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Parliament House, Brisbane, Qld. 4000 Email: eic@parliament.qld.gov.au

# *THE INQUIRY INTO ASSESSMENT METHODS OF SENIOR MATHEMATICS, PHYSICS AND CHEMISTRY*

*Presented by Brad Ahern, B.Sc., Cert. T.* *Signed:* [redacted]

*A Chemistry and Science teacher since 1968, I have taught predominantly in Ed Qld High Schools, and since 2006 in private schools. In 2011, I was invited to teach Chemistry for the IB course at Qld. Academy of Science, Mathematics and Technology.*

*I was first appointed as Science Subject Master in 1976 and by the time I retired from ED Qld in 2005, the job description had been renamed Science Head of Department. I was the recipient of a NEiTA Award in 2000, and was the founder and organiser of the Kelvin Grove State College Science Fair which continues to this time.*

Email: [redacted]

Mail address: [redacted]

## *Table of Contents*

The comments in this submission are made with reference to my experiences as a Senior Chemistry and Physics Teacher since 1968, (although these comments would apply equally well to assessment practices, even though it is not included in this inquiry, of Senior Biological Science, which I have also taught).

The Table below shows the contents of this submission:

## 1. *Concerns about the present Assessment regimes in Senior Physics and Chemistry*

In the period of time since the introduction of the present assessment system, I have become increasingly concerned about its impact, to the point where I now believe that it is palpably damaging not only the teaching and learning processes, but also leading to lesser outcomes for students. At the same time, the well-being of the stakeholders and their ability to cope with the rigours of the system, is in serious question. The following points are my personal observations and interpretations to support these claims:

- **Unrealistically huge study and assignment workloads** are imposed on students, leading to alarming stress levels for all students of these subjects.
- **Overly long assignments** set in all Senior Science courses i.e. EEI's and ERT's – Extended Experimental Investigations and Extended Research Tasks. Long hours spent and high word counts.
- **Student performance in such lengthy and complex assignments tends to be lower than would be achieved for more traditional assessment.** It frequently occurs that very intelligent, hard-working students only achieve B's (High Achievement Level) for those types of assessments. There have been many instances of private schools with students of good educational backgrounds having very few or no students graded at A standard. **The standards required are too high and are in fact set at levels which have always been university levels.** The situation here is addressed further in Section 3 of this submission.
- **Many students are unable to complete assignments unless they have tuition and guidance from teachers or tutors outside the school.** Students have enormous difficulty even getting started on such assignments and require significant guidance from teachers.
- **Extensive time loss from the normal curriculum** as courses become narrower when more class time is devoted to research assignments.
- **Very high, even unsustainable, workloads also for teachers** who must design the assignment tasks, the assessment criteria sheets which specify the requirements for the marking of every standard of performance, and also the time required for **marking of the student scripts, often at 25 minutes per student** and frequently more than this. A Class of 25 students' work would require a minimum of 11 hours concerted work for marking and grading alone, but this can only be achieved in many sessions because the **grading requires high level analysis and high concentration levels**.
- **Grading of assignments is overly difficult because students usually perform unevenly across the required fields of performance** and teacher subjectivity is required.
- **Inherent difficulty and subjectivity of Letter Grades leading to loss of validity and reliability.** Different teachers very often will grade the same item differently.
- **Variation and inequity between schools** as no two schools have exactly the same course (curriculum, topics studied, assignments set, exams set). Comparability is moderated but is not necessarily reliable. Different schools set the "goalposts" differently.
- **Student burnout illnesses resulting in time missed from school**. It is actually alarming to see the number of students suffering from colds, 'flus and glandular fever in Terms 2 and 3.
- **Burnout, illness, absence and dropout of teaching staff** as a consequence of such difficult workloads.

The list above makes manifest the inefficiency of the system across the state – **teachers across the state are duplicating each other's work to such extent that the total work being performed by teachers is multiplied to enormously greater levels than should be necessary**. If all schools were following a less onerous prescribed curriculum and using the same resources, teachers would be enabled to devote much more time to quality preparation for routine curriculum delivery. Such **economies of scale should be utilised across such a large educational system. In Sections 4 and 5, I will address the process whereby the QSA has altruistically set out to create a rigorous**

**assessment scheme focussing on higher order thinking skills, but in reality, has designed a system too complex and onerous to be sustainable.**

## 2. *Responses addressing the Terms of Reference categories of the Inquiry*

### *Category 1. Ensuring Assessment processes are supported by teachers*

At the employer/employee level, teachers appear to have no option but to support the assessment processes since they have been made mandatory through parliamentary statutes controlling the QSA. In practice, I can attest that I have seen how the immense workload take its toll on teachers.

