QSA ref: 13/33551 (800/2/1/0122)

Mrs Rosemary Menkens MP
Chair, Education and Innovation Committee
Parliament House
George Street
BRISBANE QLD 4000

Dear Mrs Menkens

Thank you for your letter dated 26 June 2013 requesting further information from the Queensland Studies Authority (QSA) to inform the Education and Innovation Committee's inquiry into assessment methods used in senior Mathematics, Chemistry and Physics in Queensland schools.

The attached supplementary information contains QSA's response to the specific questions, namely:

- The matters raised in submission 286:
  - The Queensland Core Skills (QCS) Test and its comparability to school-based assessments of mathematics achievements, and whether the test is an indicator of the reliability of school-based assessment in mathematics, chemistry or physics.
  - The "recent audit of the QCS Test which suggested that girls are favoured in terms of OP scores, due to current assessment practices".
- Clarification on data presented by QSA in its submission and at public briefings.

In relation to the committee's invitation to respond to matters raised in other submissions, QSA considers that it has already addressed in sufficient detail the main issues that are relevant to the terms of reference of the inquiry. The information in QSA's submission, responses to specific questions and statements provided during the public briefings represents its position on these issues.

However, QSA would like to offer some points of clarification on two issues not addressed in sufficient detail in its previous submissions or statements:

- The influence of constructivism in QSA's syllabuses.
- Differences in performance according to gender.

Brief statements are included in the attached document, followed by QSA's response to submission 286 and answers to the committee's specific questions.

I invite you to contact John McGuire on telephone (07) 3864 0428 or by email at john.mcguire@qsa.qld.edu.au should you wish to discuss this matter further.

Yours sincerely

Neil McDonald
Acting Chief Executive Officer

10 / 07 /2013

enc.

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Attachment

Additional information for Education and Innovation Committee inquiry into assessment methods used in senior Mathematics, Chemistry and Physics in Queensland schools

Constructivism

Contrary to the claims made in many submissions, QSA is not a proponent of a radical constructivist agenda. Constructivism is actually a theory of learning which is underpinned by the observation that students learn best by trying to make sense of something on their own with the teacher as a guide to help them along the way. It should not be equated with Queensland's system of externally moderated school-based assessment which, like other systems of assessment, accommodates a range of pedagogical theories and encourages teachers to cater to students' individual learning styles.

Queensland senior syllabuses do not prescribe pedagogy; rather teachers choose a pedagogical approach suited to their students and reflective of the goals and aspirations of respective schooling systems and individual schools. They are developed using two key principles:

- **informed prescription**, that is making clear what students should learn (content) and the standards of learning

  balanced with

- **informed professional judgment**, which refers to teachers making decisions about how best to teach the required content.

This approach to syllabus development recognises that a key aspect of teaching is acknowledging that each student does not learn in the same way. This means that if the teacher chooses just one style of teaching (collaborative learning, inquiry learning, etc.), the students will be unlikely to maximise their learning potential. Using teaching strategies that accommodate a variety of learning styles throughout a course provides all students with opportunities to learn in ways that match their learning styles.

Differences in performance according to gender

QSA noted in its submission that relative differences in gender performance are complex and related to a number of factors including such things as subject selection and learning styles, which are broadly correlated with gender. It also proposed that one of the strengths of school-based assessment is its capacity to accommodate differences in students in a way that a single mode of assessment, such as a one-off test, is unable to do.

Some differences in the correlation between how boys and girls achieved in their school assessment compared with how they achieved on the Queensland Core Skills (QCS) Test have been identified in an external review. The review was commissioned by the QSA to ascertain the ongoing relevance of the QCS Test and its capability to act as a statistical scaling device in the calculation of OPs and FPs for tertiary selection. Conducted by a consortium of academics, the reviewers found that overall the QCS Test continues to perform well the functions for which it was designed and introduced. Their report may be accessed via the QSA website at the following address: http://www.qsa.qld.edu.au/downloads/publications/report_qcs_test_review_2012.pdf.

