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HOUSE OF REPRESENTATIVES

STANDING COMMITTEE ON EDUCATION AND TRAINING

Reference: Vocational education in schools

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HOUSE OF REPRESENTATIVES

STANDING COMMITTEE ON EDUCATION AND TRAINING

Thursday, 5 June 2003

Members: Mr Bartlett *(Chair)*, Mr Sawford *(Deputy Chair)*, Mr Albanese, Mr Farmer, Ms Gambaro, Mr Johnson, Mrs May, Mr Pearce, Ms Plibersek and Mr Sidebottom

Members in attendance: Mr Albanese, Mr Bartlett, Mr Farmer, Mr Johnson, Mrs May, Mr Pearce, Ms Plibersek, Mr Sawford, Mr Sidebottom

Terms of reference for the inquiry:

To inquire into and report on:

The place of vocational education in schools, its growth and development and its effectiveness in preparing students for post-school options, with particular reference to:

- the range, structure, resourcing and delivery of vocational education programs in schools, including teacher training and the impact of vocational education on other programs;
- the differences between school-based and other vocational education programs and the resulting qualifications, and the pattern of industry acceptance of school-based programs;
- vocational education in new and emerging industries; and
- the accessibility and effectiveness of vocational education for indigenous students.

WITNESSES

Committee met at 9.07 a.m.

DURANT, Professor Graham, Director, Questacon—The National Science and Technology Centre

SMITH, Mr Graham, Manager Outreach Programs, Questacon—The National Science and Technology Centre

RIDGE, Mr Lee, Chief Operating Officer, The Photonics Institute Pty Ltd

CHAIR—I declare open this public hearing of the inquiry into vocational education in schools. I welcome representatives from Questacon, Professor Graham Durant and Mr Graham Smith, and from the Photonics Institute, Mr Lee Ridge. Thank you for coming and for sharing your expertise and for your time with us today. Just as a formality, I need to remind you that the proceedings here today are formal proceedings of the parliament and warrant the same respect as proceedings in the House. I invite you to make some introductory comments. I understand there is a video presentation as well. We will hand over to you, and then we will follow that up with some discussion and questions.

Mr Ridge—I am sure you are interested to find out what photonics is about and what it actually means. To start off with, the Photonics Institute is the education and training company of the Australian Photonics Cooperative Research Centre, which has been operating for the past 10 years, mainly at the Australian Technology Park in Sydney, at ANU, at Melbourne University and at RMIT. It has been going since 1992. Australia in photonics punches above its weight. We are probably regarded as one of the top 10 hot spots of photonics worldwide. Photonics is the control, manipulation and storage of data using light. So it is the photon that we are processing; that is our fundamental particle. Its major application is in telecommunication systems and, by application of optic fibres, it is the underlying hardware of the Internet. Using an optical network, we are able to put the equivalent of 300 million phone calls down the one optical fibre compared with the copper network. If you have a modem at home, you probably have 56k, unless you are in Canberra or connected to broadband. So it is a disruptive technology; it has a wide application, particularly in telecommunications. Now we are branching out into sensing—

Mr SAWFORD—When you use the word ‘disruptive’, what do you actually mean?

Mr Ridge—It is an enabling technology disruptive—it actually makes a number of new processes possible. So, rather than using electronics in a chip that we use in computers at the moment, we are using light; so it does not actually use electricity. Fibre gives off light but not heat or electricity, so maybe we can—

Mr SAWFORD—I understand that, but I do not understand the term ‘disruptive’.

Mr Ridge—Its power is that, by its sheer capacity, you are able to do more things. So, rather than the existing copper telephone network, with photonics and optical fibre you are able to now string digital media down; you are able to send gigabytes of files rather than use the old network. That makes a whole number of new industries possible.

Mr SAWFORD—But 'disruptive' diminishes; 'enabling' expands. I just do not understand the sense of the word 'disruptive'. Why is the word there? It just does not make sense, because disruptive does not do what you are saying. Disruptive does the opposite: it diminishes.

Prof. Durant—It disrupts the existing—the status quo.

Mr Ridge—You are probably familiar with Moore's law, the doubling of capacity of a chip every 18 months, the doubling of the transistors. Photonics is actually doubling capacity every nine months. So, instead of shooting one wavelength down an optical fibre, they have the ability to shoot 40 channels or 64 channels down the one fibre using the different wavelengths of light. So, rather than the existing network with voice, we are able to send down data, streaming video—whatever you like—down the one fibre.

The Photonics CRC has 26 participants. I think we are one of the largest cooperative research centres. We have five universities: Sydney, Melbourne, ANU, RMIT and UNSW. I think we are the only CRC with a TAFE connected—we have New South Wales TAFE as a member—and we have 20 corporate members. We have been working with the TAFE industry partnership located at the Australian Technology Park for the past five years, and in particular we have some close links with Lidcombe TAFE and Mount Druitt TAFE. Also we received some funding and we have developed some curricula in photonics at the Canberra Institute of Technology. We will get onto that a bit later.

The aim of cooperative research centres is to commercialise research. We have been successful via Australian Photonics Pty Ltd, our commercialisation company, in the creation of 14 new spin-off companies over the past five or six years. Some of these have now been located to the US, actually producing product. So we actually have a pipeline of research to commercialisation to actually producing product and employing people. As you are probably aware, our major application is telecommunication, and that has gone through a significant slump in the past few years; hence, our branching out into other areas of using the technology. All CRCs have an education and training objective. That is mainly to do with postgraduate students. Generally over a seven-year life of a CRC they would be aiming at training 50 PhD students.