The teaching profession as a whole is a very diligent and altruistic body of professionals who are not, as a class of people, militant by nature. Strike action in opposition to unrealistic workloads is never an option of choice, although it is an option of last resort in opposition to salary inadequacy. Teachers in Queensland demonstrate their strong commitment to their responsibilities and to their students by showing this professional self-discipline.

In the QIEU Survey conducted in February 2013, it was clear that, although teachers in general were satisfied with QSA core structures and processes, although "there were lower levels of satisfaction amongst maths and science teachers…"

(http://www.qieu.asn.au/files/9713/6238/2885/Media_release_Survey_of_senior_teachers_QSA_Final.pdf)

58.4 % of the respondents to this survey either disagreed or strongly disagreed that they were provided with appropriate preparation and correction time to manage the demands of the current assessment and moderation processes required by the QSA.

(http://www.qieu.asn.au/files/1013/6238/1739/Subject_specific_responses_QSA_Survey.pdf)

**I can attest that a high proportion of Chemistry and Physics teachers do not support the present Assessment procedures, but nonetheless continue on with their onerous professional resonsibilities.**

The following account of QSA training workshops is perhaps illustrative of the ability of the QSA to ignore the impact of the new syllabi on the teaching workforce:

At the training workshops I attended when the New Senior Syllabi were introduced (run by QSA staff), many teachers expressed their concerns about the workloads they anticipated when they had seen the requirements of the new system. These comments were never addressed by the QSA. When Workshop 2 was held, the Chemistry teachers who ran Workshop 1 were replaced by teachers who did not teach Chemistry or Physics and who were completely immune to objections and difficulties noted by the experienced teachers present.

When I personally wrote to the QSA expressing my concerns about the sustainability of the new assessment regime in 2010, I received neither acknowledgment nor reply.

## *Category 2. Student participation levels*

An analysis of QSA statistics, below, shows attrition rates in Senior Physics, Chemistry, Maths B and Maths C through the period 2009 to 2012, the period during which the New Senior Syllabi have been in practice. Data have been taken from QSA web pages (*Subject enrolments and levels of achievement,* http://www.qsa.qld.edu.au/617.html)

***QSA BOARD SUBJECT***

| ***PHYSICS*** | ***STATE COHORT STUDENT SIZES*** | | | |
|---|---|---|---|---|
| ***YEAR*** | ***2009*** | ***2010*** | ***2011*** | ***2012*** |
| ***Year 11*** | N/A | 7009 | 7025 | 7154 |
| ***Year 12*** | 7311 | 7299 | 7363 | 7360 |
| ***Drop in cohort size*** | N/A | 302 | 274 | 209 |
| ***% Drop in cohort size*** | N/A | ***4.13*** | ***3.75*** | ***2.84*** |

| ***CHEMISTRY*** | ***STATE COHORT STUDENT SIZES*** | | | |
|---|---|---|---|---|
| ***YEAR*** | ***2009*** | ***2010*** | ***2011*** | ***2012*** |
| ***Year 11*** | N/A | 8839 | 9303 | 9278 |
| ***Year 12*** | 9232 | 9761 | 9570 | 10049 |
| ***Drop in cohort size*** | N/A | 393 | 458 | 292 |
| ***% Drop in cohort size*** | N/A | ***4.26*** | ***4.69*** | ***3.05*** |

| ***MATHS B*** | ***STATE COHORT STUDENT SIZES*** | | | |
|---|---|---|---|---|
| ***YEAR*** | ***2009*** | ***2010*** | ***2011*** | ***2012*** |
| ***Year 11*** | N/A | 16598 | 16838 | 17052 |
| ***Year 12*** | 17458 | 17883 | 18069 | 18007 |
| ***Drop in cohort size*** | N/A | 860 | 1045 | 1017 |
| ***% Drop in cohort size*** | N/A | ***4.93*** | ***5.84*** | ***5.63*** |

| ***MATHS C*** | ***STATE COHORT STUDENT SIZES*** | | | |
|---|---|---|---|---|
| ***YEAR*** | ***2009*** | ***2010*** | ***2011*** | ***2012*** |
| ***Year 11*** | N/A | 3876 | 4000 | 4182 |
| ***Year 12*** | 4005 | 4060 | 4182 | 4646 |
| ***Drop in cohort size*** | N/A | 129 | 60 | 0 |
| ***% Drop in cohort size*** | N/A | ***3.22*** | ***1.48*** | ***0.00*** |

