Submission

to

The Parliamentary Inquiry into Senior Mathematics, Physics and Chemistry Assessment

by

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[redacted]

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Dear Committee Members,

I have been teaching senior physics in Queensland since 2000. Prior to this I had seventeen years of teaching experience in the UK school system teaching both A Level and GCSE Physics. During this teaching experience I have been a Physics Head of Department and a Physics District panel member.

In 2012 I completed a research Masters of Education that considered the main indicators of senior physics enrolments and have presented my findings at the Australian Institute of Physics National Conference in Sydney in December 2012.

The full thesis can be viewed at: http://research.usc.edu.au/vital/access/manager/Repository/usc:7422

My teaching experience of two different education systems and this recent research into the Queensland education system gives me an interesting perspective of the problems in the current education system in Queensland.

I understand that the inquiry has the terms of reference that are given below; therefore I will try to address my comments to these three specific areas.

Terms of Reference

1. Assessment processes are not supported by teachers
2. Student participation levels in decline
3. Assessment processes do not support valid or reliable judgments of student outcomes.

1. Assessment processes are not supported by teachers

To be true to the ideals of academic research I will present statements that reflect the complete picture of the teacher's respondents and then my own opinion that is based on experience, research and reflection.

During my research I obtained data from 21 experienced senior physics teachers that were teaching in both State and Independent schools on the Sunshine Coast in 2009 and 2010. The question that was asked as part of the research was:

Do you think the 2007 syllabus has / will make a difference on student's perception of Physics?

The Sunshine Coast physics teacher respondents have extreme positions of support for or criticism of the 2007 senior Physics syllabus. In terms of support teacher respondent 14 stated:

> Students are more engaged, have far more diverse learning experiences and are generally more motivated. Students find EEIs [Extended Experimental Investigations] almost "life-changing" [Teacher respondent 14].

However there seemed to be more teachers against the introduction of the syllabus with teacher respondent 3 in completely abhorrence of the 2007 senior Physics syllabus: "I hate the new syllabus and am disappointed it is replacing a good '95 syllabus. I think it will have a negative impact on student perception".

Amongst the teacher respondents there seemed to be a general appreciation that the idea of moving towards a context-based syllabus was sound. However, many expressed concern about the lack of depth that has resulted with the time spent on extended investigative work, as illustrated by the statements from teacher respondent 4 and 6 respectively:

> I think the 2007 syllabus lacks focus...it is 'time heavy' with disproportionate learning outcomes. I think students exiting don't have a comprehensive understanding of physics across a range of topics but are able to research and analyse information [Teacher respondent 4].

> 2007 syllabus does make a difference to students' perception – find it more interesting and enjoyable. However this has come at a cost. Students do not gain a broad subject knowledge of the subject. Topics are often not explored in as great depth [Teacher respondent 6].

With regard to the 2007 senior Physics syllabus changing student perception of physics the following comments were received:

> My personal view – it has a negative influence [on the perceptions of physics and senior physics enrolments].With subjective criteria and criteria-based assessment it can be difficult to justify the grades to students and to parents. Students struggle with the new syllabus. Feedback after drafts to help students improve is very difficult – as both parents and students can argue the subjectiveness of the standards [Teacher respondent 3].

This opinion is supported by teacher respondent 12, who also commented on the criterion based assessment:

> I don't like the 2007 syllabus. I think the EEI take up too much time and don't cover the necessary content. Also why are we so number phobic when awarding grades? If we obtain a numerical answer then surely we can award numerical grades. The criteria sheets are too long and complicated instead of making it easier it has made it harder and confuses students [Teacher respondent 12].

Several teacher respondents did see positives in the 2007 syllabus with teacher respondent 5 commenting: "I think that the 2007 syllabus provides a great deal of flexibility – which I like. I

believe that this and the contextual approach makes it more interesting – must help." Teacher respondent 4 stated:

> 2007 syllabus puts more onuses on the student to "flesh" out the Physics in given situations. I like the experimental design component of 2007 but don't like criteria-based assessments [Teacher respondent 4].