In the Photonics Institute we embarked upon a sort of groundbreaking vertically integrated approach to meeting the labour force requirements of our growing industry. In 1999 we undertook a review of the labour force requirements of this industry, which was growing at such a fast pace. Australia has about 1½ per cent of world market share, and this was estimated to have a turnover by 2010 of $2 billion per annum that would necessitate the training of about 18,000 to 24,000 young Australians by 2010. This situation was exacerbated by a brain drain of new PhDs going especially to the US and Canada for at least double, if not four times, the salary. So this is part of the dotcom era where everything was to be over the Internet. An example of this growth is JDS Uniphase, the Intel of photonics. In 1994 this was a small company, and it was raising its first $20 million in venture capital and was actually run by an expat Australian called Kevin Kalkhoven. By 2000, at the height of the market in NASDAQ, it had a market cap of $US96 billion and it was bigger than Sony. Today it has $US840 million worth of sales, employs over 9,000 people and has a market capitalisation of $5 billion. So not a bad result still in nine years. That reflects the rapid expansion of our industry.

How do we raise awareness? How do we get young Australians doing science, which they are turning off anyway, to actually be skilled in our industry? We are faced with the task, after doing our review, of needing approximately half those people to be doing university courses and half to be doing technical training to actually do the work out there, be it laying fibre or be it in manufacturing situations. So we embarked upon a vertically integrated approach for our industry, linking researchers, whom we have plenty of—80 full-time equivalents and 50 PhD students—with the industry that we have created, the 14 new companies. How do we bring that together when we have five universities and TAFE? We do not have the school system as a member, but how do we get a holistic approach to try and encourage kids to do science firstly and photonics in particular? The first step was our raising awareness program.

Prof. Durant—At Questacon, the National Science and Technology Centre of Australia, we have expertise in communication and delivery mechanisms for science based programs. At the outset I have to say I am very much the new boy, having just arrived in Canberra, and I have to acknowledge the work of all my colleagues. It is their work that has been reported. I am very much topping and tailing it. Graham particularly has played a very significant role in developing the program and delivering the range of Questacon outreach programs.

The photonics awareness program is a joint project with Australian Photonics. The arrangement is that Questacon was contracted to design and deliver a national awareness program to secondary school students. It is one of eight outreach programs from Questacon. Others include the well-established Shell Questacon Science Circus, which has visited most of Australia over the past 15 years; Questacon Smart Moves, which is funded by Backing Australia's Ability; the Questacon Maths Centre; the national NRMA road zone travelling exhibition; the Questacon Science Squad; the Questacon Indigenous outreach programs; and Questacon Starlab.

The photonics awareness program has enabled the development and implementation of in-school presentations to raise the awareness in secondary students of career opportunities in photonics. The program aims to raise awareness of the growing importance of the industry and its importance to the economy and way of life. To date, a total of 37,880 secondary students in 280 schools have attended the program in all Australian states, except Tasmania and the ACT. It is expected that a total of more than 52,000 students will see the presentations in approximately 400 secondary schools by the contract completion date of December 2003. The program began in April 2001 and was developed by Questacon staff with support and advice from the photonics industry.

An additional program in Sydney metropolitan schools was begun in term 4 in 2002, with additional funding from Australian Photonics. More than 33,400 secondary students have seen the presentation in regional schools in 21 months. The feedback from the audience has been overwhelmingly positive. An additional 4,480 students have attended the shows in Sydney in the new program, which began in term 4 of 2002. Feedback indicates a success rate in excess of 85 per cent of students knowing more about photonics due to the show and more than 50 per cent claiming they would consider a career in photonics after seeing the show.

The core of the average program is an entertaining presentation entitled *From fountains to photonics*, and we will show some brief clips of this shortly. The presentation is designed to hold the attention of teenage audiences and is delivered by qualified science communicators. The

presentation combines live performance with multimedia projection, and it is sufficiently portable to be transported quickly between schools in regional areas by station wagon. The presentation is adaptable for different audiences and has been modified as new information becomes available. Teacher information packs—of which there are examples in the pack that we will be leaving for you—are provided to teachers at the completion of the presentation. In addition to the school audiences, a range of other public event audiences have viewed the presentation, including presentations at science festivals and science in the schools. An independent evaluation of the project has been undertaken by the Centre for Public Awareness of Science at the Australian National University.

The contract with Australian Photonics was for a total of $4,390. The total budget for the 2001-03 period included funds for the research and development of the live presentation, combined with the multimedia; staffing, travel and transport for a three-year program in all Australian states and territories; and the research and development of a dossier of potential interactive exhibits. The building of these exhibits is dependent on additional funding at some point in the future. I would like to hand over to Graham, who will show the video and give a running commentary as we go through it.

Mrs MAY—What was that amount of money?

Mr Ridge—$439,000.

Mrs MAY—You said $4,000; I thought that was a bit low. That was very cheap.

Mr Smith—The video is a collage of the show. The shows can take up to 40 to 50 minutes or an hour; they are adapted for various audiences. So what we are about to see is snippets. It is not a coherent story as such; it is more to give you a feel for the way it works within schools.

Prof. Durant—The important aspect with this slab of audience is really to engage them, and Questacon has tried a number of different ways of engaging teenagers. They are quite a difficult audience to bring on board. Questacon staff seem to have found a way that does actually get the students to take notice.

Mr Smith—There is a secondary spin-off in that we get media coverage. This clip begins with a sample news item taken at Taree.

A video was then shown—

Prof. Durant—I hope that gives you a sense of the average program. The important aspect is initially to engage the students in the program. The show is intended to do that. The follow-up then is the questions at the end when much more detail about photonics comes out, and the teacher packs. Graham, do you want to mention the teacher packs?

Mr Smith—Yes. There are packs there which we will leave with you. One of them is a sample of materials. For any one tour we will research where the nearest TAFE courses and/or university courses are and tailor them as much as possible to particular regions. As courses have developed we have taken time to find out what is actually happening in a particular area and make things as relevant as possible to particular audiences. The packs that you receive are

samples that have been built up over the time we have been doing the course. This scene is changing rapidly. Courses are coming online quickly. Working with Australian Photonics, we have been able to provide online support as well so that students are able to gain information off the web site as to what courses are coming up.

