

**Towards a ten-year plan for Science, Technology, Engineering and Mathematics
(STEM) Education and Skills in Queensland.**

Discussion Paper.

Response by

Dr. John Ridd, Innisfail

Relevant qualifications and experience

- Nearly 40 years experience as Head of Maths in UK (large comprehensive schools), Nigeria and Queensland in public schools/Teacher Training College.
- Co-author of a set of Maths textbooks for Years 8-10 in Queensland.
- Recent award of Doctorate, the thesis title being:
Participation in Physics and rigorous Maths and a consideration of educational, economic and political influences.
- Experience since 1973 with the (then) BOSSS and BOSSSS at district panel level, Chair of Maths B/Maths C panel (Cairns), Member of the statutory Moderation Committee of BOSSS and BOSSSS for many years until retirement.
- Author of a number of Education articles on Online Opinion.
- Author of Submissions to House of Representatives inquiry into Maths and Science Education.
- Author of 2007 submission to Senate Inquiry into Academic standards of School Education. It has a heavy emphasis on Queensland and, in particular, on Maths and enabling Sciences.

Introduction.

This response will be in a number of parts:

- (a) Page 1. Comments on text of the Discussion Paper referenced to relevant pages in the Paper.
- (b) Page 3. Comments on the 'Questions for Discussion' for those parts that I know I am both qualified and competent to make useful remarks.
- (c) Page 8 Senate submission referred to above.
- (d) Page 21 Brief summary of suggestions for actions that are essential for improvement of STEM Education and Skills.

It is essential to note that all of (a) to (d) are parts of a single whole. It would be totally inappropriate to consider some parts only.

Part (a) Comments on text of Discussion Paper

Page *viii* last paragraph. Very important point. Significance is amplified by the fact that lower Secondary schooling is the primary determining factor on participation in the enabling subjects – especially boys - in Years 11/12.

Page 9. Section 3.2. Third para and quotation. I do not follow the logic here. The quotation is talking about the seriousness of the problem, but the previous 4 lines are talking about a possible *method of dealing* with that problem. Clearly a different issue. Use of words ‘accessible’ and ‘attractive’ are amenable to such a plethora of interpretations that they are almost meaningless – or at least can be taken to mean whatever the reader wants them to mean.

Page 12. Marginal list of influences is remarkable in that it fails to mention the biggest influence of all – the QSA and their poor syllabi and assessment systems. This issue is dealt with in some detail in part (c) of this submission. q.v.

Page 12. paras 2 and 3. Very good. Emphasises the inevitably tension between the two objectives. At present, for years 1-10, there is no way that this tension can be resolved with current QSA syllabi/assessments (or, to be accurate, the total absence of valid assessments) and with fashionable internal organisation within the schools. This is again dealt with in part (c) of this submission.

Page 13. last para. Familiar stuff of course, but for me it highlights the pitiful state of our syllabi. As a part of my research for my PhD, I was able to demonstrate *beyond any shadow of doubt* that in lower secondary schools the *actual* time allocated for Maths and Science varied between the individual schools by a *ratio of 2:1*. That statement applied to *both* subjects and to *both* government and non government schools. A hopeless and disgraceful situation indeed.

Page 13. Marginal note. ‘Essential skills’ or ‘minima’ (used elsewhere) does nothing whatsoever for the somewhat more gifted third to a half of the students (in Maths in particular). Hence the idea is very dangerous because it deliberately fails to extend and hence empower that half of the students.

Page 14. Para 1. Please bear in mind that there is no reliable data on student outcomes at the end of year 10 and that has been true for 20 years. That fact combined with the pitiful subject syllabi for 1-10 makes ‘inconsistent delivery’ (and standards) inevitable. It is no good grumbling at the schools or the teachers within them. **The blame lies fairly and squarely on the QSA and its equally culpable predecessor, the QSCC.**

Page 17. ‘School to university pathways. Absolutely first class. The reduction in pre-requisites for entry to STEM subjects at Tertiary level has been a factor in the reduction of numbers taking Maths C (in particular), Physics and Chemistry. It is a common remark by students *and* their parents that ‘you do not need Maths C (or whatever to get in to do.....) The problems later faced by many students at Tertiary level is compounded by the fact that the Sound band is very wide and the percentage of students who achieve less than a Sound in Maths B is small. My rather brutal comment made to both students and parents is along the lines ‘well if you are going to fail at sometime or another it is better to do it at school – it is a lot cheaper’!

Whilst the magnitude of the effects of the QCA ‘rules’ pertaining to the new Certificate of Education on enrolments in the enabling subjects is presently unclear; the fact that all of Maths A/B/C ‘count’ equally towards ‘credits’ (and for the ‘numeracy’ requirement) means that there is clearly a strong possibility that students will consider taking Maths A rather than B or C because it is simply safer. One has to wonder whether the QSA have even *thought* of the fact that their rules may have deleterious effects on enrolments in more academically stringent subjects.

Page 19 re comparative performance. The document paints an unduly optimistic picture of the performance of our students c.f. other countries. It is not just that we are *below* the performance elsewhere, we are so far behind the best performances that we are not in the same league.

Page 20. I note the use of the word ‘minimum’. This has been dealt with in my comment re page 13. Re Female/Male performance. This issue is dealt with in some detail in my response to the Senate Inquiry, i.e. part c of this response. q.v.

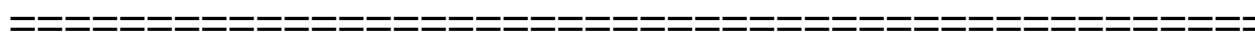
Page 21 re enrolment data. Despite the problems with the change from Maths 1/2 to Maths B/C it is possible to examine enrolment data over quite a long period (because of the ‘overlap period’.) Over a longer period of time declines in Maths C in particular have been very serious. One of the biggest worries is that enrolments per school is now so low as to make it hard for a school to justify offering the subject. The risk is a form of positive feedback making things even worse.

Page 24, 4th para in your 5.2.4. I am a little puzzled. If ‘less than 50%’ of students in STEM fields are female is a matter of concern, then why is the fact that male university participation is so weak not an even bigger problem? Please see Senate submission (part (c) of this document) for a consideration of the male female issue and in particular the application of the idea of ‘comparative advantage.

Page 26, your 6.2.1, 3rd para, is rather offensive. Since when have young teachers been necessarily better than older ones? Also is it really so bad that average retirement age is rising? I would have thought that it could be a good thing.

Page 28 top section. Good hard nosed material.

Pages 28/29, again most valuable, the brute fact is that a vast number of teacher emerging from the Tertiary level are woefully ignorant in respect of subject knowledge. Even where a student has taken a First Year subject it is frequently at a rudimentary level that approximates to Maths B at best. The problem of the lack of knowledgeable Maths/Science teachers, especially in Years 8/9/10 has dreadful consequences, because it is student performance over those three years that is the biggest determinant of enrolments in STEM in Year 11/12.



Part (b) Comments on Questions for discussion.

Note

I shall only answer questions where I know have sufficient knowledge (not rumour or opinion!) to make my response useful.

1.1 General definition of Science is, I suggest, a reflection of the low emphasis placed on the numerical aspects of STEM as a whole. Please add ‘**Measure**’ because everything is either counted or measured unless we just describe. Science is not just about trying to answer ‘what happens?’ but also ‘how much/many?’ Inevitably once we have measured something (and considered our accuracy) then it is inevitable that we will have to analyse that data and that can only be done using Mathematics. Please add the word ‘**Analyse**’. The fact that such analysis is inevitably mathematical I suggest that the phrase ‘**Mathematically analyse**’ would be useful. It is essential to note that the application of Maths is used in all Sciences; it is merely a matter of degree. It is not possible to study Physics without using Mathematics, it would cease to be Physics except in name. The applicability of Maths to all the Sciences leads, with total inevitability, to the fact that the bedrock of all STEM is Mathematics. To use a phrase from Logic; Mathematics is a necessary but not sufficient condition for the study of all STEM disciplines.