None of the respondents offered support for the criterion-based assessment and extended their comments on the methods employed by QSA for the implementation of the 2007 senior Physics syllabus with a variety of remarks. Teacher respondent 5 commented: "I find it [criterion-based assessment] very difficult – the grey areas are difficult". Teacher respondent 15 stated: "Time consuming – initially, especially", whereas teacher respondent 3 offered a more extensive observation:

> Comparing schools is useless as depends on the professionalism of the teacher (as they have control over the assessment) – using the subjective criteria leads to ambiguous interpretations. QSA should have more control over this – QSA should have a system that involves them carrying out the moderation [Teacher respondent 3].

The evidence collected in the teacher respondent's statements clearly indicates a very strong dislike and distrust of the criterion based assessment model that has been adopted by the QSA in the introduction of the 2007 senior Physics syllabus. Teachers acknowledge some of the positive aspects of the context-based teaching and indeed appreciate the merits of the EEI's; however they are in unanimous in their condemnation of the criterion based assessment model. Sadly, the resulting teacher dissatisfaction with the syllabus and criterion based assessment model is manifesting itself in a negative perception of physics amongst both the teachers and the students.

My individual feelings mirror many of the teacher respondent's disillusionment with the criterion based assessment model. My concern is that teachers do not have confidence in the criterion based assessment. This lack of confidence is not only demonstrated by individual teachers but at panel meetings and indeed when I have attended QSA workshops these have been unhelpful as the QSA staff conducting the workshops are unclear about the interpretation of the subjective criterion. Those conducting the workshops have never been experienced physics teachers. Consequently teachers are left to their own devices leading to a wide range of subjective interpretations of the standards…this is not helpful to physics students.

The increase in teacher workload (will discuss student workload in next point) that has been generated by the criterion based assessment model is untenable. The most appropriate way to describe this is by a quantitative example, but first the scope of an EEI.

Students are required to do at least one EEI per year that "*may last from four weeks to the entirety of the unit of work*" and "*aspects of each of the three criteria should be evident in the investigation*" (p22 syllabus).

Most schools offer the facility to draft an EEI – i.e. submit a first attempt for the teacher to give comment back to help improve the quality of not only the written work but also the data analysis, discussion, conclusions and recommendations. Since a Year 12 student would have been working on the EEI for at least four weeks and has had to address all aspects of the three criteria, as stipulated in the syllabus, the written EEI which includes a hypothesis, introduction, aim, procedure, results, data analysis, discussion and evaluation, conclusion, recommendations, bibliography and a journal or log book of the experiment is going to be a lengthy document…usually of the order of 3000 words to 5000 words. Even though there is an amended word limit in the syllabus this is for only:

"the discussion/conclusions/evaluation/recommendations of the report" (p22)

A student will need to submit more than this word limit to produce substantial evidence to address all criterion to an A standard.

Being a conscientious and diligent teacher who appreciates the importance of constructive feedback, as reported by Hattie (2003), each of these EEI reports take approximately one to two hours. Take an average physics class (for our school is 15 students) this equates approximately 15 – 30 hours on top of the normal teaching load. This time requirement is then more than doubled when the final EEI is submitted and has to be remarked and grades allocated with respect to the exit standards for each of the 3 criteria. After the marking stage of the EEI there needs to be an internal moderation session with the other physics teacher in the school; usually lasts another two hours. In total for one piece of assessment an additional 50 hours or so has to be found. In comparison the total time commitment for an examination would take me approximately 10 hours to mark for 15 students; the exam could be designed with an experimental component that would allow me to assess the same standards.

2. Student participation levels in decline

The first component of my research was to determine the actual numbers of students studying senior physics in Queensland. I feel it will be of benefit to the committee to be aware of my research and interpretation of the enrolment numbers of Queensland senior physics students. All data has been retrieved from the QSA website. The Queensland Studies Authority (QSA) Year 12 physics enrolment data between 1992 and 2012 is shown in Figure 1 and indicates that enrolments in 1992 were 7,281 and 7,155 in 2012, no marked change. I have had discussion with physics teachers that participated in the Extended Trial Project who noted that the introduction of the new 2007 senior Physics syllabus was supposed to address the major concerns about falling enrolments in senior physics. Clearly this has not been the desired outcome as the enrolment numbers have not shown any marked change over the last twenty years.