From these figures, we can see that the cohort sizes of the Senior Maths and Science focus subjects for this inquiry are seen to be slowly increasing, much in line with the general student population increase between 2009 and 2012.

| ***SEP enrolments 2009 - 2012*** | ***2009*** | ***2010*** | ***2011*** | ***2012*** |
|---|---|---|---|---|
| | 44549 | 46079 | 47209 | 48205 |

(QSA, *Summary of Year 12 enrolment and certification,* http://www.qsa.qld.edu.au/617.html )

In keeping with this general enrolment increase, subject cohort sizes are slowly increasing also, showing that the subjects under study are still as important to students and their aspirations as they have been in the past (students continue to recognise the value of these key subjects to supporting their future studies and aspirations).

All subject cohorts are known to drop in size from Year 11 to 12 when lower performing students drop out to take easier subjects. The attrition rates for these subjects have decreased slightly for Physics and Chemistry over the life of the New Syllabi, whereas Maths C attrition rate has fallen dramatically ( if the numbers from the source are correct), however the Maths B attrition rate is the highest of the four subjects in question.

It appears evident that students are still taking the difficult subjects which they know they need as foundations studies for their future professions. What is not always apparent is that they face horrendous workloads in order to succeed in these modern syllabus subjects. Student jargon in schools exposes the insights passed from older students to younger, when they talk about ***The Suicide Six***, a term used in our high schools and colleges to describe the six hardest subjects, English, Maths B, Maths C, Physics, Chemistry and Biological Science.

> "It is when you choose the 6 hardest subjects at school: Physics, Biology, Chemistry, English, Maths B and Maths C. Called Suicide Six as it's so hard it makes you want to suicide."

( http://www.urbandictionary.com/define.php?term=Suicide%20Six )

Significantly, all four subjects which form the basis of this inquiry are on this list and, in fact Biological Science should also be under scrutiny in this Parliamentary Inquiry, because it has fundamentally the same assessment regime as Physics and Chemistry.

Why are these scientific subjects so difficult? The reason lies in the nature of the assessment which is applied. The assessment regime limits the number of Formal Exams/ Tests and mandates that the very difficult written assignments the EEI (Extended Experimental Investigation) and the ERT (Extended Response Task) are included in each year of the course of study.

The EEI requires the following stages

- A major research project into a scientific problem of the student's choosing
- Development of a hypothesis about the problem
- Design of an experiment to test the hypothesis and identifying key variables
- Research and complete a safety analysis and list necessary hazard precautions
- Performance of the experiment and collection of quantitative data
- Processing of the data and error analysis
- Analysis of the data to generate conclusions, and also discussion of the accuracy of the results

- Discussion of success or failure of data to support the hypothesis and the success or failure of the experimental method designed
- Properly prepared bibliography of references.

One of the biggest problems with this form of assessment is that students ususally don't have sufficient preparation of foundation knowledge to do a research project about a brand new topic. Without sufficient early guidance, they typically flounder for a long period. Good teaching demands that teachers give extensive guidance in the early phases of these projects. Students and teachers are very hard pressed, to exhausting levels, in order to get good outcomes for all the students. Students and teachers 'hang in tough' at these times, but at significant cost. Terms 2 and 3 of the school year have very high incidence of student and teacher illness ( colds, 'flu, glandular fever) and absenteeism. Some students suffer breakdowns of health and mental resilience. These are stressful times for students, and sadly, while they might generate a substantial printed document, the outcome of all this effort is that they too often don't learn very much real, useful knowledge to carry forward into their science studies.

Under this regime, it is now, regrettably, almost impossible to take all three Science Subjects in Years 11 and 12 as it places far too hard a burden on the students. Imagine trying to complete three EEIs during the one term. Many aspiring students have to cope with two EEIs during the same term.

Fortunately, there are now lower word limits applied to the EEIs, however, the total time required for the completion of such a project would often be of the order of 20 hours.

It is clear to those of us who have worked under this duress that students participate in these studies, but that it is at their own very significant personal cost.