1.2 Science education is basic to any modern society. Totally vital. Without Science education there can be no Science in the long run. All that would be left would be a sequence of Belief statements. Phrases such as ‘science is *a* way of knowing’, with the PC implication that there

are other equally 'valid' 'ways of knowing' are wrong, pitiful, anti intellectual and a throw back to pre Renaissance concepts. I am relieved that there is no sign in the Discussion Paper of another ridiculous phrase, i.e. 'Western Science'. Another phrase that is missing, I am relieved to note, is 'all knowledge is culturally constructed' (or other weasel words that have the same profoundly anti intellectual implications). Bearing in mind that the crucial idea of zero is of Indian/Hindu origin and that the very word Algebra illustrates that that great mathematical tool is Arab in origin and that the concept of say pi or the exponential function are inherent in nature itself, then to peddle 'culturally constructed' is just stone ignorance dressed up to look intelligent. The Document has thrown off the yoke of PC drivel. I congratulate you, WELL DONE and thankyou. The thinking here makes it inevitable that you will have to kick QSA in the air, because their syllabi are littered with the sorts of claptrap NOT mentioned in the Discussion paper. (please, can I come and kick too? I have some really good steel capped boots!)

- 1.3 This dichotomy is important. Clearly both objectives are essential. My observations over the last 10 years or so plus solid research and research reading indicate that we are doing a very poor job on the second objective – especially in Maths and numerical science up to the end of Year 10. Insofar as the weak enrolments in the STEM subjects are caused by supply side problems (as is certainly the case for Engineering for example) then the problems can be traced back to the lower secondary stage. Once the students drop out of STEM in Year 11 they are lost. The syllabi HAVE to be drastically redrawn so as to empower students by the end of Year 10. Notably in Maths there has to be a massive improvement in algebra because it is 'the gateway to later mathematics'. The current Science syllabus has no numerical Science in it at all. That MUST change. There has to be a huge change in internal school organisation so that we can get away from the eternal mixed ability groups. In Maths in particular the whole idea of mixed ability grouping is ridiculous – and horribly cruel. PLEASE read Section (c) of this response to get a better idea of what I am thinking on this vital issue. It should be noted that with proper syllabi and sensible, realistic internal organisation we can achieve **both** of the objectives that you so cogently identify. Beyond Year 10 the syllabi should be much clearer and the assessment system changed from the present abject mess to something better. Again it is vital that you read my Section (c) on this issue. There are also articles of mine on Online Opinion on this issue, notably '*Floating gently on a waft of Edudribble*', an article that upset some people in the QSA. Also '*Wadderloader!*' may be of interest. Consideration should be given to some sort of proper State wide, validated assessment at Year 10 exit.
- 1.4 As indicated above and of course in section (c) of this submission.
- 2.1 My response here is short and definite. First question reply – Totally. Second question reply – unless we ensure the workforce is STEM literate we shall become a backward nation.
- 2.2 No problems. Any list can be criticised but yours will do for me. All it needs to do is illustrate the fantastic importance of STEM, and it does that.
- 2.3 I can accept that division. I reason as follows: the odds are very high that anyone who goes in for financial type jobs will have taken Maths B. For Health related jobs there must be a foundation of STEM knowledge and understanding or the person will emerge into the workforce as no more than a mindless 'doer' of trained tricks. I do not wish to be in the care of such people, I want them to understand what they are doing, not just 'perform'.
- 2.4 STEM, the 'enabling' disciplines, is essential for two reasons. Firstly so that the employees (in whatever occupation) can work efficiently in the short term. Secondly when changes, new ideas and techniques arise – as they most certainly will – the employees have the fundamental understandings, knowledge and skills to adapt relatively easily to whatever comes along. Without STEM the person is *trained* to 'perform' some present day practices. They are hopelessly ill equipped to adapt to changes because they do not have the fundamental skills etc. They are not empowered. Poor things, they are stuck; sad.
- 2.5 No comment
- 2.6 No comment

- 2.7 No comment
- 2.8 No comment.
- 3.1 I know of none that have produced significant, measured improvements. As you are now aware(!), I am convinced that the supply side problem is overwhelmingly caused by the feeble syllabi and associated assessment systems produced by QSA or the equally culpable predecessor, the QSCC. Of course, up to the end of Year 10 there is no valid assessment at all.
- 3.2 Following on from above comment – none.
- 3.3 A complex issue. If a national set of syllabi were produced that were clearer and of a higher standard, and if the associated assessment systems were reliable and valid, then it could be useful. But as I understand it when the States met on the issue they agreed that each State would keep its own assessment system. If that is so then the whole thing is ruined because there would be no way of knowing (and hence being able to measure) the outcomes and hence no way of telling if improvement had occurred. The other killing problem is that if the ‘agreed’ syllabi were merely a list of ‘essential learnings’ (under whatever jargonesque name) that might conceivably help the less talented students, but would do nothing at all for the somewhat more gifted students. Hence, at best it might have some value in meeting the first of your twin aims as stated in your question 1.3, but would do nothing at all to meet the second of your aims. Please note that I refer to ‘syllabus’, not curriculum. It is the individual syllabi that are the problem, not the curriculum which I define as being a collection of subject syllabi.
- 4.1 No comment. (Apart from fixing up the QSA/QSCC emanations called syllabi). Internal things within Primary schools are not within my area of knowledge and competence.
- 4.2 A root and branch rewrite of the syllabi/assessment systems is essential so that they each meet the criteria of being **Defined, Reliable and Valid**. Additionally the schools themselves must, particularly in Mathematics) get away from the fashionable mixed ability groupings. Again, please read Section (c) of this Response.
- 4.3 Up to Year 10 Science should be a compulsory subject (with a radically changed syllabus). I am not sure in Years 11/12. I can see arguments both ways. For Maths it must be compulsory up to the end of Year 10 but with the root and branch job referred to previously being essential. In Years 11/12 my observations are that in the schools some form of Maths is de facto compulsory because one of the choice ‘lines’ is all Maths at some level – MB or MA or a registered subject etc. So probably this is not really an issue.
- 4.4 The opportunities for improvement are there of course but it will not happen. The reason is simple, both QCAR and the Senior Review are being done by the QSA and not only are they responsible for the current syllabi/assessment systems but are actively operating to make things worse. Only when Parliament steps in will there be any improvement. Please see the final paragraph in my Section (c) of this Response. See also, if you wish(!) another Online Opinion article entitled *Required – the deconstruction of the Boards of Study*. I feel that I should make a personal comment here. For years since 1973 I was involved with the BOSSS and the BOSSSS at various levels. I considered them to be the best organisation I had ever had the privilege of working with. They were intelligent, dedicated and had an excellent grasp of reality. Hence, although I know that neither QSCC nor QSA is the same organisation as the BOSSSS, I find it heartbreaking to have to criticise QSA as I do. But sadly they really are as bad as I say here.
- 4.5 No comment.
- 4.6 In essence this question is asking me to write the syllabi! Actually the question bothers me because it implies that it is possible to respond in a few lines. I could do that for I can speak edubabble very well, but it would only be yet another example of high sounding but hopelessly vague ‘essentials’ that are totally, and I believe deliberately, capable of being interpreted in whatever way the reader happens to fancy. Just make all syllabi meet the criteria **Defined, valid and reliable**.
- 4.7 Very little I suspect, lack of competent syllabus constructors and lack of knowledgeable teacher are problems that are not amenable to a technological fix.
- 4.8 No further comment. Adequate labs for Science of course, otherwise see previous comment.

4.9 No comment

4.10 No comment

4.11 I assume that this does not refer to university Maths, Physics, Chem etc. It is not for me to make a comment. Apart from anything else they would be far more up to date with current developments in their disciplines than any of the rest of us. If it means Faculties of Education, then if one assumes that their *raison d'être* is to produce knowledgeable and skilled teachers then they are failing badly.

4.12 No comment

5.1 I note your word 'opinion'. My opinion, which in the last ten years or so is based on my tutoring work, is that the following produces remarkable results especially in Maths, but also in Physics. I know that *I* like success and I have yet to meet anyone, child or adult that does not. Virtually all the students that I have seen over the years do very little practice to achieve mastery at a given topic. NONE of the students that have come to me EVER mark their work, repeat NONE. They have no idea if they are getting the questions 'right'. Hence none of them *ever* know the feeling of success. It is my insistence on my students doing plenty of practice – and marking every answer that changes their whole attitude. Suddenly they not only CAN do the work, but they KNOW that they can. That knowledge gives them a huge buzz and boost. The fact is that I produce huge improvements by insisting on marked practice together with the fact that I actually **teach** them (rather than expecting them to get anywhere by my being, God give me strength, a 'learning facilitator'). Of course I know that my approach would be derided by education theorists as being 'tick and flick'. Equally I know that that sort of eduspeaker is fond of phrases like that, i.e. phrases that are clever sounding but unintelligent verging on the moronic.