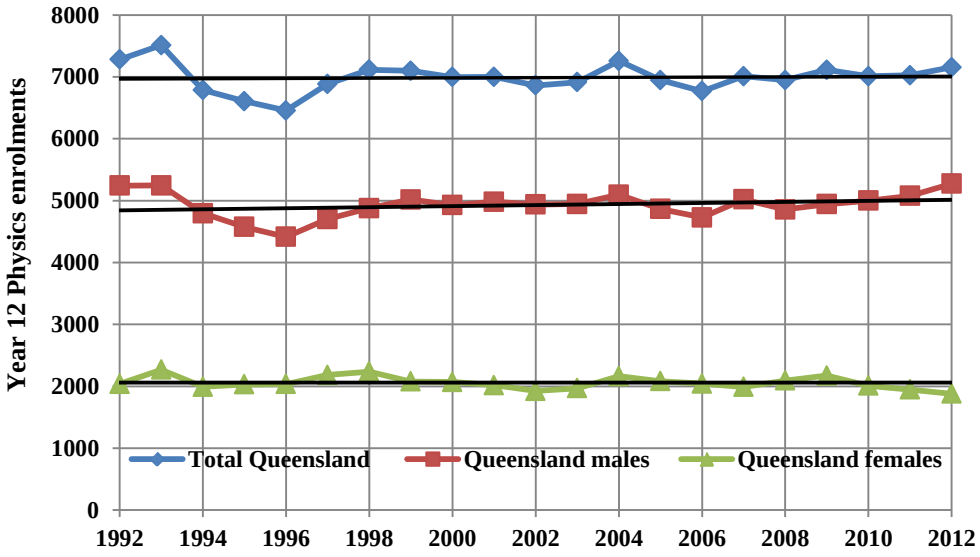

Figure 1: Queensland Year 12 physics enrolments from 1992 to 2012

However, over this period of 1992 to 2012, the number of senior students has increased markedly, with the number of Senior Educational Profiles (SEP) being awarded increasing from 35,501 in 1992 to 48,205 in 2012. Consequently the Year 12 physics participation rate displays a decline from a peak of 21.8% in 1993 to 14.8% in 2012. This is presented in Figure 2.

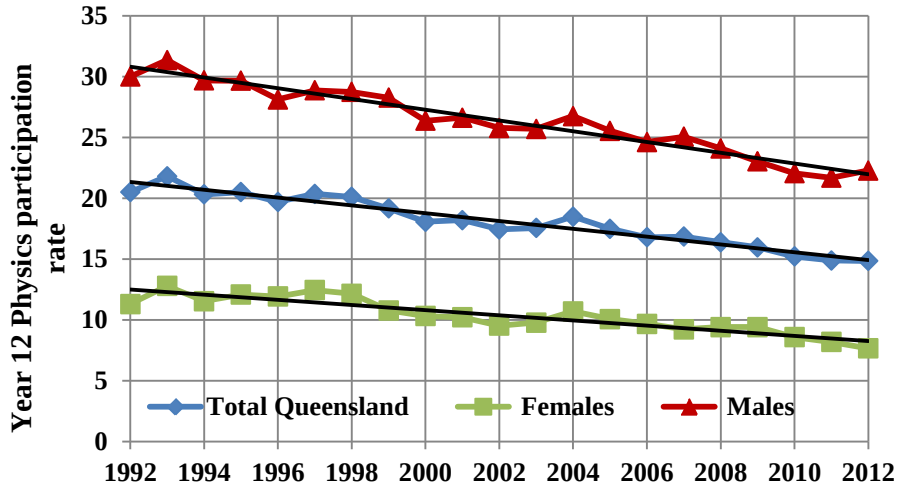

Figure 2: Queensland Year 12 physics participation rate as a percentage of the SEP awarded from 1992 to 2012

Until 2009 the decrease in the overall physics participation rate was primarily due to a decrease in male enrolments; however since 2009 the female participation rate has decreased from 9.4% to 7.7%.

The Year 12 physics participation rate in Queensland is based on enrolments which include physics students who may have completed one, two or three semesters of senior physics and who are no longer studying senior physics.

To determine the number of physics students who may continue with physics, it is more appropriate to use the completion rate. The completion rate is the number of Year 12 physics students who have completed four semesters of senior physics as a percentage of the number of students awarded a SEP, and is shown in Figure 3.