Mr FARMER—So the courses are specifically at the TAFE colleges and through the TAFE colleges?

Mr Smith—TAFEs and universities. There is a great deal of interest from students in both. There is approximately an even split between promotion of TAFE based and university based courses. But there is an increasing interest from students in technical TAFE level courses, we have found. The presentations, I should have mentioned, are for years 9 through to 12. Many of the regional schools will tend to put in entire cohorts. So, if we are dealing with a central school, we cater for the years 9, 10, 11 cohorts; in other words, that level of students who are just about to make decisions as to what electives they are going to go on to do and who are already starting to think about their careers.

CHAIR—It is obviously a very effective means of raising awareness of career opportunities in the industry. Have you any indication yet of how effectively that translates into students taking up those sorts of courses and those career options? You said that 50 per cent expressed a possible interest in a career in this area.

Mr Smith—That is what we are hoping these follow-up evaluations will do. We want to start looking at first-year cohorts in TAFEs and universities to see how they found out about the course—what sparked the interest. We do not have any direct evidence of that. We have anecdotal evidence but not any statistically significant evidence of students enrolling. It began in April 2001 so we are likely to start seeing those students who first saw the show beginning to make decisions about TAFE and university towards the end of this year and early next year.

CHAIR—Is the availability of courses keeping up with the potential demand for places? I know in your submission you talk about Lidcombe TAFE and Mount Druitt TAFE, for instance. Is there a ready availability of courses or is that deficit likely to be made up fairly soon?

Mr Smith—Lee might be able to handle that.

Mr Ridge—That is interesting. The nature of our industry is that you need a fair investment in the equipment to actually give students a reasonable demonstration of what the industry is about. So you could say our links with Lidcombe and Mount Druitt are because we are based at Technology Park and we have University of Sydney and UNSW. Our strategy has been to constantly link researchers with the TAFE level and university courses obviously.

Our next strategy is to move to Newcastle University, Newcastle TAFE, because Newcastle University are starting a course. They have made an investment in photonics in staff and equipment. That is our next venue, you could say, as well as Wollongong and Canberra, where we actually have expertise in the researchers, where we have equipment that is extremely expensive, and where we can give kids a good experience of what the equipment does. It is hard elsewhere where TAFEs and universities do not have this investment in the capital equipment. It is extremely difficult.

CHAIR—Is there also a problem with availability of adequately trained staff and experienced staff given that—

Mr Ridge—That is a good question. I said I would mention that a bit later. Our real case study is at the Canberra Institute of Technology where we employ one of our researchers at our headquarters at CIT. He works a few days a week for that institution developing curricula. We find that a lot of teachers in electronics, for example, embrace photonics; it is the new technology—they have an understanding there. We facilitate the retraining, the professional development, of those very experienced teachers into the new technology. To date that seems to be our strategy and we are also trying that in Victoria as well.

CHAIR—Just one other question before I hand over to my colleagues. I think you said there is potential growth of 18,000 jobs forecast up to 2010 with roughly fifty-fifty university trained and technical—

Mr Ridge—That was our survey in 1999—

CHAIR—Yes; so it is has been revised down—

Mr Ridge—Absolutely.

CHAIR—What would be a more realistic figure?

Mr Ridge—I would not like to be quoted on it, but it would be thousands. We are finding now that because photonics is an enabling technology which is moving into these other areas—sensing, biotech, biomedical, as well as telecommunications—we expect thousands of jobs to be there over the next decade.

CHAIR—In the 50 per cent that require technical training rather than university training, do they cover the whole spectrum? Are they mostly at the top end of technical skills or would they cover the whole range including jobs suitable for students who otherwise would have gone into your more traditional blue collar trades?

Mr Ridge—Absolutely. The business of laying a fibre network is different from copper. You have to have different equipment to splice it and connect it. It is different from just wrapping a piece of copper around a connection. So there are different skills in laying networks. Also, in the facilitation—where do these industries happen? It is manufacturing in a clean room environment. There are some traditional trades that are actually required for a high-tech environment. You have to do the plumbing correctly in such an ultraclean environment. We do not have many skilled people installing clean rooms in this country. Through another one of our businesses we hope to be installing a clean room in the next six months. We are trying to get a couple of students along for a six-week to 10-week period to get experience with people who have done it before. That is a great skill to have and it is transferable to the biotech industry, to our industry, and to anything that needs that sort of ultraclean environment.

Mr SAWFORD—Lee, you mentioned in your introduction the diminished interest in science and maths in our schools. I wonder whether you have a view about why that has occurred. In the last 20 years the language component of both mathematics and science has been enhanced, and it

is a more synthesised framework than it ever was. The analysis component of the framework of science and maths curriculums has been diminished—that is, the analysis has fallen away. There is a huge diminution in the numbers of people doing serious maths and serious science in this country. It is a huge problem. Do you have a view about why that is happening? I noticed your presentation too was a synthesised presentation. I would have thought you would have given a more analytical approach, but that is just a personal view. In terms of your efforts to raise awareness, what has been the response of the various education departments and perhaps the various sectors of education that you have had to deal with? I notice a smile coming. I am looking forward to the answer.

Mr Ridge—The general response as to why science enrolments are going down is the competition for the more highly paid professions of finance, law and medicine. Science still has that sort of white coat image, and that is what our show completely bans; everything we do bans white coats from our presentations. Parents are major inhibiters to this. They think there may not be well-paid careers in science.

Part of our strategy is that we have been able to create a number of businesses out of this high tech. There is a pathway for this—and we have done it on a number of occasions—where a researcher has made a product and gone to a spin-off business. The example of our first technology business was called Index. Six scientists went over and formed the core of JDS Uniphase in Australia and they were exporting $150 million worth of product from North Ryde prior to JDS US's decision to shut down every plant except for the US, Canada and China. Those researchers have made some money via option plans and they have now invested in a new business back at the Australian Technology Park in photonics. This is the cycle in Silicon Valley—you have inventors going around four or five times. We are now seeing our first complete cycle of researchers going to a spin-off business, making money and departing that scene because it is a manufacturing business and is not developing new products. And here they are now in a new business.

