHELL — Therefore when we set out PEEL we had a group of teachers who said 'All right, we want to get from here down to there — nothing new about that — it has been around for a long time'. It was going to proceed as a teacher research project; we felt that only teachers working alone in normal classrooms could work out how to get from here to there, and the only piece of jargon I will throw at you is that important to the project was the construct of metacognition — that is, knowing about your own knowing. We wanted kids in on the act with us, knowing, for instance, that it is a good thing to try and make a link between one lesson and another, to be more aware of what they are doing and why they are doing it and therefore able to take more control of their learning.

Twenty years ago a group of 9½ teachers and 2½ academics — I was the half in both places — gave up time and energy, and it was unfunded, to say, 'We will meet every week for two years to try and get from here to there'. It was a cross-faculty project and we thought two years was a long time. At the end of that two years we lost the two full-time academics; they just could not keep getting to the meetings, but the teachers refused to let it end because they found the process so rewarding and what was happening in the classroom was so valuable, but we had a lot more to learn. Then, to our surprise, teachers from other schools started saying, 'Can we come and have a look at what you are doing?'. Then a couple of years later we heard, 'Can we set up a group of our own?', and so it spread, in ways driven by teachers. So there is now a network around the world of autonomous, volunteer groups who donate time and energy to meet regularly, operating what I would call as interdependent innovators. What PEEL is not and as it has become — I sort of jog along behind this trying to keep up with the teachers and do some coordination — is not a profit-making industry and is not owned or controlled by the university or me. It is not a P program with a set of right answers to follow and it does not solve all problems in education. I can come across as being on the soap-box here and I am not intending to be like that.

Let us have a story from the classroom, the one on the front page for the moment if I can control your reading enthusiasm — the non-verbal practical class by Jenny Williams would be the kind of account you would see. Let me just contextualise that. You read that, Jenny identifies a problem of one aspect of learning; she builds on ideas from other teachers to do something about it, then she has a bit of a win.

The DEPUTY CHAIR — If I did that in my class — —

Dr MITCHELL — By itself it would be like tossing a rock and the ripples would spread out. The question is: is Jenny consistently thinking about aspects of learning and doing other equivalent things in her class? That is typical of the kind of discourse you get in the meeting regularly; people come in and share, 'I had this problem; here is what I did', and someone else might try another version of that as Jenny did. She extended what somebody else has shared. The other one I would ask you to read is what I would argue reflects also what happens less often because it more profound, but also keeps coming up in PEEL. Daniel Gooding of Wantirna College is now reflecting on something that took him two or three years to develop, and I think Daniel makes a major challenge to current assessment. Now I am not saying at all, that is what everyone ought to be doing all the time in their classroom, I am presenting this as an example of a teacher who has clearly been highly reflective about his

practice and been prepared to make some major changes. So PEEL has never set out to develop a P program to be adopted or implemented intact, it positions teachers as generators of wisdom, who are proactive in promoting quality learning.

Jenny Williams did not just sit there and bleat about the kids not reading instructions; she went and did something intentional about it. They [PEEL teachers] (shows OHT PEEL teachers …) are prepared to problematise their practices. In both of those articles the teachers were prepared to say, 'Well, I am not happy about X'. Not all teachers are willing to do that. It is an entry ticket into PEEL. They are prepared to generalise about effective practice and document and share their ideas and experiences.

So if we look at some outcomes of PEEL, that one outcome that has been a substantial impact upon the practice of many teachers, PEEL requires a substantial investment of time and energy and is operated without any system support or recognition — we are in our 21st year. There are about 600 teachers who have written articles for PEEL SEEDS, our journal, edition 76 of which went out last week. The multiplier effect would be that for every teacher who writes an article there would be 5 to 10 teachers involved in the project so it has affected thousands of teachers. There are significant PEEL networks in New South Wales and school groups, in the ACT and in South Australia. There is a huge network in Sweden; it has had a big impact on Denmark and there are isolated groups in New Zealand, Canada and Argentina and it has all spread in a sort of grass-roots, bottom-up way. So it is probably worth looking at in terms of your terms of reference — that is, 'Why has PEEL been attractive to teachers?'. One is the stimulation from the meetings. People meet regularly and for the first year of the project, or at least for the first three months everything failed. It was very painful. We did not have the wisdom that we now have. Everything failed for three months and. I was feeling pretty guilty. I went around and talked to all my colleagues one at a time at lunch time, and to my astonishment, 9 out of the 10 said that even though it is incredibly draining, they say, 'I am much more supportive of the project and excited about it than when I started' because of the meetings. All we were doing was sharing failures and reflecting on why that had happened against some ideas of learning. But that was enormously stimulating and once we started sharing successes that increased.