## *Category 3. The ability of assessment processes to support valid and reliable judgments of student outcomes.*

The very nature of the mandated assessment regime brings the validity and reliability of the grades awarded into sharp question on many counts :

- One cause is the fact that all standard descriptors for each criterion are written statements which are subject to differences in interpretation; there is considerable likelihood that standards will vary between different schools and different school districts. Moderation panels depend on different panel chairs who may give different interpretations. The standard criteria are subjective. This situation also creates the possibility that responses which are deemed valid by a particular panellist may not be comparable with the opinions of other panellists.
- Different schools clearly have assessment programs with a different balance of assessment tasks e.g. some schools may have more Written Tasks e.g. Formal Tests, and fewer EEIs or ERTs, and vice versa.
- The high proportion of summative assessment derived from long EEI and ERT assignments constitutes an invalid emphasis on writing skills in the opinion of many teachers. What is even more significant is that the majority of these tasks are completed as at-home assignment work and the authenticity or ownership can often be in serious question. It is well known that many students utilise the services of paid tutors to guide them very heavily in the construction of their submissions. This is a very serious practice because it means that the student's own work is not really what is assessed, and it is also a serious equity issue because many students can not afford access to tutorial help. Moreover, some schools/teachers give students considerable feedback on draft stages and some do not.
- For Written Tasks (Formal Exams and Tests), there is certainly variation between teachers and schools in the level of preparation which students receive prior to the assessment day via Revision Worksheets which may or may not prep the students to the same level.
- In this assessment regime, overall results are determined as a result of awarding of letter grades for each of the three assessment dimensions (KCU – Knowledge and Conceptual Understandings, IP – Investigative Processes, and EC – Evaluating and Concluding). Most schools utilise a coarse-grained 15-letter scale to achieve this along the range from A+, A, A-, B+ , …, E+, E, E-. These grades therefore possess significant uncertainties (as per the mathematical uncertainty rules). Combining these three dimension grades clearly leads to even greater uncertainty in the accuracy of the result. This is a very clear scientific principle which occurs in the combining of three grades into one, and it clearly strips the final result of accuracy and therefore validity.

Clearly, validity (a measure of accuracy) and reliability (a measure of precision) of results are both limited. In addition to these concerns, other substantive issues are also prevalent in the nature of the assessment for the Science subjects:

- The relative emphasis of the three performance dimensions is that they are equal in the weighting they contribute to the final grade. However, this combination distorts the desirable contributions well away from what they should be, in the eyes of my colleagues, long-term

experienced teachers who assert that each branch of Science possesses its own characteristic knowledge and methodology, its own algorithms and standards, some of which are lost in the new assessment regime. In their place, courses are required to place substantial emphasis on the set of 49 CCEs, the Common Curriculum Elements, which are essentially a set of thinking and information-processing skills, rather than Chemistry- or Physics-related skills. The reason for this (not always understood by people from outside the education profession) is that the QSA mandates these elements into every Board Subject's requirements so that all subjects can then be treated as equal in their ability to contribute the subject results of a cohort towards OP calculations. To a certain extent, this means that the assessment regime for every Board Subject must be a substantive Scholastic Aptitude Test which is in fact a microcosm of the QCS Tests. This correlation between subject assessment and the QCST, in fact, attempts to repeat the QCST measurement, and relies on the assumption that the performance of the cohort in the Subject assessment should strongly correlate with the cohort's overall QCST performance distribution.

To the author, this is not necessarily a valid construct. You do not need to be an A or A+ performer in the QCST in order to be a very knowledgeable and highly competent Chemist, Physicist, or Biologist) and to me this imparts a serious injustice to the assessment of some students in all of the Sciences.

- The very length and duration of the EEI and ERT tasks is also an issue of some concern. Too much time is lost to these assessments, to the detriment of traditional elements of Chemistry and Physics courses. It must be remembered that Chemistry and Physics are Knowledge-based subjects. In studying these subjects, a broad knowledge foundation is essential for success in the subject as well as for future studies. To illustrate this, the biggest growth areas of Biology at the moment are Molecular Biology and Genetics; clearly, Chemistry foundation knowledge is needed to inform success in these areas. The over-emphasis of scholastic aptitude assessment items is taking away from the essential Science knowledge that our Senior graduates should possess and carry forward.