Mr SAWFORD—What is your view about the curriculum frameworks? How have they changed over the last 20 years, particularly in science and maths?

Prof. Durant—If I may come in on the first question, and then I will pick up that question. You are asking about science enrolments. I have just arrived in Australia from 25 years at the University of Glasgow and I am a former member of the Scottish Science Advisory Committee, advising the Scottish government. The issues that are being faced here are repeated elsewhere. I would not say they are global but they are certainly Western trends.

Mr SAWFORD—English speaking.

Prof. Durant—English-speaking trends—there is a complex variety of factors that influence it, but it is not across the board in all sciences. The biomedical sciences are doing very well. Recruitment is high in those areas, particularly the recruitment of females, which is a very important aspect. The hard sciences, the maths, physics, chemistry and engineering, are struggling in the UK. As to the reasons, Lee mentioned career differentials. Science is very hard and it has a long learning period. These days you have to do a three-year degree, three years postgraduate work and three or four years post-doctoral work before you become a professional scientist. So there is a very long lead time before you even start to make reasonable money, and

even then you are behind the curve in comparison with other professions. So you do not go into science to make money is the general view. However, there are people in the biomedical sector and photonics who can do that.

The media have an important role. There has been an antiscience bias in the media in the UK over probably the past 15 years, particularly in some papers. For example, on the issue of GM crops, certain newspapers were campaigning actively against GM. They were using that to sell papers, using particular stunts. One has to counter these types of interventions and it does not help. The quality of teachers has diminished, and this is because the nature of science has changed. The average age of science teachers in Scotland, I believe, is 52. I think in Australia it is about 47.

Mr Ridge—It is 49 plus.

Prof. Durant—Thank you. So the teachers who did their training in science 20 years ago, unless they are getting constantly upskilled, will be falling behind. As individuals they have to invest a lot of time in learning the new science, so there are issues about ongoing training for teachers.

In the UK again, the quality of the facilities in the schools, in science labs, has changed. The chemistry labs that you see today in most schools in the UK are exactly the same as they would have been in our day when we were in school. They have not changed a bit. There has been a lot of introduction of IT, but the environment for teaching science has not moved forward in the way that perhaps it could. There is a need for more positive role models in science. So I think a complex range of issues have led to a turning off of interest in science. The curriculum in the UK—I am sorry to keep referring to the UK, but that is where my experience is—has been increasingly filled to the point of overflowing, without getting rid of things. There is now a lot of effort to try to restructure a curriculum that allows for both the development of scientific competency and an understanding of some of the broad issues of science.

Mr SAWFORD—What about the response of education departments to your sort of connection?

Mr Ridge—If I could just sort of get there eventually, with the outreach program 'raising awareness'—this is a sort of physics, which is really a non-starter for most 16-year-olds at the moment. The wonderful thing about photonics is that they can actually see the physics applied: here it is in a network and here it is in a sensor. So that engages the audience from the start; they can see it applied. We ran a detailed intensive workshop at Calwell High in the ACT. Our approach there was, rather than being at the front and telling them all about photonics, to use their medium of games and video, the digital media. So the strategy was that we want to teach them something about physics and photonics and they want to make a game. So it is a nice conjunction: they think they are making a game and they have actually learnt something about photonics, because it is a photonics game. Question, answer—they have to look on the Web for their own question and then put it into their medium. We have 13-year-olds developing web sites and games, which is fairly common. Teachers are battling to turn on PowerPoint.

The result at that particular school, which focuses mainly in the biological area and there we were giving them physics, was that the class off their own bat decided to go to the ANU to attend

a physics lecture. So that was quite a great conversion: physics can be interesting; it is applied. 'We are not sitting at the front of the class trying to tell you how to do it. You come up with the problem and you solve it in the way you want to.' So that was a different approach. We have had some support from the ACT in doing that there.

We received a small grant from the Victorian government to do the same—rather than Questacon do their show through Victoria. We also did an intensive workshop at Ballarat, where I think we had five or six schools involved. Basically we have to lock the doors at 6 o'clock to get rid of the kids, because they are so engaged. We have an online community where they share this information over the Net to actually produce a better game between themselves, because that is the medium they are used to. They are SMSing and they are chatting over the Web. So here is a way to produce a better project over the Web for them, and they deliver a game or a video or a web site.

So the Victorian government has been very encouraging, and we are hopeful to have photonics as part of their senior physics curriculum from 2004, I think, as a seven-week block. So they are looking for the new content. Teachers find that difficult because, as we have said, they are in their late 40s, photonics was not around when they were trained and how do they keep up to date. It is difficult when you have some intelligent kid asking pretty intelligent questions. So it may be easier not to do the new technology if they do not understand it or it is not their field.

So Victoria has been encouraging to have photonics—it is exciting material in physics—adopted in their curriculum. How do they keep up to date? That is where we use our strategy of linking them with our researchers at Melbourne University and RMIT. Here are some industry people who actually know what is going on out there, and our industry is moving very rapidly so we are able to keep that sort of connection going. In New South Wales it is a bit harder.

CHAIR—You did say that in New South Wales it looks like being included as a board recognised course?

Mr Ridge—In TVET, and that has been most encouraging to have.

CHAIR—Not recognised by the unis for UAI, though?

Mr Ridge—Our approach, and one of the recommendations, was to get this adopted quickly and so we decided to just have TVET approved rather than go the UAI route.

CHAIR—Is New South Wales the only state where that is done?