The differences in performance on the QCS Test identified by the reviewers was linked to whether students attended co-educational or single-sex schools. The review team also noted that it is possible the differences associated with gender could be attributed to other factors, stating that if the population is subdivided by other criteria, there will probably be differences

in the groups' performances in the QCS Test and their school-based assessments. The review recommended the QSA undertake further analysis and research into the issue. This project is currently underway and a brief summary follows.

1. There is extensive scholarly research into differences in educational performances of boys and girls. A clear finding of this research is that differences do exist, but ascertaining what those differences are and finding reasons for them is difficult to achieve. Many authors express concern about simplistic representations of a "gender gap" in educational achievement that do not consider the complex mix of social, cultural, economic, developmental and educational factors that may equally contribute to achievement differences.
2. A number of established trends have been identified in literature related to gender differences and educational performance:
    - Historically, girls have performed better academically than boys, except at the very "top" and "bottom" ends of distributions where there are a greater number of boys. For example, although girls, on average, achieve higher OPs than boys, more boys than girls obtain an OP1. It is very important to note that this phenomenon is not unique to Queensland. In New South Wales in 2012, there were 31 boys and 17 girls with the maximum ATAR of 99.95[1]. In Victoria, there were 25 boys and only 12 girls with the maximum ranking[2].
    - Girls in single-sex schools tend to perform better academically, but it is difficult to separate this from socio-economic factors since single-sex schools are more likely to be independent schools.
    - Boys and girls may have different strengths or preferences for certain subjects but this does not necessarily create advantage or disadvantage for them as learners.
    - Boys and girls do perform differently in different types of assessment.
    - Despite lower overall academic performance at school, boys still continue to progress through the education system or labour force to better paid employment than girls.
3. Many researchers focus on addressing perceived "gender gaps" through the need to provide quality education for all students, regardless of gender. Avoiding stereotyping, offering inclusive choices to engage all preferences and learning styles and having high expectations of both boys and girls are recommended for improving outcomes for both genders. Gender differences in achievement are important and require monitoring, particularly with regard to assessment methods. However, these differences in achievement must be kept in perspective, because they can be associated with social background.

Submission 286

The Committee has specifically requested that QSA respond to the matters raised in submission 286, particularly in relation to comments made about the QCS Test and its comparability to school-based assessments of mathematics achievements, and whether the test is an indicator of the reliability of school-based assessment in mathematics, chemistry or physics.

The author of submission 286 (and 121) acknowledges what s/he considers to be both positive and negative features of the Queensland system. Submission 121 contains a lengthy discussion of the issues that have, for the most part, been raised in other

[1] Source: NSW Vice-Chancellors' Committee – Technical Committee on Scaling, *Report on the 2012 Scaling of the NSW Higher School Certificate*, Universities Admissions Centre, 2013 (p.16).

[2] Source: Victorian Tertiary Admissions Centre (VTAC).

submissions and addressed by QSA in its submission. Submission 286, however, makes some claims about what the QCS Test can reveal about student performance in school subjects. The QSA submits that the analysis in this submission is based on an incorrect statistical understanding and misrepresents the nature and purpose of a tertiary entrance rank. The analysis appears to assume that any numbers on a similar scale can be compared, no matter what their purpose or what they represent. For the author, any statistic, whatever it represents, is called an "r-squared" and is assumed to be comparable. In fact, in almost all cases, what is being compared in the submission is **not** comparable either statistically or conceptually. There are four main examples in the submission:

1. Within-school measures (WSMs) and the QCS Test

Within School Measures (WSMs) are a ranking within a school derived from subject results that allow QSA to identify very unusual QCS Test results for individual students. They are identified so that the effect of these outliers can be reduced when scaling takes place to increase the robustness of the procedures. The author of submission 286 misunderstands the nature and purpose of WSMs, and consequently identifies statistical outliers that do not exist. These errors mean that the analysis has no legitimate basis in statistics and its conclusions are therefore compromised.

