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SMC&PA Submission 108
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Rosemary Menkens MP
Chair, Education and Innovation Committee
Parliament House
George Street
Brisbane Qld 4000

Re: Inquiry into assessment methods for senior mathematics, chemistry and physics

Dear Ms Menkens,

Thank you for the invitation to make a submission to this inquiry. I begin by summarizing my professional experience as the background to my submission. I then address **two** of the issues to be considered by the committee, in relation to assessment in senior **mathematics**:

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

Relevant professional experience

I am a Professor of Mathematics Education at The University of Queensland. Having designed and taught pre-service teacher education courses for prospective secondary mathematics teachers at UQ for ten years, I consider myself to be an experienced mathematics teacher educator. In 2004 I gained national recognition for my expertise as a mathematics teacher educator through an Australian Award for University Teaching. I am also the lead author of the only tertiary textbook used in Australia for preparing secondary school mathematics teachers and in 2007, its year of publication, the quality of this book was recognized through an Australian Award for Excellence in Educational Publishing. I am a past Vice-President of the Queensland Association of Mathematics Teachers, responsible for designing and delivering a state wide professional development program for teachers of mathematics at all levels of schooling. In this role I personally delivered many workshops on assessment to secondary school mathematics teachers in Queensland and the ACT (which, like Queensland, has a school-based assessment system).

From 2006-2012 I was co-Director of two research projects, commissioned by the Queensland government, that evaluated the state wide implementation of the Queensland Curriculum, Assessment and Reporting (QCAR) Framework. This evaluation included a detailed appraisal the alignment of assessment with curriculum, the quality of assessment tasks, and the reliability of teachers' assessment judgments in Years 1 to 10.

I also have experience of developing and monitoring the implementation of criteria and standards based assessment (i.e., the assessment processes used in senior secondary schools in Queensland) at The University of Queensland. UQ adopted this form of assessment in 1997, and as a member of university-level committees I contributed to the development of assessment policy and provided professional development to university teachers to help them implement these policies. In 2006 I gained national recognition for my expertise in assessment through an Australian Learning and Teaching Council

Fellowship that allowed me to investigate how to support university teachers to adopt new assessment practices.

With respect to assessment and curriculum development in school mathematics, I served on Mathematics Subject or Syllabus Advisory Committees of the Queensland Board of Senior Secondary School Studies and the Queensland School Curriculum Council from 1999-2004, and from 2005-2007 I was Chair of the Queensland Studies Authority's Mathematics Syllabus Advisory Committee. In the latter role I oversaw the last revision of the senior Mathematics A, B, and C syllabuses.

I believe that my professional experience in mathematics education, curriculum development for senior secondary school mathematics, and criteria and standards based assessment enables me to make informed comments in relation to this inquiry's terms of reference. I make this submission as an individual academic, not representing any particular organisation.

- **The ability of assessment processes to support valid and reliable judgments of student outcomes.**

Validity has many technical meanings, but in simple terms the validity of assessment refers to the ability of assessment to do **what it purports to do**. For this to be possible, it is necessary for assessment to be in **alignment** with the curriculum. In other words, assessment tasks must elicit the kinds of performances from students that the curriculum says students should be able to do.

In the senior mathematics syllabuses, expectations about "what students should be able to do" are expressed by three General Objectives:

- Knowledge and procedures (e.g., students should be able to recall and use mathematical definitions, rules and procedures);
- Modelling and problem solving (e.g., students should be able to identify, analyse, and solve problems, and investigate and model mathematical situations in the real world);
- Communication and justification (e.g., students should be able to organize and present mathematical information, develop logical arguments, and justify procedures and results).

These objectives are consistent with current research in mathematics education and they express expectations similar to those found in mathematics curriculum documents in many other developed countries, such as the United States and Singapore. There is nothing about these objectives that marks them as unusual or unreasonable in comparison to international benchmarks.

To enable **valid judgments** of students' outcomes in relation to these three objectives, the right kinds of assessment tasks have to be used. Some kinds of assessment task are more appropriate than others for eliciting different types of mathematical performance. For example, a timed supervised test is appropriate for finding out if students can recall and use mathematical definitions, rules and procedures "on demand" (Knowledge and procedures objective). But this type of task is less appropriate for finding out if students can identify

and analyse problems, create mathematical models of real world situations, or develop logical arguments (Modelling and problem solving; Communication and justification). The second and third syllabus Objectives require complex thinking and analysis of situations that may appear somewhat “messy” or unfamiliar to students, even though they will have already learned the mathematics they need in order to find solutions. That is why the mathematics syllabuses require that assessment techniques other than supervised tests must be used at least twice each year, and why the syllabus offers information about alternative techniques such as extended modelling and problem solving tasks or practical and investigative tasks.