Mr Ridge—That is our pilot because we feel that to link it to the TAFEs and to the universities in Sydney, Newcastle, Canberra—

Mr SIDEBOTTOM—I would like to refer to the submission that you gave us this morning. It is a very frank submission. In relation to the VET industry and the national training framework it effectively reads that you do not see the framework or the VET sector as being contemporary with your demands in your industry. It seems to be completely behind the eight ball and that you do not seem to be able to plug into it and that it is certainly not mindful of your needs. As an

emerging industry, indeed an established emerging industry now, that is a relatively damning report. Would you like to elaborate a bit more, or have I read it a little pessimistically?

Mr Ridge—We set out a strategy of how we are going to train and skill these people. The industry is changing so rapidly technologically, as are the applications. Prior to April 2000 telecommunications was it—that was the killer application that was growing at an unbelievably fast rate. So you are faced with the problem of technology: what was on a bench yesterday is on a chip today or in nine months time. How does a training sector keep up with such rapid change in the technology? By the time you have actually got through the process of a year or two and developed some curriculum—we were advised that that would take five years—our sector has completely changed and moved on. So it is hard. We appreciate it is very difficult to keep up with a moving target. We are employing hundreds of people and then we are declining in the sector. Now we are hopefully on the upswing again, but it is a different sort of business than it was in 2000.

Mr ALBANESE—Taking that up, what are the solutions? How do you think the TAFE system, for example, could be modified so that it could meet your demands?

Mr Ridge—Our example is the brave and courageous Lidcombe TAFE, which made the decision to invest in photonics. They bought some equipment and decided to develop the curriculum to an advanced diploma. We sat on their working groups as the industry participant. They made an investment decision that this was a technology they saw a future in, facilitated by the partnership centre at the ATP, who are very aware of the demands of industry and where it is going. So they really branched out on their own, and you could say Mount Druitt has sort of followed along with them. Through help from the ACT government, CIT has also been able to invest in photonics. But they have really been out on their own making their own investment decision. At the moment, Lidcombe TAFE is investing in a clean room facility.

Mr SAWFORD—Were there key people in those organisations who pushed it along?

Mr Ridge—Yes.

Mr SAWFORD—Who were they?

Mr Ridge—It was slightly before my time, but at the TAFE partnership centre it was Karen Whitingham, whom I think this group has had before it. You could also say it was Ron Wright at Lidcombe TAFE, and they had a great teacher, Mick Moulton, who is still there. They had a number of people who were willing to embrace the new technology and they have made the investment. With the downturn in telecommunications at the moment, there is a lot of equipment going at reasonable prices, and Lidcombe TAFE have seized upon that and made an investment, and Newcastle University has done the same. There are some entrepreneurial colleges out there that are willing—

Mr SAWFORD—It is a bit haphazard.

Mr Ridge—It is. But how do they actually keep up with the technology? It is very difficult, especially if we are looking at a long approval process. Where you have researchers who are leading worldwide—Australia actually has a recognised world position in application based

technology—and you have links to the industry, you have a lot of things actually going there so that we can maybe say that if we do develop a curriculum it is going to be of a high standard, because you have that research link from the universities. You have the industry driving it to be relevant. So you have a number of factors that might cut down the approval process so that we could say, 'We will approve this curriculum within a year,' as long as the industry does the hard work and research to get there.

Prof. Durant—But generally the approval process would take longer than a year. It can take three years to get a course validated and through the books. There is a natural lag time there that does not help.

Mr Ridge—We were advised at CIT that it would take five years, and we have done it in one.

Mr SIDEBOTTOM—On accreditation, at point 7 here you said:

> The trade off for expediting the approval of the TVET course—

which again is talking about the short time taken to introduce it—

> in photonics was in its exclusion from calculation in a student's TER score. It is recommended that these subjects be approved quickly and be included in the TER score.

That seems to me to be almost purely and simply devaluing something to get it in. I find some of this extraordinary. I am not critical; I am just saying that if that is the nature of what is going on when we talk about VET in Schools then we have a real issue here. Goodness gracious!

CHAIR—Before you respond to that question, given those complexities and the problems of slow approval of courses and large capital investment requirements to keep up with rapidly changing technology, should we be trying to set up courses everywhere or are we better off just developing those core skills in maths, science, physics and so on with a few centres of excellence for those who want to pursue career options?

Mr Ridge—You have to actually have some centres of excellence that are linked to universities. The field has moved on. You have to actually continually professionally develop the TAFE teachers and tell them what is going on. We are completing another memorandum of cooperation with TAFE New South Wales and, as the institute and the CRC, we have undertaken to give TAFE two workshops every year on new technology. You have to do something like that. Photonics is the enabling technology of broadband. Why should only the students close to the major universities that invest in photonics get this experience? We can give simulations and we can deliver big content if there are links to regional centres of TAFE. We can beam modules in and give them simulations over the web. Our ideal, of course, would be that every school had access to this, but we could at least have some hubs where TAFE had a reasonable broadband connection and could get great content and have the look and feel of using an instrument. There is lots of material out there.

Mr SAWFORD—Just following on from what Mr Albanese was saying about solutions, you mentioned centres of excellence and this seems to be part of the vexed question of which really is the best way to go. Do you set up centres of excellence that people can get to or do you have

the generic secondary comprehensive school? From your perspective, which is the best way to grow this?

Mr Ridge—We want kids who are open to innovation and entrepreneurship and who are good communicators—these generic skills. The technology is moving on, so there is no point teaching them something from a year ago when it is now on a chip and we do not have to worry about it.

Mr SAWFORD—Does that mean you are saying centres of excellence?

Mr Ridge—There are some generic skills that could go across the spectrum in these areas, but I think that to have a reasonable experience for a lot of kids the sector has to have some centres where there are investments in appropriate capital equipment.

Mr PEARCE—I would be interested to know what your relationship is with private sector organisations within the ICT industry. How do you interface with them and how are you working with those private sector organisations within the telecommunications and optical fibre manufacturing sector et cetera?