Another reason why it has been attractive to teachers is the big changes in classrooms, with dramatically higher levels of student interest and engagement. That is one reason why other teachers come in; they see what is going on. Consequentially there are far fewer problems for management. We have learnt that most problems of management are symptoms of dissatisfaction with teaching and learning. There are substantial rises in good learning behaviours [shows list]. We have a list of those things like 'offer and justify opinions', 'seek a link with personal life', and you can count these. We have noticed 15-fold increases from about one every 15 minutes to one every minute for non-PEEL to PEEL classes. It is a huge change in the classroom climate.

Teachers also appreciate the considerable expansion of their teaching repertoire. The last thing on the handout that I gave you to read describes generically silent teaching. You will see in the box in the top right-hand corner states that this article is an example of A25 silent teaching — do not worry about the A25 — and also un-jumbling instructions. If you look at [the article on] silent teaching, that is not a story from the classroom, that is a generic description of a teaching procedure with the reasons for it. I just pause to let you have a look at that for a tic. That has been one of the outcomes of the project. PEEL was a cross-faculty project — that was the only way we could talk to each other. If am a science teacher and a history teacher comes in and shares an idea, we needed to look for the generic features of what the teacher had done, so that we could transport that from one classroom to another. PEEL involves a massive expansion of the range that teachers have of those, and they are all linking to various aspects of learning. Teachers appreciate that expansion and they appreciate the greater sense of professionalism. Their practice makes sense to them in more ways as they think about why they are teaching in ways with student learning and student change that are different from just content considerations. By student learning I mean student behaviours like making links and thinking about the purpose of what they are doing as distinct from content.

The other thing that is attractive is that the wisdom has come from teachers and it includes crucial advice and ideas that are often missing from packages. It is the 'how to' wisdom — how do we achieve the rhetoric? How do we get from here to there? To give one example of many, one of the reasons why we failed inevitably for three months is that we did not appreciate that students not only had habits of learning but they also had developed very conservative beliefs about their role and their role in the classroom. A belief like 'discussion is not real work' is one that is quite widely held. Once you are aware of those you can sit down and do something about them, but that list is usually not present in education literature or curriculum packages.

There have been substantial changes in how students go about their learning, new visions of what is possible, and big changes in the classroom environment. This issue of understanding the nature of student change and teacher change is really central. That is not well understood in education, particularly the student change one. On understanding teacher change, the standard literatures are better. The understandings of student change are much more are limited. Systems typically operate in ways that have fairly primitive understandings of teacher change, about how that is going to occur. One thing that has occurred serendipitously is that focusing on how students learn turned out to be central to everything else, more important than thinking about what would be in the curriculum packages — I am not saying that is not important. More important than thinking about management issues, the focus on how students are learning gets everything else sucked in.

That focus also turns out to sustain. By sustain I mean it keeps the teachers engaged, we are not talked out and we are in our 21st year. Let me give you an example of that. Here are some notes from an early meeting of teachers who were meeting with a focus on 'We want to get kids asking good questions'. You can see that they have tried to think through what they mean by good questions. There has obviously been some productive discussion in the group. A few months later their notes look like this: the first dot-points are the same, here are the ones they have added to it and you can see that new issues have been opened up for them. How are teachers to handle good questions once they are asked? Good questions can change the direction of a lesson, often for the better. We need to take a risk and follow the student's lead. It kept blowing out, it sustained the group for two years just thinking about that sort of issue.

