To: Ms Bernice Watson, Research Director
Education and Innovation Committee
Parliament House, George Street
BRISBANE QLD 4000

Email: eic@parliament.qld.gov.au

From: Dr Tony O'Connor
[redacted]

Dear Ms Watson

I would like to submit the attached document to the Education and Innovation Committee's inquiry into the assessment of Senior Maths, Physics and Chemistry.

If the submission is accepted please can you delete my address and phone number and the name of [redacted].

Sincerely yours

AJO'Connor

Submission to the Education and Innovation Committee inquiry into Assessment Methods for Senior Maths, Chemistry and Physics

Dr Tony O'Connor, B Sc (Hons), Ph.D. in Mathematics

I would like to make a submission to the Committee based on my experience as a lecturer in mathematics at Griffith University for over 30 years and, since retirement 5 years ago, as a volunteer tutor in a homework help program for secondary students from non English speaking background by [redacted]. However the views expressed here are my own and not those of either Griffith University or [redacted].

The terms of reference of the committee include consideration of :

- Ensuring assessment processes are supported by teachers
- Student participation levels
- The ability of assessment processes to support valid and reliable judgments of student outcomes.

I would like to concentrate on the last point.

1. **Preparation of students taking Maths B for basic mathematics courses within Science degrees**.

   For 20 years I was heavily involved in teaching the introductory mathematics course for students intending to study physics, mathematics, chemistry or engineering at Griffith. These courses always start with a review of grade 12 mathematics and particularly seek to consolidate student's understanding of calculus. I also taught an introductory statistics course for 25 years as well courses at higher levels.

   The pre-requisite for entry into these courses was a Sound Achievement in Maths B.

   Over this time there was a noticeable drop in the ability of average students to quickly and confidently handle basic mental arithmetic (addition, division by 10), to handle fractions and to use basic algebra (as learnt in grades 10 and 11). To emphasize the importance of these skills we introduced a simple 'algebra quiz' (covering arithmetic, basic algebra and simple logarithms and powers). This contained 30 questions and was worth 2% of the overall grade. Students had to obtain at least 27/30 to pass and could not pass the course without passing this test. A sample test and a revision booklet was provided to students before hand and students could repeat the test up to 6 times in order to pass. Less than half the students were able to pass on the first attempt.

   I came to the conclusion that a Sound Achievement in Maths B is highly variable. Yet this is a standard entry requirement for many Science and Engineering degrees in Queensland Universities. It is reasonable to expect that students with an SA grade can routinely carry out standard procedures.

By itself the Maths B syllabus looks quite reasonable and it was tempting to put the decline down to the greater range of students going onto further study.

However it was always noticeable that the small number of students from northern NSW who had taken the NSW 2 unit HSC Maths subject often had much better preparation.

It is also quite difficult for an outsider to get a true picture of what Qld students are tested on. The whole internal moderation process is opaque to the outsider and the reports from State Panels published by QSA are uninformative (concentrating on the interpretation of panel comments). This contrasts to the detailed examiners reports provided in NSW, Victoria, South Australia and New Zealand where external exams are used. These comment on the difficulty of each question, what students were good at and what they found difficult. These reports far exceed anything that a local or state panel would have the time to produce.

2 Experience in homework help program

This program provides additional assistance to secondary students from migrant or refugee families. Students who come are motivated – they come after school for 2 hours or on Saturday morning for 3 hours. Mostly they do not speak English at home and are not likely to have family friends who can help them. Mostly the tutoring is one to one. The aim is not to do homework or assignments for the student but to help them understand what they are being asked, to spot and fill in gaps in their background and to review what they have already studied. Sometimes they come with nearly completed assignments for proof reading. Before exams it often involves checking their answers to revision sheets or helping them to solve them during the session..

I have mostly concentrated on Maths A, B and C from grade 11 to 12 and on Physics in grades 11 and 12

Generally exam revision sheets look reasonable.

However assignments are highly variable. Some are fairly clear and offer a chance to consolidate a range of topics. Others are written in a complicated way and require a lot of work for little obvious benefit. I have seen completed assignments that exceed 30 pages and was told of one that was over 60 pages. This can easily happen when students are asked to do a lot of calculation (usually not by hand but using graphics calculators). Students show the working. Questions that as students to interpret the results or to comment on the limitation of the method, model or answer often produce long, woffly answers. These assignments must be difficult and draining to mark.

3 The role of assignments in undergraduate and high school mathematics

Most of the courses I taught at Griffith used some assignments. However over the years I learnt that writing reasonable assignments is much more difficult than setting problem sheets or exams. It is very easy to set an assignment that looks interesting and challenging but which turns out to demand too much student time, to involve too much concentration on a limited part of the course and, in the end, to take a great deal of time to grade and to provide useful feedback to students.

Assignments that seek to apply mathematics to 'real world' or 'partly real world' situations are useful when used sparingly. Many skills that teachers and lecturers may take for granted are not intuitive to students. These include truly understanding the context of the problem, being to make sensible diagrams (and sometimes, to be able visualize 3D situations), to understand what things are important and which can be neglected and also to be able to write concise and clear conclusions. These are skills that need to be taught.

Many students struggle to write clear, focused paragraphs.

I went through high school nearly 50 years ago. The type of assessment was very simple and well understood - homework problems, internal and external exams. Structured applications were present and the process for applied problems was actually taught. That was good because they are harder for most students. I am not suggesting that all was perfect then but I don't think that the average student is much different now.

4 Some problems with the internal moderation system used in Qld.

There many other submissions from practicing teachers pointing out ways in which school and panel based moderation can fail. Comments on who really writes assignments are very telling. Although a great deal of paper is generated with schools and panels very little is available to the public or to universities. It is particularly hard to know whether standards are maintained or slip over time.

This problem is addressed in the report by Marion, Peck and Raymond (" Year to year comparability of results in Queensland Studies Authority senior secondary courses that include school-based moderated assessments") mentioned in the QSA evidence (page 2, March 7 transcript) They spent 3 days examining the process of review and concluded that " Queensland's current procedures for ensuring both the within year and year-to-year comparability were strong overall". (page 2, QSA evidence, March 7).

However the same report stated that "While the reviewers thought that QSA engaged in many thoughtful approaches for evaluating the year-to-year comparability, the Queensland system could benefit from "seeding" work from previous years into the current year's moderation processes. This would be a direct approach to evaluate the degree to which standards are maintained across years."

The Marion report really assumes that procedures that look good on paper work that way in practice. I'm not sure how people outside the system can really know this. However a closer reading of this report shows that it refers to the organization of the local and state panels. It did not look at actual assessment items.

5 Some other comments.

Unfortunately graphics calculators are over used in Maths B and C. They are complicated to learn and after high school they are not used much (they are certainly not allowed in most university maths exams partly to create a level playing field but also because students are increasingly expected to be able to make reasonable sketches of simple functions by thinking. For more involved problems there are much friendlier and powerful computer programs.)

Geometric skills and motivation are badly neglected in the Queensland syllabus. The emphasis is on algebra and numbers.

The textbooks in common use are acceptable but are not outstanding. As these are the first point of reference for teachers and students one can only hope that with the introduction of a national syllabus there will be a concerted effort to produce a smaller range of nationally used, high class textbooks. There are times when the present books reduce mathematics to a set of rules without motivation that can be supplied without excessive algebra (this is particularly true for the rules of differentiation and the simplex method).