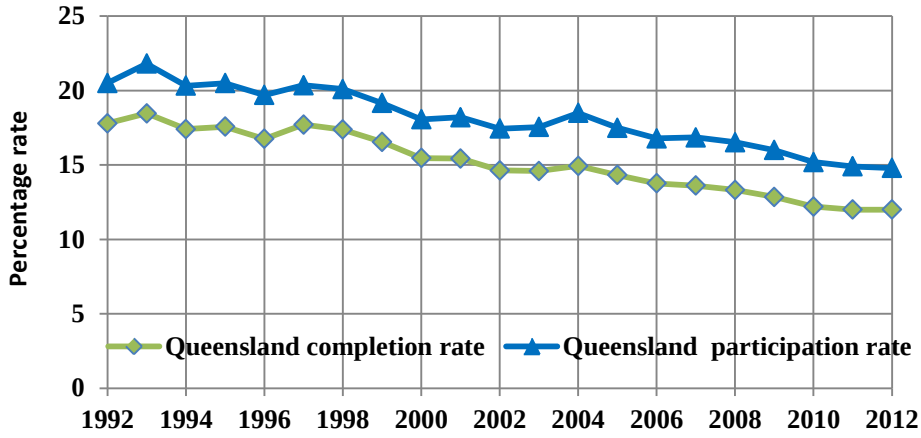

Figure 3: Queensland physics completion and participation rates from 1992 to 2012

The number of Queensland Year 12 students completing senior physics for each of the last 20 years is shown in Figure 4.

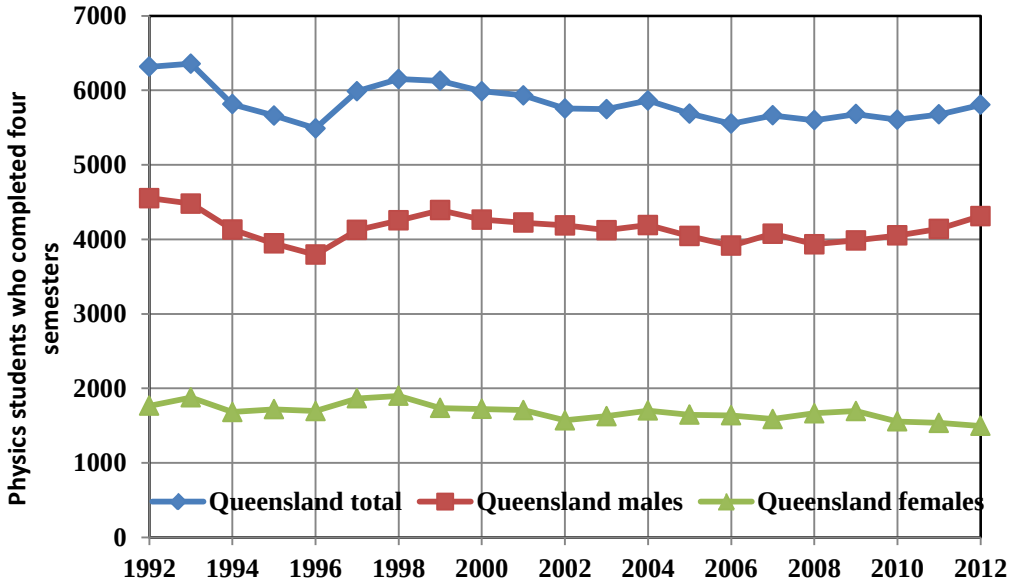

Figure 4: Number of Queensland Year 12 physics students who completed 4 semesters of senior physics from 1992 to 2012

The Year 12 completion data reveals that the number of Queensland Year 12 students who are completing four semesters of senior physics has dropped from 6,317 students in 1992 to 5,805 students in 2012. In 2009 the composition of this 10% decrease in completions was almost entirely due to the decrease in males but has since become an even split with the females.