I also know that my methods achieve measurable success and that is a whole lot more than the eduspeakers can claim. Many students NEVER use a textbook at all. I know for a fact that my oldest Grandson never uses a book for Maths B, Maths C, Physics or Chemistry. He does not even take them to school and they moulder on his bookshelves. He does poorly of course. What the students do get is lots of loose sheets. Of course, apart from the few that are well organised they lose them or, for a few have them but cannot find them. About 30 years ago one teacher and I decided that we did not like the current text books. We wrote out hundreds of sheets that contained general text, worked examples plenty of questions for the little dears to do and of course answers. We duplicated them. We then had a brilliant idea (drum roll) we bought a very big stapler and stapled the lot together. Wasn't that clever? I watch all these odd sheets flapping around and wonder what on earth people think they are doing. Either use a text book (or books) or do the job yourself *properly*.

5.2 I refer you to my section (c) on this topic. Note the idea of comparative advantage.

5.3 No comment

5.4 No real comment. Could be similar to ideas referred to in 5.2 above.

5.5 Same response as for 5.2 above, i.e. see my Section (c) of this submission.

5.6 The issue of social discriminatory effects is also dealt with me in Section © q.v.

5.7 I can only respond to the problem within the schools at the end of Year 10 into Year 11. Again dealt with elsewhere. See Section (c) please.

5.8 I am told by people inside Tertiary institutions that it is having a bad effect, but obviously that is second hand information. What I can state from my own experiences is that the students and the parents all know what the prerequisites are and regularly 'throw them into your face' when you try to persuade (competent only) students to take Maths C in particular in Years 11/12. I refer you to your excellent material on your page 17, and to my comment on page two of this document.

6.1 Very important indeed, essential; you cannot teach what you do not fully grasp yourself.

6.2 Two years of successful tertiary study in the subject. As mentioned previously many First year courses are at a pitifully low level and are useless in this context.

- 6.3 Frequently they do not prepare them for the realities within schools. I have a vivid memory of a long discussion with an Education lecturer on this issue. When I pointed out that a teacher who has had no Maths in a B.ED course can, and often does, find that the exigencies in the school they later go to require them to teach Maths; his response, made with total sincerity was that that just does not happen. He is a very nice chap, honest, hard working, dedicated etc, but he had no idea at all of the realities within schools. So the young teachers get put into a difficult position and that is bad. But much worse are the consequences for the students. The problems for the suffering teacher are compounded by the pathetic syllabi and the failure to use textbooks as an 'aid'. Sometimes the textbooks are not the best either. This issue is also dealt with in Section (c) of this submission.
- 6.4 Can be useful possibly, depends who runs the courses; but they are no substitute for good subject knowledge, half way decent syllabi etc.
- 6.5 No real comment.
- 6.6 This raises a possibility. There are sometimes academically well qualified people who are perhaps in their late 30's or early 40's who are in industry or whatever and who would like a change to teaching. The problem there is that they are discouraged by the fact that a Dip Ed takes so long – about 18 months I believe. That is silly and only serves to provide employment for people within Education faculties. It is beyond my comprehension that it should take more than six months as an absolute maximum.
- 6.7 I'm afraid I can only suggest money!
- 6.8 Perception of better opportunities outside perhaps. A realisation that teaching is not what they imagined perhaps. A recognition that they do not have 'what it takes' perhaps. Frustration at the low standards notably in Years 8-10 perhaps.
- 6.9 As for 6.7, I can only suggest money. Well qualified (academically) STEM teachers can always get jobs outside. For most other subject area teachers that is much less true if at all.
- 6.10 It is obviously ludicrous that it costs students more to get a BSc/BEd than it does to get a B.A./B.Ed. I fully understand that it is far more expensive to the universities to run science courses than Arts courses, but that inevitable financial burden should be borne by government, not the student. Simply counter productive.
- 7.1 Very few of the many students that I have tutored have even the faintest idea of the amazing number of career possibilities or the staggering variety of course offerings at the universities. It is a huge problem. I find that if I force the students to sit in front of a computer and start to Google as I show them for the various institutions they are staggered at what they find. They had had no idea that there is a big wide world out there and it is, or should be, at their feet. My observations are that that sort of thing is never done within any of the many schools I know about. I presume that it is the Guidance Officers responsibility. However either they do not have the time, or they do not have the knowledge or for some other reason(s) the fact are, as I see them, that it just is not being done. It should be of course. If ever there was an area where the students need guidance it is this. By the way, it does not take long because the students not only realise that opportunities are out there, but also now know how to 'snoop' around themselves on the web.
- 7.2 Really a continuation of 7.1. So hard to make constructive suggestions. All I can think of is that the emphasis in the 'job description' should be much more on this important topic and less on some of the things that currently use up their time. Sometimes I wonder whether some schools think of Guidance officers as convenient places to dump difficult children. Perhaps that is too cruel. Certainly the aspect of guidance that is to do with opportunities beyond school is not receiving the 'weight' that it should.
- 7.3 Be knowledgeable and enthusiastic about the subject. Let it be obvious that you get a buzz from the subject. Learn, off the web perhaps what are the opportunities outside and tell them. Make clear that Science is vital to our world and that New Age stuff is hog wash. Challenge the students to justify their opinions. Be keen, be willing to get involved in whatever are the big news items at the time and put the scientific aspects in front of them. Be *alive, passionate* for truth and verifiable ideas as opposed to what are often no more than belief statements.

- 7.4 Not known to me. No comment.
- 7.5 Very hard. The only sort of Science that appeals to the public is medical science. There, a slight possibility that some piece of research might possibly cure a disease in 20 years time will be on TV forthwith. Anything else just does not get attention. I wrote up to that last sentence yesterday (27th) late, and then gave up for the day. This morning at 6.15 there was a radio item on the 'Rural Report' about the setting up of a very important forest research establishment at JCU Cairns. The interviewed Professor talked about the current lack of much knowledge – except for tree species - and talked about fungi, micro organisms etc. The interviewer couldn't get in quick enough and started to talk about the possibility that they might discover a cure for cancer. The Prof. tried to de-emphasise that possibility, but that was all that the interviewer wanted to hear about. *That* is the problem that STEM disciplines have. Unless something is 'medical' or alternatively a prognosis of some sort of catastrophe then the media just do not give a damn.
- 7.6 No comment.

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Part (c) Senate Inquiry Submission 2007.

Inquiry into Academic Standards of School Education

Senate Committee, Parliament of Australia

Submission

John C. Ridd

B Sc (London), AKC (London), PGCE (London), BA (UQ), B Ed (UQ), Ph D (JCU)

Biographical note

John Ridd taught in UK for ten years, mainly as Head of Maths in large London Comprehensive schools, for six years in a secondary school and a Teachers Training College in Nigeria, and from 1970 until retirement as Head of Maths Innisfail SHS, North Queensland. He was heavily involved with the Queensland Board of Senior Secondary School Studies, Brisbane and was co-author of a series of Qld Secondary Maths texts (Oxford U P).

Summary

This submission responds in some detail to the Inquiry Terms of Reference 1(a), 1(b), and to a lesser extent and by implication, to 2 and 3. The vexed issue of male performance is also examined. It mainly considers the condition of Maths and the numerical Sciences and has a strong emphasis on Queensland.

There is only a small amount of good international data. It shows that Australia is performing relatively poorly. Enrolments in rigorous Maths and Physics in particular are poor across the nation

leading to problems at tertiary level. It is strongly argued, and much supporting evidence is given, that student experiences in lower secondary school are particularly crucial because of their effect on subject selection/enrolments in Years 11/12, standards at the end of senior schooling and on later life. It is demonstrated beyond doubt that in Queensland there has been no valid system of assessment at the end of Year 10 for twenty years. Students are ill prepared for the transition to senior schooling. Two studies of the condition of Maths and Science in Queensland are examined; one demonstrates that the position is poor, in particular for the powerful tool Algebra. The other includes critical opinions of secondary principals from across the State. The general condition of syllabi up to Year 10 exit are considered and heavily criticised. Evidence is produced to demonstrate that the Maths and physical Science syllabi and school internal structures do not cater for 'bright' students. Syllabi and assessment systems for Years 11/12 in Queensland are considered. They are shown to be poor, vague, depend for both teaching and assessment on 'assignments' and are socially discriminatory. An examination of the assessment system to the end of Year 12 demonstrates that the excellent system that once existed has been ruined. Male performance and influences on those performances are examined. There is powerful evidence that taken together syllabi, assessment systems and lower secondary school organisation are collectively sexually as well as socially discriminatory.