Another outcome has been a huge body of wisdom about what to do. We are not a capital-p program, but we have had a wide range of peers operating at all levels, in all subjects, in thousands of classrooms, and there is a huge body of wisdom about to get from here to there. That is organised in various ways. In 1997, so that was seven years before the government put out its PO2S (I helped to work on that project at the last minute) we identified a dozen recurring themes in what the teachers reported as working. Both of the stories I got you to read were examples of sharing — Rod Greer's *Geography Coastlines* and Daniel Gooding's *Tell Me What You Know* were examples of a very important construct: build a sense of shared intellectual control. That is one very generalised way of thinking about teaching. It only makes sense when you connect it to stories; by itself it is a useless phrase, but it helps make sense of the stories. We are currently, when we put out this book, up to 193 teaching procedures like silent teaching; we have identified teacher behaviours associated with those and a huge base of first-person cases — teacher-authored first-person cases — which are credible with teachers and which keep the complexity of learning.

This leads me, looking at your terms of reference, to one of the things that really we have bumbled around with for a while and it took a number of years to realise what a complex issue it was — how to communicate sophisticated wisdom of teaching. One of the real problems that we have had as the project has developed for so many years is how do we go about communicating to other teachers something that someone who has now been in the project for six years has been doing? Do we say to them, 'Be like this person now' when they have had a journey of six years? It took me a long time — years — to realise, 'Hang on, do not try to do that, Ian, that is a no-no'. Teachers need their own journey. One reason for that is that practice precedes understanding, you have got to try something before you understand it and there are some things that cannot be told. Rod Greer had to live that experience with *Geography Coastlines*, you cannot tell someone about that.

Another one is that teacher learning is really about, as my friend Cliff Malcolm used to say, taking steps out of the comfort zone, but not too far out of your comfort zone in one go — one step at a time, that should be incremental. In the process of doing this, of reflecting on your practice and identifying an area that you want to do something about and trying something new, that process is as important as the destination. What is complicated about this is that the starting points are different for different teachers. With the Rod Greer story, *Geography Coastlines*, some teachers could say, 'Yes, that is something I could do, it is close to my own practice'; others would say, 'No, that is too far away from me at the moment'. When sharing ideas about practice we need to share them in ways that are going to stimulate innovation and provide multiple entry points, but it does not mean that we cannot facilitate or accelerate the journey.

We have had a range of experiences [in sharing teaching wisdom]. At the end of our first year we put out a book where all the teachers and one student quoted a case study, a narrative of what it was like to try to change their practice. It was very readable, it was first person, people loved it, but it was not a 'how to do it'; it is still in print. Six years later we put out a 'how to do it' distilling a huge amount of wisdom and that was a big mistake because, with hindsight, we were trying to get teachers to be like we were after six years; there were too many lists in it and we tried to lead with the lists. The only good part about this book which sustained it for a long time was that it had

76 teaching procedures. Teachers loved that because it gave them entry points and it required them to develop their own versions of them.

I now argue — this third book [adds this from a different menu]which we put out starts with stories — start with stories and then from the practice bring out the issues you would want to bring out. PEEL SEEDS is full of stories; you just read, included in the transparencies, three different PEEL SEEDS' articles and the one, *Geography Coastlines*, came from no. 1 in 1989 and it is still fresh; the stack of back issues is 50 cm high so as a print resource it is completely useless so we have put it on a database, which is another way of trying to communicate ideas about teaching. The way we have structured the database reflects the kind of journey that we have engaged with in PEEL; it is not structured as a curriculum database. You can call up science and year 9 and 10, but we encourage people not to do that. If we open up a menu here of classroom practices, and any one of these — even though note taking and drill and practice sound boring — any article coded to those, is there because it offers ideas for improving that practice. I am now going to be in role thinking about my practice, okay — when I am Getting started [selects that classroom practice], introducing new ideas, then letting me think about what Concerns [opens menu of teacher concerns] I have when I am starting a new topic. I would like students contributing ideas of their own [selects one concern] and I would like those ideas to be making links between schoolwork and outside life [selects a second concern]. Now I am down to a manageable number of articles and one of them was *Geography Coastlines* which I had on the overhead transparency. You will notice now I can also say, 'Right, let me put the focus on me when I am getting started'. I would like really, when I am starting out, to [adds this from a different menu] build a sense of shared intellectual control; and, can I get started in a topic where the kids have to work out things for themselves? *Geography Coastlines* also comes up under that search because it is coded to all those search fields.