Mr Ridge—The last sheet in our submission is our corporate diagram. That is what we have created out of the Australian Photonics CRC. Victoria has a small but growing photonics sector, and we are linked via the Victorian Photonics Network. You could say that in Sydney we are the industry. The labour requirements discussed in the submission are the ones that were sort of deemed from 1999 when the survey was done. The businesses in our corporate diagram have their own life cycle. They have attracted foreign investment and venture capital.

Also mentioned in our submission is the fact that we are not great on students actually visiting these sites, because they are real, operating businesses in these high-tech environments. But our experience has been that on a set date once or twice a year they are more than willing to provide their time. We have a regular thing with TAFE where we actually address about 40 students. They come in one evening. It suits them and it suits our companies to let them know what the latest and greatest is in the field. It is difficult on a day-to-day basis because they are actually producing product. But via our network, because they have come from the CRC, it is also about actually putting something back and keeping the information flowing directly to students.

Mr PEARCE—But, with the chain, you are dealing mainly with those organisations that are manufacturing and producing photonics products, and those people are then on-selling those products to the Telstras or the CISCOs of the world or whatever else. Is that right?

Mr Ridge—Overseas we are sort of two systems groups, and Telstra is at the top of the food chain.

Mr PEARCE—So are you having any contact with the end users, like those people who are in ICT, or are you largely working with the people who are manufacturing?

Mr Ridge—That is a difficult question to answer. The product is all exported. The two systems consolidate, and then they sell to the Siemens and Alcatels of the world. We do not have a policy of buying locally and test spending here anymore. That is another issue.

Mr JOHNSON—Thank you for your presentation. I thoroughly enjoyed it and I also learnt a lot. I come from Queensland and I notice amongst all your material that there is no reference to any Queensland TAFE and/or university—correct me if I am wrong. To me, that is a concern. Perhaps you could comment on that. Also, I am very interested in the paragraph where you talk about the expat Australian who has been at the heart of the phenomenal explosion of photonics and the sums of money that you talk about. Could you elaborate a bit more on that? That seems to me a pretty inspirational story. The figures there are mind-boggling.

Mr Ridge—The University of Queensland does some photonics. They are not a member of our Photonics CRC. We have concentrated on where our members are: Sydney, ANU and Melbourne.

Mr JOHNSON—Is that through lack of interest or not having got around to it? Is there any particular reason—no drivers there?

Mr Ridge—I think the expertise of University of Queensland in photonics is in a different area than our field. So we have just concentrated on where our members are.

Mr JOHNSON—What about some of the TAFEs in Queensland?

Mr Ridge—We can only do so much, I guess. So we have just concentrated on where we have networks rather than spreading ourselves too thin.

Mr JOHNSON—Sure, I understand that.

Mr Ridge—That was the nature of the dotcom boom. It is a great story. One thing I would mention is that the Questacon show is great at raising awareness, but you have to provide the other steps of doing detailed workshops with kids to tell them an intensive story about how greatly this science can be applied. You have to develop a portal where kids go after the show so that they are excited about photonics—what do they do that night and what do they tell their parents?

Prof. Durant—Could we just come in with regard to Queensland and—

Mr Smith—Can I make the point that our arrangement with Australian Photonics is very good in that, although there weren't direct links in Queensland, we took the awareness program to Queensland because there were photonics courses and training courses that we promoted, even though they were beyond. The money was not just tied to in-house promotion; it was for the industry and the discipline in general. So it was for more a generic educational advantage. We toured quite extensively in Queensland and we have been there again this term.

Mr JOHNSON—I noticed some of the regional locations you went to. But have you been to Brisbane and the schools in the more urban areas?

Mr Smith—The agreement was to concentrate on rural and regional. The money has not allowed us to do a great deal in metropolitan areas. It was a cost decision to go for the areas of greatest need first. Should we get more money, we could come back into metropolitan areas.

There are other science programs within Brisbane metropolitan areas that we work in with as well, particularly the Science Centre in CSIRO.

Mr JOHNSON—There is the science centre that the Queensland government has a strong association with. Do you have any connection with that?

Mr Smith—Yes, there are former Questacon staff who work there. We have an Australian science and technology education network that we meet with. We coordinate our programs with other science centres, and CSIRO also have an education program. So, in any formal way, we try not to duplicate or overlap programs so we do not waste money and resources.

Mr JOHNSON—I find it particularly interesting because both CSIRO and the University of Queensland are in my electorate. I am certainly keen to play any part in coordinating, encouraging and/or coercing some kind of awareness and a more proactive involvement. This is a fantastic field, and I can certainly see the potential in it.

Mr Smith—Queensland schools have been particularly active in setting up networks with this technology—more so than some of the other states—making use of the actual technology to have modules and movement of material from one school to another, which we have appreciated with some of our other programs.

Mr JOHNSON—Going back to your response to my question about this company, can you elaborate further on what you said? You put it down to the dotcom boom. With sales of almost $US1 billion today and the number of people it is employing, is there anything in that that we can learn in this country rather than saying it is just part of the boom? Is it just that this particular individual is a brilliant entrepreneur? Can he come here and impart his experience and wisdom to our entrepreneurs?

Mr Ridge—We have had him along to our seminars. If only it were that easy. The trouble is that, were I in an industry development committee, to get new products adopted, you need a test bed, a site, to actually demonstrate that the technology works. We have great difficulty getting that test site in photonics in Australia.

Mr JOHNSON—So his focus is entirely in the US?

Mr Ridge—In the US and Canada.

Mr JOHNSON—And he has all the foundations and all the tests beds there?

Mr Ridge—Correct. They are a laser company and they sort of rode that photonics boom. Ninety-nine per cent of all our product is exported. Our difficulty in getting new customers is actually having that tested in a new network and a company, and generally we have to look overseas to have those technologies adopted and tested.