Background to submission

The committee may consider it relevant for me to state that my Ph D, awarded in 2004, had as its thesis title

*Participation in Physics and rigorous Mathematics
and a consideration of educational, economic and political influences.*

The work for that qualification was done over six years. Throughout that time, and ever since, I tutor Secondary students privately so giving me a 'finger on the pulse' of current education practices.

This Submission will not use education jargon; not because I imagine that the Senators could not handle such jargon, but because it my observation that education jargon is frequently used as an exercise in obfuscation.

Because my experience is mainly in the fields of Mathematics and Physics (although I am also qualified to, and have taught, Modern and Ancient History and Study of Religion,) the Submission will concentrate on Mathematics and the numerical Sciences. There will be an emphasis on Queensland.

The Senate is to be congratulated for instituting this Inquiry. The timing is highly appropriate for a number of reasons.

Firstly there is fundamental agreement between the current Minister for Education and the shadow Minister. It is evident that both of the major political groupings accept the fact that there are major problems in schooling. Both Maths and the numerical Sciences were mentioned as being areas of concern. There are differences of view as to the best way to handle the problem, but the fact is that they agree that a major problem exists.

Secondly there is the unfortunate fact that an Inquiry in the House of Representatives in respect of Maths and Science education 'died' on the calling of the last election and the new House did not restart that Inquiry. A most regrettable decision.

Thirdly there has been a major Review of the condition of Maths in Australia. That has been backed by an 'Open letter' of support for that Review signed by some hundreds of people involved in Maths education or those involved in disciplines that to a greater or lesser extent depend on Mathematics – Physics, Chemistry, Engineering etc. Whilst it has to be said that mathematicians and scientists et al have been shockingly slow to recognise the problem, it is a case of 'better late than never'. (There have been a small number of honourable exceptions to that tardiness. Such people deserve our respectful thanks).

Data

There is not a great deal of reliable data in respect of Australian student's standards in Mathematics and Science with the notable exception of the long running TIMSS data. That demonstrates unequivocally that our children's results are poor in comparison to a lot of other countries such as Singapore. This data is repeated every few years and it has to be said that there is no sign of any improvement. It should be noted that after the last but one TIMSS results came out ACER tried to defend the results by comparing Australia with a number of other English speaking countries. It was pointed out at that time that such a comparison was self serving. The comparison should have been then, and still should be, with the 'First division' not the 'Second or Third division'. Mr Rudd and others have raised the obvious economic effects of poor education standards, in particular in comparison with our economic competitors. It is those countries that do better than us. That is a most serious matter from a national point of view let alone the clear injustice of knowingly providing an education to our children that will put them in a weak position in the global world they live in and will live in.

To the best of my knowledge there are no hard international comparisons available later than Year 9. In view of the fact that a major objective of this Inquiry is *'the extent to which each stage of schooling (early primary; middle schooling; senior schooling equips students.....to progress successfully to the next stage...'*, the absence of good international data at the end of Year 10 is especially unfortunate.

The declines in enrolments in rigorous Mathematics and the numerical Sciences in senior schooling will be well known to the Senators. There is hence no point in repeating that information here. Sufficient to say that they are nigh on catastrophic. What may not be so well known to the Senators is the fact that (in Queensland at least and probably elsewhere) the vast majority of that decline is a decline in male participation. For example in the period 1981 to 2001 enrolments in the most rigorous Maths in Queensland declined by about 27% (and that decline has continued since that period) *'there is no indication that the decline is slowing much if at all. In absolute terms male decline was 778, female decline was 247. As was the case in Physics male enrolment was by far the biggest contributor to the total decline, being 76% of the total.'* (Ridd J. 2004 unpublished PhD thesis.) It should be borne in mind that these declines have taken place in a State with a very high rate of population increase.

The Senators will have noted that the declines started many years ago. That is why I earlier remarked that mathematicians and scientists have been 'shockingly slow' to recognise the problem.

Implications for Tertiary study

Declines in enrolments and standards in upper secondary school rigorous Maths and the associated numerical Sciences have inevitably led to serious problems in enrolments at tertiary level. Whilst it is possible – as has been suggested in some quarters – to argue that those tertiary problems are a consequence of lack of demand, i.e. employment opportunities, it is clearly not in the case of Engineering. In January 2006, Professor Archie Johnston, President of the Australian Council of Engineering Deans, referring to the feeble condition of engineering enrolments by domestic as opposed to overseas students at a time of high demand for engineers was quoted in *The Australian* as saying *'the biggest hurdle is the mathematics; the demand for mathematics(in schools) has plummeted'*. He went on to remark that university training in engineering demanded a solid preparation in mathematics at school. To put it in quasi economic terms, the declines in enrolments cannot be put down entirely to a weak demand side; some of it must be driven by a problem in the supply side.

Importance of lower secondary schooling

It is intuitively obvious that the education experiences in Years 8/9/10 must be a prime determinant of each student's selection of subjects to be studied in Years 11/12 and success in those subjects. However it is not necessary to depend on an intuitive feeling (no matter how blindingly obvious it may be); there is good research to support that intuitive feeling, especially for 'physical' i.e.

numerical Science. The influence of student's previous experience in Years 9/10 on subsequent participation in physical Science was examined by Ainley as long ago as 1993. Emphasising the importance of prior experience he concluded that *'as a generalisation, participation in a physical science type course is most strongly shaped by earlier achievement in numeracy, an interest in investigative activities and gender.....among males, the influence of earlier achievement on physical science participation is independent of, and much stronger than socio-economic status.'* (Ainley 1993).

There is also solid evidence that lower secondary performance has an effect on results at the end of secondary education. The most usual measure of the 'result' of secondary education is the Equivalent National Tertiary Entrance Rank (ENTER) result, (called TES or OP et al in various jurisdictions). A Longitudinal Survey of Australian Youth (LSAYR 22, 2001) showed that numeracy/literacy in Year 9 was by far the biggest determinant of final student performance. Furthermore the effect of numeracy was greater than the effect of literacy in every State. (This issue will be re-visited in the section on 'males') There is currently a rather excited 'discussion' over the relativity of 'Private' v "Public' schools. In that context it should be noted that 'school type' was a very minor determinant, almost negligible. 'Individual school' a much larger determinant – though still small compared to literacy/numeracy in lower secondary schooling.

There is yet further confirming evidence of the importance of earlier education from both UK and US. Alison Wolf, professor of Education at the University of London's Institute of Education, repeatedly emphasises the importance of lower secondary education. (Wolf 2002). One of the outcomes of a UK longitudinal study that followed students born in 1958 and 1970 demonstrated that, when all other variables including formal education are controlled, basic skills showed up as vital determinants of a persons future life. *'(the study) underscores the enormous importance, in modern societies, of basic academic skills. Poor literacy and poor numeracy – especially the latter – have a devastating effect on people's chances of well-paid and stable employment'*. Wolf also reports on another longitudinal survey in the US for students who were in their final year of high school in 1972 and 1980. It examined *'whether (language and maths) skills, as measured by these tests, affect future earnings over and above the effects of any formal qualifications.....It seems that they do'* Furthermore *'it again seems to be mathematical skills which matter most'*.

This firm establishment of the importance of lower secondary schooling, together with the fact that students make almost irreversible decisions in respect of subject choice at the end of that time, makes an examination of the situation at Year 10 exit essential. The 'interface' (as people these days like to call it) between Year10 and Year 11 is one of the crucial aspects – I would feel the most crucial - of a central issue of this Inquiry: to examine *'the extent to which each stage.....equips students to progress successfully to the next stage.....'*

Queensland the data vacuum State

The two matters that have to be considered are the syllabi and the assessment systems. Clearly it is impossible to know how well students are prepared for senior schooling without a valid system of assessment at the end of Year 10. As I indicated at the start of this submission I shall concentrate on Queensland with a sub emphasis on Maths and numerical Science.

The Queensland situation in respect of legitimate, valid, assessments at the end of Year 10 is very simple. There aren't any and there have not been for 20 years. Understandably and rightly the Senators will doubt that sweeping statement and expect clear justification of it.

I must explain that in 1987 the Queensland Parliament abolished the Board of Secondary School Studies that had previously been responsible for syllabi and assessment for Years 8 to 12 inclusive and replaced it with The Board of *Senior* Secondary School Studies responsible for Years 11/12 only, together with the Queensland Schools Curriculum Council that had responsibility for Years 1 to 10.