I will give just one more example. If I said, 'Right, I am a teacher of practical work and now let me think about practical work'. I am concerned, when I am doing practical work, that the kids dive into task without planning and they do not read instructions carefully. Jenny Williams's article on the non-verbal practical class is there. If I call that up, this article is an example of the teaching procedures A25 and D8 and these are live links to the generic descriptions. Just the final point then about this database is, what is this A25? There are 193 teaching procedures in eight groups, with very fuzzy boundaries between those groups. But there is one group, the building understanding school knowledge, the new ideas people take into the classroom, and if I call up silent teaching I get the generic description and five classroom examples, one of which was Jenny's. All I am saying is that was about four times too quick for showing a rich resource, but it is a way of sharing knowledge that, provided the teacher has a problem about teaching or learning, allows them to track round and find ideas that are deliberately structured in ways that require them to develop their own adaptations of them. I had a few comments, but I will just save them and if you are interested you can ask. I had a bit of a think about PEEL and systems and why PEEL is something that I think is difficult for systems. There are some problems and if you want me to elaborate on that for 2 or 3 minutes I will, but I think I will shut up now and respond to questions.

The DEPUTY CHAIR — Thank you. We need to ask a few questions.

Mrs BUCKINGHAM — Our inquiry is about maths and science; how many maths and science teachers participate in PEEL?

Dr MITCHELL — A lot. In fact for a long time in this faculty there was the myth that because the academics involved happened to be science educators that PEEL was just about science teaching. It is a cross-faculty project. If I looked at your terms of reference, what have I got to say? I have got things to say really about how we achieve change in students and teachers — that would be my main theme. There is buckets of science on there. Of the articles that are coded — there are 1200 articles on there — I think 260 of them are coded to science. That would give one type of answer to your question.

Mrs BUCKINGHAM — Is there any evidence that students who have participated in junior science PEEL classes are more likely to go on — when they have the choice — to take science at a senior level? We are trying to find out how you make science more appealing. This approach certainly sounds like it makes learning more appealing overall, but have you got any evidence that a PEEL approach is more likely to head kids — —

Dr MITCHELL — If all of the kids in year 10, for instance, when they are going to make decisions about what to do in year 11, had five PEEL teachers in five different subject areas, one of which was science, I do not see any reason why they would then be more likely to pick science. David?

Mr LUMB — I do not think so. On the other hand if you only had a science teacher, they might be more inclined to do that than history and geography.. It certainly generates interest, so if you use it in science, it is going to have an impact.

Dr MITCHELL — Dave and I would both have anecdotal evidence of kids saying, 'You have got me really interested in science', but I do not think it is going to privilege science over other areas. In terms of some of the problems we have with science I would be arguing that you should focus on how they are learning and you will get higher levels of interest.

Mrs BUCKINGHAM — In respect of teachers participating in PEEL, do you get a lot of first-year teachers?

Dr MITCHELL — That is an interesting question. It is also partly affected by the dynamic, or rather the demographic of teachers. We have a black hole moving through the teaching profession. As you may or may not know, there was effectively no recruitment from about 1989 until 1996 in government systems. I really notice that when I finish my classroom teaching there was no-one under 30 in the staff room. Now as we are getting more young teachers coming out the answer would be yes. At this year's PEEL conference, there will be a session at which three primary teachers who are in their first years are going to talk. I find it fascinating, when you have a first-year teacher who is systematically documenting what they are doing, to track that journey. Some people will say, 'You cannot do all this until you have been teaching for three or four years — get the basics sorted out'. That is an understandable argument. I would say no, I do not think that is appropriate, I think it can be very helpful in first year.

Ms MUNT — It is really a teaching method that you are talking about. Is it part of the curriculum in the teacher education courses here and elsewhere?

Dr MITCHELL — It has had a big impact here. We do not run a program on PEEL but there would be 15 or 20 of the staff here who have been significantly influenced by PEEL.

Mr LUMB — You would not have any graduating teachers from here who would not be aware of PEEL.

Dr MITCHELL — No.

Ms MUNT — So it is part of their curriculum, the Dip. Ed. and the B. Ed?

Dr MITCHELL — Yes, all of those teachers would know. The word would carry meaning and they would have some sense of what it means. One of the issues with student teachers is that they get really interested in constructs like teaching procedures and what you can do in the classroom. The equally powerful aspect of what it means for teacher learning and those professional communities is just meaningless blather to them at this stage. I do not see any way that you could build a real meaning for that until you have been out and discovered the isolation of teaching.