Mr FARMER—My question is directed to Graham Durant and Graham Smith. This is the education committee, and you mentioned that students are not so interested in science these days, that they are dropping off in numbers and that the whole idea of Questacon is to try to revitalise those numbers and to try to revitalise an interest in science. You also mentioned that

people do not go into the field of the science because of the money value. I suggest that that would be a factor for somebody in their later years of schooling, who is looking at their professional career and how much they can get paid in whatever career they decide to take on. You stated that you do not go into science because of the dollars and cents at the end of the line—you either have an interest in it or you do not. I would like feedback on this from both of you. I believe that students are set in their minds what they want to do, what sort of paths they want to travel along, in their lives at primary school age rather than secondary school age. That is where they develop this dream philosophy of what they want to be when they grow up or where they would like to go. It is at the primary school level that they develop their interest and fascination with science or various aspects of their lives. With that in mind, I would like to know what you are doing at a primary school level and whether you agree with my observations.

Prof. Durant—I think they are broadly correct insofar as children develop interests very early on. Again in the UK it was felt to be upper primary and the first two years of secondary where there was a great opportunity to influence them, and a lot of programs were targeted to that primary-secondary interface. The primary school children, the ones that come to Questacon in large numbers, are great enthusiasts. At that age they seem to love science—and a lot of other things. When it starts to get hard in the classroom, I think there is a movement away from science because you do need to start taking on board some quite hard concepts fairly early on as part of your learning of science. What happens by secondary years 3 and 4—I am sorry if these do not equate directly to the Australian ones; I can come back to the committee on that—which is by mid-range secondary level, is that they seem to turn away from science in significant numbers.

One of the problems in the UK in the primary sector is that the curriculum changed to introduce more science at primary level, but many of the teachers had no science training whatsoever. Suddenly they found that they had to teach science and they had no confidence in doing that. So over the past probably five or six years in the UK, particularly in Scotland, there has been a big problem with primary sector teachers trying to get up to speed to have the confidence to teach science. That has been a problem.

You are right that we have to get to the children very early on. Questacon programs do that, and the Science Circus, which has travelled all around Australia, pitches a lot of its programs at that younger age range and the early secondary range. As a set of stimulation activities, Questacon is trying to engage the minds of those very young children, and I think that is where you have to start. Those young children rapidly grow up, and we have to make sure that we continue to develop programs to grow as the youngsters grow so that we have appropriate secondary level programs. This is why Smart Moves has been introduced as a secondary level program. Graham, do you have any observations?

Mr Smith—I could not agree more with what you said. I think Questacon's programs, up until the association with the Photonics Institute and then about a year later with Smart Moves, concentrated almost entirely on that younger age group exactly for those reasons—particularly the teachers' lack of confidence with science and the demand for science. We knew it was matching supply with demand from schools. How to get the secondary audiences into Questacon in an affordable way for us was a difficult question. We had a very big uptake. We are seeing anything up to 120,000 primary school kids a year with the Science Circus.

The secondary audience was a much harder one to crack because of the specificity of the curriculum. Being able to match something like photonics with the physics, maths and careers curricula meant that we had a way of supplying what they needed. The more generic or broader curriculum in the primary areas enables us to fit in much more flexibly right across Australia. We found that the photonics awareness program fits into state curricula in different ways and with different terminology. For example, it fits into a year 9 unit in New South Wales on communication and light. Different states have different terminology, but the content is very similar.

Mr Ridge—Can I just make a comment. I mention here that New South Wales ran an e-summer school for disadvantaged kids out in the west at Mount Druitt and Lidcombe. We found out that there was a major ethnic community—lots of young women in scarves. We asked them at the start what they wanted to do, and it was child care, maybe because they did not want their expectations to be too high. After an intensive three-week course in photonics, they wanted to do photonics, biometrics, ICT and so on. At the end of the three weeks they said, 'I want a job in telecommunications.' Before that, they do not see the prize; they do not see the light. 'So why should I do physics, which is pretty ho-hum, when I can't see a job at the end of it? But if I see a light there, there's the job—it's physics being applied—maybe I will do the hard work and get enough physics to get this qualification to get into TAFE and do my advanced diploma.' But it was really interesting to show kids, 'This is high tech in action.' They went to industry and they could see, 'Yes, there are actual jobs out here that I could do and I'm interested in.'

CHAIR—Is that a general lesson for us in addressing areas of skill shortage generally? Obviously we have a mismatch of skills shortages to the skills of students—or the interests of students—and there are shortcomings in the effectiveness with which the education system addresses that. Is this the general approach we ought to be taking? Should we have a lot of other industries also doing outreach programs in our schools to make students aware of job opportunities?

Mr Ridge—I think you have to do the vertical integrated approach that we have done. You have to raise awareness and let everyone know what is out there and what is happening. But then you actually have to get into the classroom and develop courses and content, assist and professionally develop school teachers and TAFE teachers, and link researchers—who can say what is happening now and what they expect to happen in the next five or 10 years—with industry that is producing product now.

CHAIR—Are you confident then that your approach will deliver the work force requirements for your industry over the next decade?

Mr Ridge—I believe so.

Mr SAWFORD—Following on from what Pat was saying, it seems to me from our observations of primary schools around the country that primary level science increasingly does not exist in the schools. It is not even there. I heard you say, Graham—and it is a common thing that teachers say—that kids drop out of physics, chemistry and mathematics because it is too hard. That is what the teachers say. But what the kids say is, 'It's too boring.' And to be quite honest, it is. You only have to go around to secondary schools and have a look at what they are doing—God almighty. The word content is high, and the challenge, the curiosity, the

excitement—the spirit of physics—are not there because the teachers cannot teach science and they do not have a curriculum. They have a curriculum that has had all the challenge and response slashed out of it. Kids do not fall out of things because they are hard; they fall out because they are bored. I think that is the problem.

Mr Ridge—Sorry to interrupt, but I think that is sort of what we have tried to do. Kids at 13 are developing games and web sites. At Calwell High School we asked, 'Do you know any programming languages?' This kid says, 'PDP, Pearl,' and the teacher's jaw hits the floor as they go, 'I know PowerPoint.' These kids are programming and they are 13 years old. They are so far advanced. This is their medium, and you have to adapt the teaching to what they are used to—and that is what they are after, rather than sitting up in the old way.