The completion rates revealed the number of students who 'drop-out' from senior physics. The drop-out data was based on the difference between the number of Year 12 physics students who completed four semesters and the number of Year 12 physics students who were considered enrolled – completed at least one semester. The 'drop-out' rate is presented as a percentage of the Year 12 physics enrolment data and is shown in Figure 5. The average drop-out rate has increased from 13.2% in 1992 to 18.9% in 2012. It is noted that the percentage of females dropping out is consistently higher than the males.

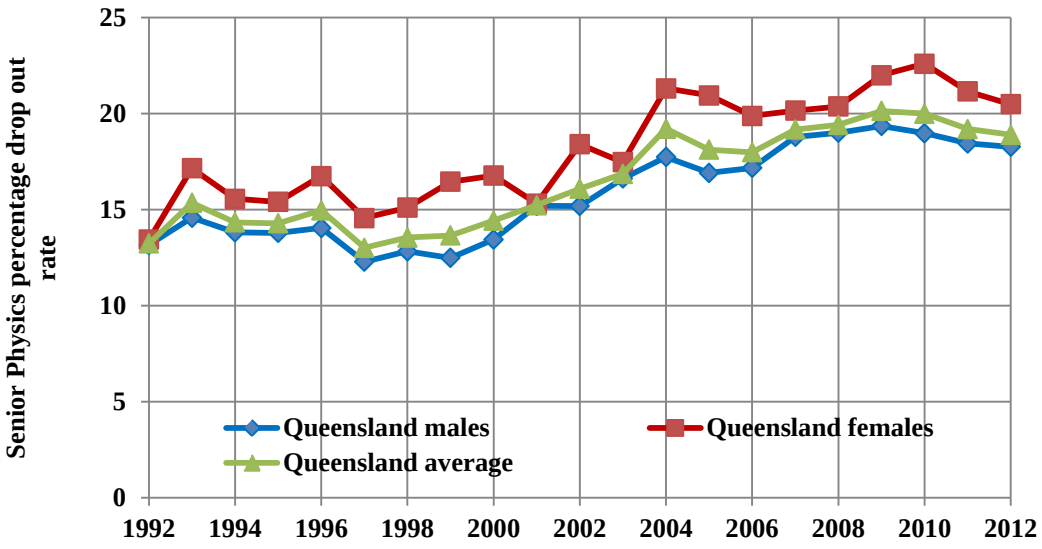

Figure 5: Queensland senior physics 'drop-out' rate from 1992 to 2012

Clearly this data begs the questions why are so many students dropping out of senior physics? The cohort of students that I interviewed was not specifically designed to identify those that dropped out, but rather those whose students that did not select physics in the first place. There are many reasons why students do not select senior physics and these are presented in my study, but a main issue that is relevant to this inquiry is that students, especially girls, are judging the risk and reward of taking a subject. Is there too much risk (including time commitment) to take a subject that has a reputation for being challenging and is not a prerequisite for any University course in Australia – only a recommendation!

3. Assessment processes do not support valid or reliable judgments of student outcomes.

The following are a summary of the main issues that I see with the assessment process and the ability to make reliable judgments.

- Standards vary from school to school, district to district and year to year
- Aspects of the course are assessed by assignments and these can be copied or students can achieve a lot of external help from older students, parents, tutors and indeed the feedback from the individual teachers vary, especially if the schools have a drafting policy.
- Time taken in assignments takes away from teaching time but also takes the student away from revising for examinations (in other subjects) or from the day to day routine of practicing skills in homework exercises.

- The assessment is inequitable. Students who can afford tutors, those with better writing skills and with family working in mathematics and science do better.
- New teachers at schools which are under resourced cannot cope
- Even the process of an examination is fraught with problems; if the school sets the examination they can equally set 'Revision Questions' which are very similar to the actual examination questions.

This issue of assessment being inequitable was recognized in the UK system and internal coursework that was used to judge students was scrapped in mathematics and limits placed on the Sciences with the coursework being done under examination conditions and students not allowed to get external help – hence being a true reflection of the students ability rather than a parent, tutor or an older sibling!

Please see attached document: *A brief history of the QCA investigation into GCSE and GCE coursework in the UK* that details some of the research into using coursework in the UK.

I would welcome the opportunity to have more input into creating a better education system for the benefit of our children. Please contact me if you require further insight into my wealth of experience of teaching physics in Queensland and the UK.

Yours sincerely

Paul Evans