- EEIs may be well-intentioned educational assessment tools by virtue of the fact that they are designed as authentic (they investigate real problems using the Scientific method), inquiry-based, socially collaborative, rigorous, learning tasks. However, they are laborious and overly complex. *Occam's Razor* needs to be applied, as well as a fundamental principle of fairness: Just as it would be unfair to assess Hockey skill by giving Secondary students two 75 minute lessons on hockey skills and then applying a stringent skills test, it is not sound assessment practice to combine inquiry-based learning tasks to make a rigorous assessment task. The practice of turning Learning Tasks into Assessment Tasks is manifestly unfair. When students start an EEI on a topic to which they have never been exposed, their inexperience of the key knowledge is a critical block to progress. Usually, the teacher will give some direction. In general, getting started on the EEI project is often an almost insurmountable hurdle to many students.

## 3. Recommendations about the future of the assessment model

The scope and knowledge of the topics studied in the Senior Sciences and Mathematics are already well-defined, appropriate and well-accepted by teaching practitioners. The key changes needed to Senior Science and Mathematics Syllabi are changes to the Assessment regimes.

Education in Queensland has experienced turmoil and controversy during the past five years, mostly about the need for well-defined national standards in literacy and numeracy. Concern is widespread not only in the educational community but also in the community at large, as a result of Australia's rankings in literacy and numeracy falling behind many international competitors. (See Section 5, Appendix, Note 11). At the same time, Queensland's NAPLAN results are attracting criticisms for being low in the national rankings.

The task of rectifying this state of affairs has been planned and implemented nationwide via the National Assessment, Curriculum and Reporting Authority, ACARA. The remedy has been fairly straightforward – national standards of knowledge and application have been clearly defined for all schools, and are measured by national standardised tests.

Prior to this NAPLAN approach, schools under the umbrella of the QSA and Ed Qld have had a very open approach to what constitute Key Learnings, and the consequence has been that different "goalposts" for literacy and numeracy have proliferated across the system. The same problem has infected Senior Assessment with no two schools in the state having exactly identical "goalposts" or assessment plans, simply because the QSA assessment regimes are too open-ended.

***Three Recommendations*** in order to rectify this situation:

1. The adoption of state-wide Standardised Tests (i.e. via public exams) at the end of the course of study in all of the Senior Science and Mathematics subjects, the results to be combined with data from internal school assessments to generate an exit grade.

   An appropriate balance between the external and internal components would be
   - External Exam - 50 % of Subject total
   - Two Internal exams – 25 % of subject total
   - Two internal assignments – 25 % of subject total

2. The use of numerical marks must be reinstated so that internal school assessment is capable of producing fine-grained data with which to rank students for Tertiary Entrance calculations.

3. The QCST should still be taken by senior students wanting university places, but it should be used to produce a stand-alone subject result for the Senior Certificate and should not be used as a vehicle for OP or TE calculations.

## 4. *Discussion and Conclusions - The Genesis and Evolution of the Assessment Model in the Queensland Maths-Science context*

This submission puts forward and argues to support the thesis that

i. An educational and assessment "theory" developed by academic researchers has been implemented by the Queensland Studies Authority (QSA) in the form of the Senior Syllabi for Mathemetics subjects, Chemistry, Physics and Biological Science (which, is not within the purview of the educational inquiry)
ii. The the rigourous asssessment regimes put in place have proven to be both detrimental to Senior Maths and Science education and injurious to the health and well-being of the stakeholders affected (students, families and teachers).

Supporting evidence for these claims is manifest in the archived literature publications of the QSA and its previous incarnations, the Board of Secondary School Studies (BOSSS) and the Board of Senior Secondary School Studies (BOSSSS).

Professional academic researchers in Education faculties of our universities lie among the intellectual elite of the nation, and it is no surprise that their research unpicks brilliant understandings about the interplay of a huge number of educational variables in the dynamic education process in ordinary classrooms. Such professionals are highly reliant on output of research publications for their very livelihoods since external grant monies finance their work. The very privileged among them are salaried staff of the QSA. In order to develop and maintain careers, a "publish or perish" mindset fuels competition and career advancement. However, academic researchers can also be seen as uninformed about real teacher workloads, school resources and curriculum demands on students because they do not work full-time in high school communities. The consequence of this is that the assessment schemae and regimes are overly complex and overly onerous to the stakeholders and, in fact, unsustainable. In fact, a simpler, clearer, less demanding assessment model could produce more valid and reliable outcomes than the present model.

It is quite straightforward to trace the origin and evolution of the present Asessment Regime of the QSA in the Senior Sciences, because archives of all QSA publications are available through its home website links.