To summarise: Assessment processes can support **valid** judgments about student outcomes if assessment tasks are designed to **align** with the syllabus objectives.

Like validity, **reliability** also has many technical meanings. Probably the most helpful meaning for the present purpose is: reliability refers to the extent to which another teacher would make the **same judgment** about a student’s learning outcomes.

There are two important complementary processes for strengthening the reliability of teachers’ assessment judgments: (i) provision of explicit criteria and standards and (ii) social moderation.

Queensland senior syllabuses use criteria and standards based assessment. The mathematics syllabuses provide explicit criteria and standards by which to judge the overall quality of students’ work over Years 11 and 12. (A criterion is a property, dimension or characteristic by which something is judged or appraised. A standard is a fixed reference point for use in describing the quality of something.) The criteria and standards used in senior mathematics are expressed in words, and they have been progressively refined over three syllabus revisions (1992, 2000, 2008), in part in response to feedback from teachers.

Explicitly stated standards on their own are insufficient for ensuring reliable judgments. But using marks or percentages instead of words to describe standards does not make judgments inherently more reliable. This is because the allocation of marks to assessment items (as a means of indicating the “value” of the items) and to students’ responses to these tasks (as a means of indicating “how much” students know) requires human judgment – just as much as any other aspect of assessment.

Social moderation is a fundamental aspect of school-based assessment in Queensland. Social moderation occurs within a school, when teachers of the same subjects and year levels compare their assessment judgments of students’ work, and between schools, via district panels comprising teachers from different schools. Social moderation is important because it helps teachers learn to make more reliable judgments, and because it provides a form of quality assurance that should contribute to public confidence in Queensland’s senior secondary school assessment system.

To summarise: Assessment processes can support **reliable** judgments about students’ outcomes when teachers (i) use **explicit criteria and standards** against which to compare students’ work and (ii) engage in **social moderation** to test their judgments against the judgments of other teachers.

- **Ensuring assessment processes are supported by teachers**

My comments above referred to assessment processes. I now turn to the ability and willingness of teachers to implement these processes.

Every time a QSA syllabus is revised, a state wide survey of teachers is conducted to gauge satisfaction with the current syllabus and identify areas needing improvement. This was the case for the last revision of the senior mathematics syllabuses, which was carried out in 2006-2007. Teacher feedback indicated that the mathematics syllabus assessment criteria and standards, and the method for deciding on students' final levels of achievement (Very High, High, Sound, Limited, Very Limited Achievement), needed to be adjusted to make them easier to use. Note that there was no real support for changing the way that assessment is conducted, only for refining existing processes. This revision was part of the incremental improvement to the assessment criteria and standards that has been achieved in each successive version of the syllabuses – published in 1992, 2000, and 2008.

Having been involved in curriculum development and assessment reform in school and university education for many years, I know how important it is to ensure that teachers are supported in implementing new approaches. Support needs to come from many places: universities (pre-service and postgraduate teacher education), the QSA, professional associations, and the employing authorities (government and non-government school sectors). I also know that innovation is most likely to succeed when it happens slowly, allowing time for teachers to understand and commit to change. It is for these reasons that I view the gradual refinement of the senior Mathematics A, B and C syllabuses over a period of 20 years as an example of reasonably successful innovation.

To summarise: Assessment processes required by QSA senior syllabuses are most likely to be supported by teachers when they have access to appropriate **professional development** and sufficient **time** to adjust to change.

I would like to conclude with the observation that assessment is probably the most difficult part of a teacher's job. Good assessment involves designing tasks that elicit evidence of the kind of learning that the curriculum values. It also involves making reliable judgments about the quality of students' learning – not just "how much" they know but "how well" they can use their knowledge. Thus all aspects of assessment require the exercise of sound professional judgment, and continuing efforts must be made to ensure that teachers are properly prepared and supported in this important aspect of their professional work.

I would welcome the opportunity to elaborate on this submission or to contribute in any other way to the inquiry.

Yours sincerely,



Professor Merrilyn Goos