Mr SAWFORD—I think Pat's got the point. Basically you need to change these primary school kids' views of themselves. If you go to a good primary school with a good primary school teacher and ask the kids in ordinary classrooms what they want to be, they say, 'I want to be a fireman,' or 'I want to be a nurse'—the basic things. But, if you go to an exciting teacher, the kids will say things like, 'I'm going to design the best motor car in the world,' or 'I'm going to design the best cutlery.' They have a different view of things. They have been taught a different dynamic, a different framework. They are the good teachers, but they seem to get lost in the system. Schools do not hang on to them. That is what is wrong with teaching these days; it is all sort of passe. I think what you said just a while ago, Lee, is correct, that the kids are way above the teachers.

Mr Ridge—How do you make it interesting? We are in contact with a guy who is an ex-lecturer developing little sorts of robotic circuits. How do you get approval? I think a teacher's budget is about $150. So our aim is to provide kids with a hands-on experience for less than $150 per school. It is a pretty hard task. We have to get industry to bury a bit of cost into that. So how do you make it really interesting? You can only do so much PowerPoint and look at the Web so many times. Where can you touch? Schools are not adequately resourced to provide simple little test kits that cost dollars, but they should have lots of them and they should have them every week.

Mr SAWFORD—In the past those at good schools would make a telephone system, their own radios—they made their own stuff. That needs materials. But you do not see that in schools these days. It is a rare school where you do.

Mr Ridge—At the Science Festival in Canberra every year we put a competition out to our researchers to come up with interesting experiments that cost less than $500. We have a technique in photonics, dense wave division multiplexing, where we split the light wave into 40 channels. Our researchers came up with four transistors. There is the sound going into the fibre—into a glass tube—and light comes out of the end. With some coloured cellophane you can say, 'This is four channels together, and with a different colour we can hear one radio station.' We have the manpower and the people to do it, but we need resources. Every school should have that little kit—and kids love it. They love the hands-on.

Ms PLIBERSEK—Chair, what you were saying—and Rod has made this point as well—about the difference in kids' sense of the possibilities that the workplace holds for them really fits in with what we have had in the vocational education evidence as well. We have heard all

over the place that most careers advisers just do not have the life experience themselves to talk about such things.

Mr Ridge—They are far too narrow.

Ms PLIBERSEK—Photonics is such a new area. I know that you have a partnership with TAFE now, but before the partnership with TAFE they were looking for technicians that could work in a photonics laboratory: not fully trained scientists and not people with no training but people somewhere in the middle. That is a terrific job for a young person who does not want to necessarily spend five or six years getting a high science degree but does want to work in an area like science. Where would you ever hear of jobs like that? Where would you ever hear of them if you are a normal kid in a normal school? How do you know that they exist?

Mr Smith—That is the behind the awareness program we are running. Information is one thing; resources are another, but they are down the track. It is just that initial spark. The fact that somebody has taken the trouble to go that far to talk to that particular group can set off a cascade of inquiry.

Ms PLIBERSEK—You are doing it in your area, but it is true that there is a world of jobs that I do not know the name of and that I do not understand.

CHAIR—They are not all just in emerging industries: other industries, traditional ones, have said to us the same thing, that kids just do not know that there are jobs available. A lot of it is about the information process.

Prof. Durant—There is a pattern of activity that I have noticed. I am not sure if I want to be quoted, but quite often—bearing in mind my experience is elsewhere—it was the poorer teachers who ended up being the careers teachers.

Mr SAWFORD—Sorry, the?

Prof. Durant—Poorer teachers, people who perhaps just get tired.

Ms PLIBERSEK—They cannot discipline a class.

Prof. Durant—They end up being moved into careers guidance. I think careers guidance is such an important area that you really need dynamic people—

Mr SAWFORD—It is selection on the short-straw method.

Ms PLIBERSEK—Bright kids get no careers guidance because careers teachers are trying to get apprenticeships for the kids that are not interested in university or further education. People think bright kids will look after themselves but lots of bright kids do not have parents or family who have been to university. They have parents or family who work in very average jobs. What do you do for those kids? You learn about what is in your life experience and, if your life experience is that the people around you are unemployed or are working in fairly basic sorts of jobs, you do not hear of—

Mr Smith—It is absolutely important. That is why I think our coming in from the outside or elsewhere adds a certain excitement. It does not require prolonged contact to get that spark going for kids to make their own inquiries, but they need to know about it to begin with.

Mr Ridge—And if you are really bright and your parents have not been to uni, you pick the safe professions of law and finance.

Ms PLIBERSEK—Law, medicine and accounting.

Mr FARMER—Mr Ridge, I want to know if you think that we should be developing greater relationships between industry and school, even at primary school level. If relationships seem to be the problem and if industry can have spin-offs of people moving into industry at a later date because they were invigorated by the science knowledge that they had been able to pick up—and you mention that you can get one of those kits for $500, which is peanuts to industry—could we as a government best facilitate that by bringing together as partners the links between industry and the school curriculum?

Mr Ridge—It is interesting that state governments chose TAFE to manage that e-summer school, and I think that was ideal because TAFE was the moderator. I do not think school straight to industry will work, but there is that moderating. That is what we act as in our industry. We are the facilitator—that is the institute's role for those types of events. TAFE was the moderator because it was able to organise some educational content and organise the industry visits in a programmed way. I think you need that. You need someone to facilitate it rather than having a direct school and industry link.

CHAIR—Thanks very much, gentlemen. That has been very interesting and very helpful. It has been very enlightening.

Resolved (on motion by **Mr Sawford**):

That this committee receive as evidence the submission from the Photonics Institute and authorise it for publication.

Resolved (on motion by **Mr Farmer**):

That this committee authorises publication of the transcript of the evidence given before it at public hearing this day.

Committee adjourned at 10.23 a.m.