Right from its inception as the previously known Board of Secondary School Studies (BOSSS), the organisation was informed by the academic research of key employees who, as professional academics, were very active in resarching the educational literature and produced many excellent Discussion Papers under the leadership of John Pitman, with Royce Sadler being a principal author. One particular research conclusion which was destined to reverberate throughout future publications was the insight of Janice Findlay that "Two basic assessment mechanisms through which the quality of student performances can be improved are feedback and information supplied about task expectations prior to performance". This was destined to become a foundation plank of a modern push for Inquiry-based Learning mandated in the present Syllabi. (See Section 5, Appendix, Note 1)

In the same publication, Royce Sadler recognised the limitations of using marks as the principal means of measuring the quality of student achievement. (See Section 5, Appendix, Note 2).

His paper also introduced to Queensland the notion that matching statistical distribution and spread can be valid tools for comparing student performance across subjects of vastly different nature, a critical plank in the statistical process used to combine subject SAIs (Subject Achievement Indicators) in OP calculations. (See Section 5, Appendix, Note 3)

Across the years since its inception, the QSA and its previous incarnations maintained a constant output of educational research to inform its policies and took noticeable pride in its academic successes and publications being presented around the world at educational conferences, as reported by Gabrielle Matters in her 2006 paper, *Assessment approaches in Queensland senior science syllabuses*. (See Section 5, Appendix, Note 4)

A discussion paper entitled *High-Quality Assessment: We are what we believe and do*, was but one attempt to promulgate the Queensland view of the merits of Internal Assessment internationally and was presented to a conference in Slovenia in 1999. It showed the development of the belief system that relates the quality of learning to the quality of the assessment applied. This paper laid out core values emphasising the need for contextualised learning with appropriate criteria-based assessment to guide the learning, as well as a shift away from simple measurement of performance against traditional standards using marks. (See Section 5, Appendix, Note 5)

The release in 2006 of a germinal report, *A Report to the Queensland Studies Authority - Assessment Approaches in Queensland Senior Science Syllabuses*, produced by Gabrielle Matters, a description of the development of an assessment "theory" was used. (See Section 5, Appendix, Note 6)

The report tied together all of the significant research advances of the preceding two decades, which were to become central to the future Science and Maths Syllabi, summarised in a list of Conclusions (Section 11) and Recommendations (Section 12). (See Section 5, Appendix, Note 7)

Significantly, this report followed the brief experimentby *Ed Qld*, of the *New Basics Project* implemented in selected Queensland schools as a tradeoff for immediate funding for infrastructure and school improvements. The program for Middle School students was trialled with fanfare for several years before being quietly dropped, and was centred around core beliefs such as:

- Students are engaged in authentic educational experiences derived from the real world and having real world value and context
- Students make their own meanings and knowledge best when learning in a social context with their peers via collaborative learning (social constructivism)
- Students are engaged in multidisciplinary *Rich Tasks* which require significant skills, attitudes, depth, scope and rigour
- Students performance is assessed against clearly articulated criteria and standards of achievement

Matters' report included key analyses and learnings from the New Basics Program and subsequently laid the foundations for the new Science Syllabus' Assessment to be founded on similar beliefs as had been incipient in the Rich Tasks of the New Basics regime as typified by the statement:

"The proposed new model … does contain features necessary to support the nature of complex, multifaceted tasks that assess multiple knowledges, understandings, skills and dispositions." (See Section 5, Appendix, Note 8).

Regrettably, the QSA researchers had not identified or taken to heart one of the key causes of the demise of the New Basics program, that being the immense strain from workload placed on the New Basics teachers, even though this was identified in the report.
(See Section 5, Appendix, Note 9)

These statements clearly indicate the extent to which professional academic researchers in education were found to be strongly attached to their developing "theory" and intent on pushing it further, to the extent of looking for opportunities to test the "theory". To me, it seems most clear that, even though the limitations of the "theory" should have become apparent through the implementation and demise of the New Basics Program in selected Middle Schools, the QSA nonetheless was determined to continue testing the "theory" through the new Syllabi for the Senior Maths and Sciences. Regrettably, the Senior Science and Maths communities of teachers and students have been required to pick up the tab for this experiment.

The process has been well-intentioned and altruistic. However, nobility is not sufficient to guarantee successful outcomes. The foot-soldiers in this educational campaign who actually attempt to implement the mandates are the HODs and Subject Co-ordinators have been huge workloads as they work to

- Design their courses and Work Programs
- Write the resources
- Write the assessment items with the sophisticated standards vs criteria matrices
- Implement the assessments
- Grade and moderate the assessments
- Compile the student spreadsheets and profiles

and, at the same time cope with the myriad other responsibilities of a teaching life.