In response to a letter from me that I sent as a part of my PhD research, I was informed that: *'There is currently no ongoing collection of systematic data concerning the adequacy of mathematics programs at Years 9 and 10 in preparing students for entry to mathematics courses in Years 11 and 12.'* (Dean Wells 1999 pers. com.) Mr Wells was at that time the Queensland Minister for Education in the Goss Labor government.

Earlier I had made the same enquiry of the previous Coalition government. The reply on that occasion was: *'Since 1987, there has been no legislative process to ensure schools complied with syllabus requirements. Technically, accredited school programmes are being followed.....The newly formed Queensland Schools Curriculum Council does not have accrediting responsibility.....QSCC..... has determined that matters associated with implementation are the responsibility of the schools and the school systems. Schools and their systems will determine time allocations. Education Queensland is establishing a number of processes, including 'teacher outcomes' and processes associated with schools' annual reports that will contribute to comparability of education programs in state schools. Non government schools will retain their own independence'.* (Eltham 1998 pers.com.) Eltham was the Senior Policy Advisor at that time. The refusal of the QSCC to have anything to do with assessment in respect of all students in all subjects in the State may strike the Senators as being reprehensible. It makes me think of Pontius Pilate.

The Senators should note that the total lack of any valid assessment to the end of Year 10 applies in Queensland to all subjects without exception.

Importance and centrality of algebra

Before examining the small amount of reliable analysis of 'standards' of student work in Queensland at the end of Year 10 – the crucial point in a student's education – it is worth stating that one of the chapters in my thesis was 'Algebra as a tool'. Simple observation makes it clear that, without the ability to use algebra and the willingness to use it, students are effectively hamstrung in all higher Maths from Year 11 onwards. Furthermore any student who lacks the algebraic tool is in desperate trouble in Physics, physical Chemistry and, later, Engineering.

However, just as it was not necessary to depend solely on common sense and observation for the statement that what happens in Years 8/9/10 are crucial determinants of success in later years because there is good research that confirms the fact; so also there is strong expert opinion to support the notion that algebra is crucial for later Maths and numerical Science.

Writing in 1999, Stacey and Macgregor put it this way: *'.....the special role of algebra as the gateway to higher mathematics. Algebra is the language of higher mathematics and is also a set of methods to solve problems...'* Another authority stated *'.....a gatekeeper to educational opportunity.....(and) introduces students to mathematics as a style or method of thinking, involving modelling, abstraction, and the formalisation of patterns and functions'.* (Silver 1995).

'Maths as a Foundation'

The crucial nature of algebra in enabling students *'to progress successfully to the next stage'* - in this case into senior schooling makes the one piece of high quality research into the condition of education in Queensland to end of Year 10 of especial significance. (Allen, 2001) That research was completed in 2001 by people within the (then) Queensland Board of Senior Secondary School Studies, but was at the request of the Queensland Schools Curriculum Council. The report was entitled *Maths as a Foundation*. It is interesting to note the similarity in thinking between the title of that report and drafters of the Terms of Reference for this Inquiry.

The first part of the research involved obtaining a large number of teacher opinions. The teachers involved were all teachers of Mathematics in Year 11. They were asked about the preparedness of their Year 11 students in the two rigorous Maths subjects, Maths B and Maths C. Those opinions were worrying but unsurprising. In particular for the section of Maths under the heading 'applying techniques' demonstrated that the situation was already poor. (My guess is that things are worse now).

Year 11 students who have opted for Maths B or Maths C or Physics or Chemistry are confronted with a wide selection of material requiring the use of algebra. Financial Maths, all trigonometry, projectile motion, physical Chemistry are but a miniscule sample of such topics. For that a student must be able to translate a word problem into an algebraic sentence. The Allen report found that for that area of work *'there are no items showing perceptions of widespread familiarity'*. (Their emphasis.) Furthermore only a minority of Maths B or Maths C students were really reliable at the task 'translate a simple word problem into algebra'. It is a reasonable deduction from the data that less than 35% of students in even the best classes can reliably translate a word problem into an algebraic sentence. There is no way these students are prepared *'to progress successfully'*.

The second part of the research was a very detailed examination of the work of students from a large number of schools. All of the students had been awarded the highest possible Level of Achievement by their respective schools. Their work was examined by a panel of 'expert teachers'. Subsequent analysis of the comments by the 'expert teachers' showed that the standards variation noted *'by the judges are much, much bigger than there would be if there were no clear differences amongst the folios'*, and that there was *'variability in the content, coverage and standards'*. (Allen 2001, pp. 31, 32)

There is no shadow of doubt that Maths to the end of Year 10 fails abjectly in providing circumstances that enable students to *'progress successfully to the next stage'* in any rigorous Maths or the physical Sciences – and hence, later, Engineering. That this has been allowed to go on for decades is a scandal.

The report *Maths as a Foundation* was examining the situation in Mathematics only. However the report also commented that a wide variation in standards could also be assumed to exist in all other subjects. That is logical because the root problem for Mathematics also existed for all of them too – the total absence of proper assessment over many years. The report also commented on the fact that the implications for syllabus construction for Years 11/12 were very serious. Any syllabus has to 'start' somewhere, in the process making assumptions as to the previous skills/knowledge of the students. Because there is no sound information of that student skill/knowledge at the end of Year 10 in Queensland, there is nothing left but guesswork and rumour.

I have gained some degree of amusement by the fact that a number of people from the Queensland Studies Authority (the heir of the QSCC and the BOSSSS) have indicated that they have not heard of or are able to find Allen's report *'Maths as a Foundation'*!

Opinions of secondary Principals

At a similar period to the construction of the Allen Report, as a part of my research, I carried out a State wide survey of Secondary school Principals in an attempt to find out what was happening in Years 8/9/10 in Queensland. (Obviously no individual, organisation or government Department had any idea at all). The response rate was remarkable – just over 70% - a fact that I thought then, and still think, represented a substantial degree of concern. There was a huge majority of the Principals who thought there were differing standards from school to school. A majority of them opined that the differences were of concern. The times per week allocated to both Maths and Science varied in an astonishing ratio of 2:1 in both government and non government schools. There were remarkable differences in internal organisation for Mathematics. In addition to responses to questions, the Principals were given the opportunity to comment freely. Most did, some of them at great length. A few samples of those comments which may be of interest to the Senators are:

The abolition of the accreditation and monitoring process at Years 9 and 10 has increased the gap between Years 9/10 and 11 and 12.

Of greater concern is the apparent 'jump' from Year 10 Maths to Year 11 Maths.

Standards of work should be moderated at Years 6 or 7 and at Years 9/10 in at least English and Maths.

The erosion of standards in Years 9 & 10 has been an ongoing process – even in literacy/numeracy areas.

It is time that some in depth research is done into the state of middle schooling years – the department is dragging its feet.

We need to revisit syllabus and critically examine what is taught. I believe it is essential that Algebra is given its true significance. There is a need for formal integration of Maths/Science topics. Quantitative analysis should be mandatory in Science programmes – a degree of rigour is not the death knell of interest!

Three of those six comments were from government schools, three from non government. The furthest North was from the Cairns area, the furthest South was from Brisbane.

All the evidence pointed and still points the same way. In Queensland at least middle schooling Maths does not provide a reasonable basis for success at the next stage.

The Principal who wrote the last of the comments quoted above must now be nearly suicidal. Apart from the failure to improve algebra since the comment was written, the condition of numerical Science has become much worse. There is now no numerical Science in Years 8/9/10. As a very bright Year 9 commented to me a few years ago *'it is not true that there are no numbers in this Science book – there is one at the bottom of every page'*. It is a sad fact that Science in the years up to the end of Year 10 in Queensland is essentially all descriptive. It is non numerical, pre Newtonian.

The awful gap between the end of Year 10 and the start of Year 11 in Queensland is there for all to see. As is inevitable the work to be studied at the start of Year 11 Maths has had to be softened, weakened, by a large amount. Work that used to be done in Years 8/9/10 now appears in the first sections of the Year 11 Maths B texts. Naturally the longer term effect of that is that the standards reached by the end of Year 12 have declined – with implications for the next stage – University Maths, physical Science and Engineering. There is a gap there too.

It is noteworthy that QSA does now recognise that there is a problem due to the 'gap' between 10 and 11. The Senators will be unsurprised to know that QSA claims that the problem has arisen because of the nationwide introduction of the Key Learning Areas, the KLAs. No blame attaches to QSA/QSCC apparently.