Ms MUNT — What does PEEL stand for?

Dr MITCHELL — Project for Enhancing Effective Learning, but I do not like the word 'project'. We chose that very casually after we had started. We were trying to get a bit of leftover — I do not know if you remember SIP and PEP. There was a thousand bucks or so left over and we needed a label. It is a meaningless acronym, except that we keep peeling back layers of complexity and discovering new issues. It is the only thing that has acquired meaning.

Ms MUNT — Thank you.

The DEPUTY CHAIR — How do you inform teachers who have been teaching for a while about the program?

Dr MITCHELL — I am reactive; I react to requests, as it were.

The DEPUTY CHAIR — You have got to know the program exists.

Dr MITCHELL — Yes. We run three different types of short courses, four times a year. One on what you can do inside the classroom, one for PEEL convenors, and for the last three years I have run another day on professional learning teams. Schools are going to put everybody in professional learning teams since that is such a complex and interesting area. We advertise those. There is an annual two-day conference in August that is quite popular — PEEL is subscribed to by many schools. But the real answer to your question is that someone goes into a school and says, 'At my school we had a PEEL group and it was fantastic and we ought to get something going'.

The DEPUTY CHAIR — Have you got links with the associations, the English, maths, science — —

Dr MITCHELL — No, not particularly. We have never set out to. It is a sin of omission rather than deliberate intent in terms of building those sorts of links. Up until the last three years, coordinating PEEL was not something that was part of my job; it was a sort of add-on. I have for the last three years bought myself out of about 20 per cent of my teaching. David, and Howard who does sales, work a total of 0.7 or 0.8 on the project, but it is a nickel-and-dime shoestring industry.

The DEPUTY CHAIR — You said earlier that the project is being done overseas. Is there any feedback as to how successful it is?

Dr MITCHELL — Yes, sure, come and talk to the Swedes at this year's PEEL conference. There are mixed stories. In Canada there have been a couple of academics who are close friends I know well and they are as good as you could get in people working with teachers — they do not come across as ivory towers — who have really struggled to get PEEL groups going. It is very hard for an academic to start it up, whereas there is a terrific group of French teachers in Halifax that is going now that was begun by a group of teachers.

In Sweden and in Denmark it was teachers who took the initiative. There was a guy in Sweden who somehow read about PEEL. He read our first book; paid his own way in the summer holidays to come out here and went back and started a group in his own school. At that time, and coincidentally, the Swedish government introduced a new national curriculum that stripped out most of the content. It was not that they said, 'You will not be teaching content', but the curriculum documents devoted very little space to defining the content and put a lot more space into talking about thinking and better cognition. Coincidentally PEEL — or PLAN as it is in Sweden — turned up in one school at that time and within three years Sven Olaf Hagglund had a network of 50 schools which grew to 150 in a country with a population of 8 500 000.

Mrs BUCKINGHAM — Who has access to that database you showed us?

Dr MITCHELL — Anyone who buys it. It costs me about $25 000 a year to produce the annual editions of that and there is an online and CD version. We sell that. PEEL is non-profit-making but last year costs were about $130 000. Lots of schools buy that. I say to them, 'Do not buy it unless you have teachers who in some way have identified problems of teaching and learning'. If you just say, 'It is a good thing, here it is, we have a copy in the library', firstly, no-one will use it or secondly, if they do, they will go in and select science and years 9 and 10 and say, 'What have you got?'.

Mrs BUCKINGHAM — And look for a lesson plan.

Dr MITCHELL — Look for a lesson plan. But there are lots of schools that do use it; we have sold thousands.

The DEPUTY CHAIR — And you get no money from government schools, apart from what you sell?

Dr MITCHELL — No. We charge for the sales — is that what you are saying?

The DEPUTY CHAIR — Yes.

Dr MITCHELL — We have to be self-funding and cover our costs. The faculty, as they do for all centres, charges $10 000 for handling of salaries, room rent and so on.

The DEPUTY CHAIR — Thank you very much for coming. It is appreciated. Hansard will have the transcript ready within the next few weeks and I will send you a copy. Have a look at it and send back any changes. If Andrew needs more information, he will contact you.

Committee adjourned.