It is appropriate to state here that the Matrices of standards and criteria are extremely complex and sophisticated, to the point where they are too often overwhelming to many students and almost impenetrable and opaque to parents who read them. A sample of such a complex assignment and its assessment sheets is included with this submission.

This criticism about the level of complexity has resonated in the community affected by its rigours. Justine Ferrari, writing for *The Australian*, of July 10, 2012, stating the case against the new syllabi in simple terms, and demonstrating that Deans of Australian Universities have expressed grave concerns and brought strongly into question many of the statements of educational philosophy and methodology of the new Science pedagogy.
(See Section 5, Appendix, Note 10)

## 5. ***Appendix of Quotations and References***

1. *ROSBA Discussion Papers*, BOSSSS, 1985-87, Findlay, J., *Discussion Paper 15*, *Improving the Quality of Student Performance through Assessment*, p.90.
   http://www.qsa.qld.edu.au/downloads/publications/research_qbssss_rosba_11.pdf
   A major goal of education is to improve students' learning. Feedback is one mode through which this is attempted. Feedback in the assessment context can exist in various forms. A preferred form has the following dimensions: reference to criteria, some favourable comments, and information on actions which effect improvements. This often is time-consuming. The complement of feedback, the prior specification of criteria and standards, seeks to reduce time spent on the first dimension of feedback and to allow both student and teacher to concentrate more on improving the former's achievement level. By incorporating both feedback and prior information, the quality of student performance should improve.

2. *ROSBA Discussion Papers*, BOSSSS, 1985-87, Sadler, R., *Discussion Paper 21*, *The Place of Numerical Marks in Criteria-Based Assessment*, p120.
   http://www.qsa.qld.edu.au/downloads/publications/research_qbssss_rosba_11.pdf
   In this paper, a number of assumptions underlying the use of marks are identified, and the appropriateness of marks in criteria-based assessment is examined. The conclusion is drawn that continued use of marks is more likely to hinder than to facilitate the practice of judging students achievements against fixed criteria and standards.
   On the other hand, too great a preoccupation with numbers and scores may get in the way of determinations of quality.
   The use of marks in criteria-based assessment is inappropriate… diverts attention away from criteria, standards, and the processes of qualitative appraisals, and to that extent is educationally counterproductive.

3. Stanley, G. et al. *Review of teacher assessment: Evidence of what works best and issues for Development,* Oxford university Centre for educational assessment , p22
   http://oucea.education.ox.ac.uk/wordpress/wp-content/uploads/2011/01/2009_03-Review_of_teacher_assessment-QCA.pdf

   The QCS test is designed to measure achievement on the common curriculum elements underlying the Authority subjects, independent of specific subject content. There are 49 such common elements. The QCS produces scores with a mean of 175, a maximum of about 275 and a minimum of about 75. The SAIs for each school subject group are linearly transformed to match the scores of the QCS. This is performed after ensuring that outlier students, who score atypically high or atypically low on the QCS, do not affect the scaling conversion. The QSA regards this step as calibrating the scores on the different subjects within a school onto a common scale. However, it also has the effect of undoing the results of the consensus moderation. A school subject group with an average Very High Achievement in that subject, but with relatively low scores on the QCS, would find the scaled SAIs to be much lower than expected.

4. Matters, G., *A report to the Queensland Studies Authority*, Theoretical Underpinnings, ACER, 2006, p6.
   http://www.qsa.qld.edu.au/downloads/publications/research_qsa_science_assess.pdf

   Pitman and Dudley's paper on the Queensland experience of criteria-based assessment that was delivered at the 1985 IAEA (International Association for Educational Assessment) conference in Oxford (this was not long after IAEA had been established by luminaries in educational measurement from the Educational Testing Service (ETS), Princeton, and conference papers were awash with reports on standardised testing). In 1987, Sadler's seminal paper on 'specifying and promulgating achievement standards' was published in the *Oxford Review of Education*.
   http://www.qsa.qld.edu.au/downloads/publications/research_qsa_science_assess.pdf

5. Pitman, J. A. et al, *High-Quality Assessment: We are what we believe and do*, IAEA Conference, Bled, Slovenia, May 1999, p1.
   http://www.qsa.qld.edu.au/downloads/publications/research_qbssss_assessment_quality_99.pdf
   Assessment is an integral part of the learning process. It is most adequate, comprehensive and authentic when it occurs close to the learning environment. It should be based on clearly articulated criteria and standards of achievement. An assessment regime must be fair to all students, deliver value for money, encourage reflection, and provide mechanisms for improvement to be made.
   Drawing on the 'Cronbach–Moss framework' involving tighter notions of validity and broader notions of reliability, we propose a set of constructs, principles and values that underpin a high-quality assessment regime, and the

structures and procedures that deliver a high-quality assessment system.