Syllabi and school organisation fail the more 'gifted'

Mathematics and, to a slightly lesser extent, the physical Sciences are highly sequential subjects. Any and all weaknesses in concepts, skills etc result in all later study being analogous to trying to erect walls on a foundation that can 'give way' at any time. Any question attempted relies on a quite large number of ideas and techniques. Just one weakness and all is lost. No three strikes and you are out in Maths; just one is enough. Associated with that reality is the fact that students vary widely in their Mathematical attainments – and hence what it is reasonable to expect them to be able to learn 'next'. In one large London comprehensive school years ago all students were given a standardised test soon after entry. They were 11 years old at that stage. The results came out as a 'mathematical attainment age'. The minimum result possible was 6 years. Every year a number could not even reach 7 years equivalent, and every year there were people who scored in the range 14-16 years. So mathematically speaking they varied between very little boys and teenagers. To try to teach similar material to all of them would not only be an exercise in fantasy but more importantly unbelievably cruel. Of course we didn't do that.

Supporting evidence for the wide variation between students at quite a young age is to be found in an article by Endler and Bond. In 2000 they analysed the cognitive development of some children

from a Piagetian viewpoint. In a long term study of students in a North Queensland school they examined changes to cognitive development over time. They reported that at the Year 8 level nearly 30% of the students were still at the 'Early concrete level'. At the other end of the spectrum 40% were either in the 'Early formal' or 'Late formal' stages. Hence it is simplistic to operate on the assumption that all students are, or are not, ready for algebraic thinking. Some are ready at the start of Year 8, others will never be.

There is only one Maths syllabus up to the end of Year 10 in Queensland. It follows that for the more Mathematically gifted third or so of the students there is a high probability that they will be given only a modest opportunity to excel. The consequences of that are certain to be serious in later more rigorous Maths subjects in Years 11/12. As with many places these days, Queensland schools are wedded to mixed ability groups. Such a structure leads inevitably to a failure to 'stretch' the more gifted students. As one (current) Year 12 student has put it on more than one occasion: *'I learned nothing in Year 8, very little in Year 9 and not a lot in Year 10.'*

The survey of Principals referred to above showed that schools are resorting to an extraordinary set of ways to try to deal with the problem. A common method used is a form of 'streaming'. However that is a very crude and inflexible system, having two major problems. The biggest is that by making a 'top' class that stays together for all subjects it is inadvertently making the very false assumption that a student is equally 'good' – or otherwise - at all the subjects. Clearly that is false for many students; it is common for a student to have a higher ability at Maths than English – or vice versa. Another problem inherent in 'streaming' is that when a student shows – by improving – that she/he is now in an unsuitable group it is hard if not impossible to make the necessary adjustment. A far better structure is 'setting'. With that structure all Maths (or English perhaps) classes for any particular Year are timetabled at the same time. This has the twin advantages that it is flexible because a student found to be 'wrongly' placed can be moved easily, at any time, and without causing problems for any other subject area. It recognises that a student can have, and very often does have, differing abilities at different subjects. 'Setting' used to be common. Nowadays it is regarded as too hard to timetable. To which the reply is obvious – if school administrators could do it years ago, what is the problem now? My strong opinion is that whereas the skeletal structure of a timetable used to *start* by putting in the 'setted' Maths and English, other things having to fit in with that, nowadays those two subjects are not regarded as the bedrock disciplines that they really are.

Syllabi in Queensland

In Queensland, syllabi up to the end of Year 10 are weak. In Maths it is particularly poor in respect of that great tool algebra. The Years 8/9/10 are a shadow of what they used to be. As the Principal of St. Augustine's College, Cairns put it (Cairns Post 2005), the current education system is a flawed and discredited fad that is failing the students and that the move away from a clear syllabus has meant that Queensland's curriculum has *'degenerated into a confused and confusing morass where students are missing out on the basics they need'*. He commented on weakness in grammar, syntax, shocking habits in the setting out of arithmetic and the lack of general knowledge of basic history, geography and world events. He also spoke with palpable sadness and anger of the fact that Queensland once led the Commonwealth in early and middle years learning but is now selling young people short. This tragic decline is a part of the overall collapse that has taken place in Queensland education over the last few years. I agree with all of that and more. So this dyed in the wool ex public system teacher and the Principal of a Catholic school experience the same emotions: anger and sadness. I also feel contempt for the people who have perpetrated this nonsense.

Another critical comment was made by geographer Professor Lidstone of QUT. He stated that *'high school students are not presented with the fundamentals of geography, such as the formation of mountains or glaciers or the science behind issues such as the rain-fall cycle'*. Criticising the syllabi produced by the Boards of Study he stated that *'integrated social studies doesn't do history well, it doesn't do geography well, it doesn't do citizen-type things well. It quickly becomes a hodgepodge'*.

Having earlier quoted a Catholic, I will now quote from a very different viewpoint. An editorial in *The Skeptic* magazine (Spring 2006 Edition) emphasised the obvious idea that critical thought must be based on verifiable evidence. Enabling people to think critically *'is not made easier by the fatuous notions pervading far too many of our education systems, luxuriating under the rubric of 'postmodernist theory'. Ostensibly aimed at fostering critical thinking, it does no such thing, being strong on the critical and weak on the thinking. By holding inter alia, that truth and facts are relative concepts, it fosters the belief that all opinions are equally worthy'*.

I ask the Senators to consider the position of a Queensland student at the end of Year 10. When faced with the crucial decision as to what subjects to take in Year 11 what knowledge does that student have? The Maths is variable but usually weak. The great tool algebra is lamentable. There has been effectively no numerical Science. There is no hard data whatsoever as to 'how well' she/he has performed. Many students do not even know what some of the subjects in Years 11/12 are (except a name). They have no choice but to depend on 'advice' to a small extent, and rumour to a greater extent. (A survey of late year 10 student opinion showed without doubt that the biggest reason by far for *not* taking Physics or Maths C in particular was *'I've heard it's hard'*.) They depend on scuttlebutt – what else have they got?

So a huge number of students who, given a proper set of learning experiences up to the end of Year 10, would have known that they were in a position to take those subjects (if they wished to) do not do so.

Senior syllabi/assessment in Queensland.

The feeble condition of Maths and numerical Science in lower secondary schooling has led to a huge 'gap' between Years 10 and 11. Sadly the rot does not end there. Weaknesses in Years 11/12 make it inevitable that there will be problems on entry to university.

I submit that any syllabus and its associated assessment system should be such that it is *defined, reliable and valid*. That is my way of thinking about what a syllabus/assessment system should be as a minimum. (No Board of Study these days would regard that as being even slightly reasonable).

It should be *defined* in terms of content, concepts and depth of study so that *'a syllabus is a well defined set of learning experiences'*. That neat definition was a footnote explanation at the bottom of a page of a draft study by the Queensland Studies Authority *'Review of syllabuses for the Senior phase of learning'*. Such clarity was obviously a slip by the QSA because by the time the next draft appeared it had vanished. There was no definition at all of what a syllabus is – in a document that is all about 'syllabuses'. When the final Review appeared in July 2006, there was a definition of 'syllabus' in the Glossary. I reproduce it in full for the enlightenment (?) of the Senators:

Syllabus is a document that supplies a curriculum framework for a course or subject either developed and approved, accredited, or recognised by the QSA. QSA syllabuses provide advice about the scope of learning or subject area and any mandatory components for learning, assessment, standards and quality assurance required for reporting or certification. Schools interpret a syllabus and develop work programs or study plans. The syllabus provides the basis for schools to decide on the curriculum they offer. So now you know! Incidentally, in the same glossary the word 'curriculum' is defined thus: 'Curriculum in this paper means a collection of subjects'.

I understand that. Neat and unambiguous.

In addition to being well defined, syllabi/assessment systems must ensure that there is *reliable* evidence that the material in the syllabus has been handled. Furthermore the final results, the thing that both students and parents are most interested in, arise from a system that is, and is seen to be *valid*.

As the Senators will understand, any syllabus/assessment system constructed by an organisation that has thought patterns that result in the sort of definition above will inevitably produce syllabi that are undefined in respect of content and concepts to be covered, and assessment systems that are neither reliable or valid.

The ruination of a fine system

In the mid 1970s an ingenious system of school based assessment was set up in Queensland. In outline it operated as follows:

Syllabi for each subject were constructed that provided a sufficiently detailed description of the concepts and material that was to be studied and assessed in each school. Tests/exams were given regularly. District Moderation Committees/Panels comprising teachers from the schools, both public and private, met and examined the exam papers and the student work from all of the schools. The school was then advised as to whether the school's suggested results were acceptable, appropriate. The key issue was comparability of results/standards between the schools. In essence the objective was to ensure that a student receiving a given rating in one school would have received the same rating in any other school. When a Panel considered that a schools ratings were inappropriate, not comparable with other schools standards, detailed suggestions were forwarded to the school. In the relatively rare event that a school maintained that the District Panel was wrong it appealed to the State subject panel. They, being cognisant of standards over the State as a whole, were in a position to adjudicate on the issue.

I had many years of teaching experience on three continents. Although I was at first somewhat dubious about the system, I rapidly recognised that it worked very well indeed. In my opinion the assessment system in Queensland at that time was by far the best I had seen. It was fair.

It should be mentioned that there was a substantial amount of co-incidental professional development in the system because any person on the Panel saw in detail what was happening in the other schools. I know I learned a lot.

However it is vital to note that:

- The subject syllabi were clear, hence ensuring that when student work was being examined by a Panel it was evident that each school had fulfilled its syllabus/assessment obligations.
- The various Panels knew the conditions under which the various assessment instruments were done. Hence their provenance was certain.
- The students knew the worth of each piece of assessment and how the various pieces would be used to reach their final result. In sporting terms they knew the rules of the game.

With the rise of the influence of (mainly) university based education academics all of these three essential requirements were weakened and continue to be further weakened. Effectively they do not now exist.

The newest syllabi are short on detail as regards to the material/concepts to be studied. For example, the gross deficiencies in that area of the new Physics syllabus make it inevitable that wide variations in what 'Physics' means from one school to another will occur. The recent interest nationwide in trying to ensure comparability between the various State systems is somewhat futile in that light. It is an exercise in futility to worry about differences between Cairns and Canberra when we have the potential for huge differences between Cairns and Coolangatta. The implications for the next 'interface' – secondary to university – are obvious and severe.

A side issue, but an important one. There has been a lot of comment and worry recently about the lack of Maths/physical Science teachers and the weakness of many of them. My observations are that that worry is justified. Now it seems evident that the weaker the teacher, the more that teacher is dependent on a clear syllabus. Hence a syllabus should never be written with the brightest, best educated, most dedicated and most experienced teacher in mind. Quite the reverse; it should be written with the 'willing struggler' in mind. The current crop of syllabi in Queensland are entirely inappropriate for those people – and hence for the students in their care.

With the rise in the use of ‘assignments’ as both the primary (or only) teaching approach as well as for the assessment of results it is certain that nobody can possibly be confident of the provenance of any piece of (supposedly) student work. Of course the students manipulate the system – cheat if you like. The Queensland Studies Authority takes great offence at the mention of the word ‘cheat’, and, according to them, it is the schools’ responsibility to prevent that happening. Naturally QSA accept no responsibility for events that are an inevitable consequence of the system they have set up. Yes, I’m thinking ‘Pontius Pilate’ again!

Students can, and do, manipulate the system in two ways. Firstly they get ‘help’ from whoever they can: from parents, siblings, friends and any knowledgeable people they happen to know. Who is to know that that has happened and, even more far fetched, to what extent? It should be noted that this sort of assessment favours students from the more well to do families.

It is undeniably socially discriminatory, a fact that I find extraordinarily offensive.

The students nowadays have quickly become very adept at ‘tuning in’ to the teachers ideas, prejudices and foibles. They then adopt whatever approach they know will produce the best assessment result. That is very sensible, calculating, behaviour albeit intellectually dishonest. We are actually training the students to be amoral because we reward them for that amorality.

The unrelieved stream of ‘assignments’ has resulted in the fact that I no longer give tutorial assistance to students in any of the Histories or Study of Religion. If I were to give help I would simply be doing their ‘assignments’, for there is nothing else. And that I refuse to do. I just watch with sadness and anger the students spending all their time on ‘assignments’ and consequently too little on those few remaining subjects in which they still get proper teaching and valid examinations.

In Queensland assessment systems today there are certain words and phrases that would be in an Education theorist’s version of an *Index Expurgatorius*, words that must never be used. Prominent among those words are *marks, numbers, average, weighting* and *add*. The consequently non numerate ‘methods’ to estimate a students final result are hence vague, wordy, undefined and depend on an ‘overall judgement’. Note therefore that the student has no idea whatsoever of the relative importance of a piece of work. They are playing a game, a serious game that will have lifelong consequences and they do not even know the rules. That is scandalous.

Can anyone really imagine that it would be feasible to play or even watch AFL without knowing that you get 6 points for kicking the ball between the two inner posts but only one point if you only kick it between the two outer posts? Or play League without knowing that you get 4 points for a try (and knowing what a try is), two points for a penalty goal or conversion but one point for a field goal?

The present syllabus/assessment ‘system’ in Queensland meets none of the three requirements listed previously. It most certainly fails to meet any of the criteria I contend are essential aspects of a syllabus/assessment. They are not *Defined, Reliable* or *Valid*.

Male performance.

Although the issue of male performance is not specifically mentioned in the Terms of Reference, it is a relevant issue because nearly half the population of school age is male. Whilst it is inappropriate to make crude sweeping statements such as ‘the girls are beating the boys’ - a generalisation based on the mean results (usually at Year 12) - it is nevertheless true that a large percentage of the boys are performing at a worryingly low level. In particular males near to, or somewhat above, ‘average brightness’ are performing poorly. Perhaps even more worrying is the fact that they are performing much more poorly than they did previously. Furthermore an increasing number of males are not even *starting* to study rigorous Maths and the numerical Sciences in senior schooling. That is a participation problem with serious implications for later study in the (rightly called) ‘enabling Sciences’ and Engineering.

I will try to deal with this difficult and highly sensitive issue by putting some factual information before the Inquiry.

Earlier, on page 7, I referred to some standardised test results in a large London comprehensive school. It was an all boys school in a very rough part of the East End. The vast majority of the boys came from poorish backgrounds, backgrounds that were the opposite of mentally stimulating. As mentioned earlier the boys were all given tests on entry; one in Maths, one in English. Crucial to this discussion is that fact that the boys' average score in Maths was the same as the national average, but their average score in English was at least a full 'year' below the national average. Their weak performance in English is unsurprising given the poor vocabulary in their backgrounds. That difficulty did not show up in Maths presumably because their Maths performance was a function of their schooling, not their domestic circumstances. Clearly the boys were *relatively* better at Maths than English.

I have already commented (page 7) on the fact that Science to the end of Year 10 in Queensland is purely descriptive in nature, there is no numerical material. This heavy emphasis on description – using English of course – is typical of what is happening in education these days. There is a huge increase in the level of English comprehension even in Mathematics. As one Education analyst put it in a submission to the parliamentary inquiry '*Boys: getting it right*' (2002) with reference to a *Maths* assessment in South Australia: '*the level of nomenclature and sophisticated verbal reasoning skills that are required – to even understand what the problem is – is on average four times greater than what is required in Australian History and English Literature.*' Axiomatically that sort of questioning discriminates against a vast number of people, mainly boys.

It is to be regretted that Education theorists and the various Boards of Study have totally ignored one of the findings of that enquiry:

assessment procedures must, as a first requirement, provide information about students' knowledge, skills and achievement on the subject, and not be a de facto examination of students' English comprehension and expression.' (Boys: getting it right, 2002, Finding, page 22).

When part of the nation's highest democratic body makes findings such as that, one would have hoped that action would have been taken to rectify the dreadful situation. Of course no rectification has occurred at all. To the contrary the situation in Queensland has deteriorated further. The new syllabi, because of their overwhelming emphasis on 'assignments' both as methods of assessment and 'teaching', will inevitably discriminate against a huge number of boys. One teacher in a school doing the Trial/Pilot of the new Physics syllabus has commented that the student who is quickest on the uptake and is an excellent problem solver is not a good communicator. Consequently he is being beaten in assessment results by a far less intuitive thinker who communicates well. The teacher's suggestion was that it would be better if the boys were a year older! That demonstrates beyond any doubt that the syllabus/assessment system is sexist. Earlier, on page 3, I referred to LSAYR 22, a survey by ACER that demonstrated the huge importance of literacy/numeracy by Year 9. Another finding was that gender was *not* a major determinant when other factors were held constant. That is a most significant finding because it is known that a disproportionate number of males are performing poorly (overall) at the end of Year 12. There is hence an apparent dichotomy: gender per se is not a major factor influencing ENTER when Year 9 Literacy/Numeracy is held constant, but males do perform somewhat more poorly than females as measured at Year 12 exit. There are at least two reasonable explanations for that occurrence. Firstly that major educational problems already exist for males by the end of Year 9. Secondly that because of inadequate Maths and numerical Science just one year later, at the end of Year 10, males do not select subjects for Years 11/12 at which they are at a comparative advantage. I am using the economics phrase 'comparative advantage' in the Ricardian sense that it is demonstrable that in the rigorous Maths and the numerical Sciences males do as well as females of equal general ability, but they do worse than females of equal general ability in the other subjects. As an inevitable consequence the males are very often choosing subject combinations that make it inevitable that they will get beaten by girls of equal general ability. Of course the comment by Ainley (also on page 3) emphasises the fact that *for boys* previous experience (in Years 8/9/10) is a bigger influence on the selection of physical

sciences subjects than socio-economic factors. (when the new Physics/Chem/Maths syllabi come in the position will inevitably change for the worse).