In working through the issues raised by our introductory questions we have identified and defined what we believe to be the key assessment constructs, validity and reliability, and have described the principles and values that inform, clarify and extend these constructs. These are that **high-quality assessment** is integrated with learning, is adequate, comprehensive and authentic and produces fair and comparable results …

What we argue for is not the overthrow of the psychometric paradigm, with its emphasis on measurement and standardisation, but that it should be complemented by, and where appropriate, give way to, a hermeneutic approach that emphasises the exercise of contextualised judgments based on firm evidence. Assessment is seen as a decision-making, not a measurement, process. This approach stands in its own right as legitimate. It also provides a productive way of questioning the epistemology of validity under the psychometric paradigm. p3.

6. Matters, G., *A report to the Queensland Studies Authority*, Theoretical Underpinnings, ACER, 2006, p5.
http://www.qsa.qld.edu.au/downloads/publications/research_qsa_science_assess.pdf

Associated with the major issues identified by QSA (and listed in Section 1.5) are other (big) issues that also require attention. These other issues are not easy to treat in isolation from each other because, to a certain extent, each one shapes the other. The four big issues are:
1. The fact that the Queensland system of criteria-based assessment developed, not so much underpinned by theory but more so as a theory-building exercise in itself;

7. Matters, G., *A report to the Queensland Studies Authority*, Theoretical Underpinnings, ACER, 2006, p33.
http://www.qsa.qld.edu.au/downloads/publications/research_qsa_science_assess.pdf

8. Matters, G., *A report to the Queensland Studies Authority*, Theoretical Underpinnings, ACER, 2006, p32. http://www.qsa.qld.edu.au/downloads/publications/research_qsa_science_assess.pdf
These and other findings may or may not be generalisable to the senior schools with uni-disciplinary tasks in a high-stakes assessment regime.

9. Matters, G., *A report to the Queensland Studies Authority*, Theoretical Underpinnings, ACER, 2006, p31. http://www.qsa.qld.edu.au/downloads/publications/research_qsa_science_assess.pdf

One of the findings was that Rich Tasks produced work that was 'as rich as or richer than the best of the rest' (Queensland Department of Education and the Arts, 2004). However, another finding was that task-based curriculum/assessment is extremely demanding of teachers and of students.

Task-based assessment requires that teacher–assessors arrived at a single grade for student performance in multiple domains in a performance-based task completed over an extended period of time. Here, references to New Basics research findings (Queensland Department of Education and the Arts, 2004) should not be discounted simply because we did not recommend that New Basics be extended. There are lessons to be learnt from that research for those implementing the new science syllabuses.

10. Ferrari, J. *The Australian*, July 12, 2012, *Experimentation on the Science Syllabus Puts Feelings Before Facts*.
http://mediaspinners.blogspot.com.au/2012/07/oz-science-ruined.html

**SCIENCE as taught in Queensland schools is a "social and cultural activity" that generates explanations of natural phenomenon based on "personal experiences", a view rejected by the nation's deans of science as fundamentally misunderstanding the nature of scientific inquiry.**

This description is contained in an overarching statement introducing the syllabus for physics, chemistry and biology for Years 11 and 12 entitled: "A view of science and science education."

"Science is a social and cultural activity through which explanations of natural phenomena are generated," it says.

"The view of science as outlined by the Queensland Studies Authority was utterly rejected by the Australian Council of Deans of Science, representing the heads of science faculties in the nation's universities. The council's executive director, John Rice from Sydney University, said it was a misleading view of science and misunderstood "the unique way in which science goes about understanding things".

"That's quite wrong. It fails to understand the way in which science grounds itself in observation and testable hypotheses."

11. TIMMS 2011, Thomson, S. et al, *Monitoring Australian Year 8 Student Achievement Internationally*.

http://www.acer.edu.au/documents/TIMSS-PIRLS_2011-MonitorinAustralian-Year-8-Student-Achievement.pdf