As the Senators will be aware there have been some academic papers on the issue of male performance. There have been suggestions that there have been changes to the content of the curriculum and on assessment practices. Gabrielle Matters gave as some examples of those changes: *cutting out topics in which boys continued to outperform the girls e.g. solid geometry. Decreasing the emphasis on technical correctness in English. Redefining mathematics so that it is less abstract. Concentrating on the local rather than the global in geography. Contextualising test items, especially those in the quantitative domain.* (Matters et al, 1997)

In 1999, a paper 'Can we tell the difference and does it matter? Differences in achievement between girls and boys in Australian secondary education' was published. It was written by Matters, Allen, Gray and Pitman, all of the Queensland Board of Senior Secondary School Studies. (John Pitman was the long standing Executive Director of BOSSS). In part they referred to the fact that whereas when girls were doing poorly there was consensus that their weaker performance was a fault in the system; now, weaker boys' performance is not seen to indicate a system problem, but a fault of the boys themselves.

'There is no parallel, it would seem, between the solutions to the problems now faced by boys and to those previously faced by girls. The girls, in the main, were to have something external transform their lives; the boys, it is suggested, have to transform themselves.'

Well, they won't. So we, as a nation will continue to crucify a majority of boys on a cross of Educationalist's fatuous and sexist fads.

It seems clear that Education theorists, certain as ever that they can do no wrong, adept at washing their hands, will not accept that what they are doing is damaging vast numbers of children, especially boys. In the process the nation will lose a large percentage of its future intellectual capacity. What a waste.

Necessary but not sufficient

Schooling in Australia has many problems. Maths (notably algebra) and the numerical Sciences are inadequate. Enrolments in rigorous Maths and Physics are frighteningly low. Much education is a 'confusing mass' or a 'hodgepodge'. It claims to foster critical thinking but is 'strong on the critical but weak on the thinking'. Middle schooling is inadequate as a foundation for later study. Standards in senior schooling have declined as a consequence. Tertiary enrolments in Maths, the physical Sciences and Engineering are weak. Syllabi and their assessment systems are frequently opaque and discriminate against the poor. They often discriminate against boys. Syllabi and internal school organisation let down 'gifted' children.

A lot of education 'issues' are being discussed in the media and many of them are of some significance. Examples are teacher quality, teacher pay, 'public' v 'private', standards, vouchers, influence of teacher Unions and retention rates.

Many of those issues create the sort of dissension – rows – that are what the media like to emphasise. Consequently they are the issues that the media, the public and hence Parliamentarians discuss most. However they are not, I am convinced, the most important, the most far reaching issues.

The big issue, the one that overarches absolutely everything in every school, in every subject and in every State is the quality of subject syllabi and their associated assessment systems. All of those syllabi are the fruit of the various Boards of Study. Until and unless those syllabi/assessments are rectified all else is vain.

That drastic rectification is a necessary but not sufficient condition for improvement. All syllabi and assessment systems must meet the simple criteria: ***Defined, Reliable and Valid.***

Confidence in democratic institutions

Until they are compelled to change by our elected parliaments nothing will change for the better. The Boards of Study and their backers within Education Faculties will remain all powerful. They know that they have that power and they use it to the full.

However I have great faith in the democratic system. I know that in the long run the Education power brokers will be brought to heel by their employers - the people - through their parliaments.

I urge the Senators to start the process to rectify the situation and so give all of our children the empowerment of a good education. It would not be a costly business. It would not cost much to ensure, by fiat and decree if necessary, that all syllabi and assessment systems were *Defined, Reliable and Valid*.

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Part (d) Brief summary

Summary and suggestions for actions that are *essential* for improvement of STEM Education and Training

- The Summary in the penultimate section - entitled 'Necessary but not sufficient' – of my Senate Inquiry Submission remains totally valid. In particular the absolute requirement that all syllabi and their associated assessment systems must be **Defined, Reliable and Valid**.
- In the specific case of Queensland the problems are more extreme than is the case across the nation as a whole. The fundamental reason for that is the very poor (albeit very trendy) subject syllabi and their associated assessment systems.
- All other issues are relatively minor in comparison to that syllabi problem.
- Even the undoubted problem of restricted numbers of teachers competent to teach STEM subjects, especially in the crucial years 8/9/10, is made far worse by the lack of clarity in the syllabi. It is a reasonable generalisation to state that the weaker the teachers the more they need a decent syllabus and decent textbook.
- The cultus of mixed ability grouping in Years 8/9/10 must be actively discouraged especially in Mathematics. Schools need to provide 'setted' classes for Maths. It is most important that the comments in Section (c) of this submission on this issue are considered with care.
- As mentioned repeatedly in this submission, valid assessments at the end of Year 10 are non-existent. Assessment systems nowadays in Years 11/12 are a disgrace, they are unclear, the students have no idea of the 'rules of the game', they are indubitably socially discriminatory, they are sexually discriminatory.
- Because the non government schools educate a smaller percentage of children from lower socio economic backgrounds it follows with iron logic that the public school system and its students are discriminated against. My commitment always has been, and remains to public schooling. Consequently I find that totally abhorrent.
- I do not have any real hope that the QSA is capable of rectifying the situation. They do not see that there *is* a problem. As stated in the final paragraph of my Senate Enquiry Submission, only democratic forces operating through governments can do anything useful. The brute fact is that QSA/QSCC has failed our children. It is the responsibility of government to either 'pull them into line' or dismiss them.
- Two clear errors were made when the Act setting up the QSA was drafted and passed. Firstly it should, as a minimum have been called the Queensland Studies and *Assessment* Authority. Lack of the word 'assessment' signalled that assessment was a minor part of their responsibility. QSA's dominant predecessor the QSCC accepted *no* responsibility whatsoever for assessment; none. Secondly the Act failed to legislate that a Moderation Committee *must* be set up within QSA, that committee being responsible for ensuring that assessments were fair, clear and just. These were significant errors.
- When I came to Queensland in 1970 I rapidly realised that I had 'fallen on my feet' as regards standards in Maths. Over the next few years the situation improved even further. In 1973 school based assessment was set up and for many years was an excellent system that

provided clarity and justice. We were the leader in both syllabus standard and assessment systems.

- Then, over the last decade or so, both of these have degraded to the point that that we are the weakest as regards standards and the assessment system has been calculatedly degraded to the point where it is now little short of a scandal.
- At the end of my Online Opinion article *'Floating gently on a waft of edu-dribble*, I averred that **'In terms of student assessment Queensland has moved from excellence to lunacy, from penthouse to cellar.**

How are the mighty fallen.

And that's only the assessment 'systems'. Add in the low standards especially up to the end of Year 10 and the decline goes subterranean.

It is all so dreadfully sad.

There has been much concern expressed about the condition of Education in Australia. Both the ALP and the Coalition agreed on the need for major change, the only essential differences between them were the methods to be used.

Mr. Rudd has graphically expressed his concern by the use of the phrase 'Education Revolution'. The word 'revolution' clearly implies the need for a radical change from the status quo.

The decision makers involved in this Queensland government STEM Plan Project have a great opportunity to revolutionise a most vital area of Education in our State. The suggestions that I have made here would be revolutionary indeed. The only revolutionary action that has any chance of success is a radical change to subject syllabi and their associated assessment plans, they must be Defined, Reliable and Valid.

May I take this opportunity of wishing your committee all the best in your deliberations on this vital issue for the future of our State and, even more importantly, for the future of our children. You have a mighty task indeed.

Have an enjoyable Christmas and New Year,

Regards.

John Ridd.