A detailed explanation of the nature of WSMs and their use in tertiary entrance calculations is publicly available in QSA's *Guideline for determining Overall Positions (OPs) and Field Positions (FPs)* at the following web address:
http://www.qsa.qld.edu.au/downloads/senior/te_op_fp_determining_guide.pdf

2. Reliability

The QSA submits that there are also problems with the author's analysis of assessment reliability in the Queensland and Western Australian contexts.

The Western Australian data presented in the tables in the reliability section is problematic. For example, "reliability" is not simply the same thing as "r-squared", and what is reported is not an r-squared measure, nor what statisticians would normally consider reliability. The data reported in the tables are correlation coefficients between the school-based results in a subject and those on the external exam in the same subject. Not surprisingly, the correlation is high because it is comparing, for example, two Biology assessments.

These errors in nomenclature are compounded by a misinterpretation of the nature and purpose of the QCS Test in calculating tertiary entrance ranks. The purpose of the QCS Test is not to measure the reliability of the within-school achievement, and should not be seen as being able to do this. The QCS Test is a general achievement test which does not test content in specific Year 12 subjects. It tests the Common Curriculum Elements (CCEs) identified in the Queensland curriculum and assumes basic levels of general knowledge and vocabulary and Year 10 knowledge of mathematical operations. It is a scaling tool and its purpose is to allow comparisons **between** subjects for the construction of the Overall Position (OP) which is a rank indicating overall ability for tertiary entrance purposes.

The QCS Test does not measure the same thing as a test of knowledge and understanding in a discipline area, such as a mathematics examination. Reliability is a measure of how well it seems that different pieces of assessment are measuring the same thing. It is hardly a surprise that there are higher correlations between results in two Biology assessments than between a Biology assessment and a general skills test with no assumed Biology content. This lower correlation certainly is not an indication of lower reliability when it is compared to higher Western Australian within-subject correlations.

The author of submission 286 then goes on to compare correlations between subject results to other measures of reliability in ways that are inconsistent with sound statistical practice. It is suggested that producing correlations between Field C and Field D scores with school-based assessments will measure the accuracy and reliability of the school-based

assessments. While correlations will be higher with these results than those in subjects such as Chinese, **Field scores are not a measure of mathematics or science content, and so are not measures of the accuracy or reliability of the school-based results**.

Another misunderstanding in submissions 121 and 286 is that the CCEs are the foundation upon which Queensland's syllabuses are based. CCEs are derived from the content in syllabuses – they are observed **in** the curriculum rather than an influence **on** the curriculum.

3. Gender

Submission 286 also refers to the issue of gender differences raised in the recently-completed independent report on the QCS Test. This issue has been addressed in sufficient detail above.

4. One school's Field D results in Chemistry

While the data for the one school presented might be of interest to the author of submission 286 and the school itself, equating Chemistry and Field D, which is an area of study that emphasises solving complex problems involving mathematical symbols and abstractions, has resulted in a number of untested conclusions. Field D does not measure Chemistry achievement. Chemistry is not solely responsible for Field D performance. The two groups of students were different and no doubt were of different abilities, and Chemistry is probably not responsible for this. The conclusions drawn are therefore not sustainable.

Additional Questions

1. Could you please provide the definition of "cohort size" and "weighted population", as used on page 24 of your submission?

"Cohort size" is the number of Australian citizens or permanent residents enrolled at a school at the end of Year 12 who either:

- recorded an enrolment in at least one semester of an Authority or Authority-registered subject, or
- were Queensland Certificate of Individual Achievement (QCIA) students who recorded an enrolment in a VET course provided by the school.

"Weighted population" is a nationally used estimate of the size of the population that could potentially be at school. Because students who complete Year 12 commonly have ages ranging from 16 to 20 years, and the populations of 16, 17, 18, 19 and 20 year olds are different, the weighted population is a weighted average of the 16 to 20 year old populations, weighted by the proportion of Year 12 students of each of those ages.

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2. Could you please confirm what year group (Year 11 or Year 12) Table 3 applies to (on page 24)?

The enrolments on page 24 of the submission are for Year 12 students in the given year. The first table shows counts of Year 12 students who have studied one or more semesters of the given subject in either Year 11 or Year 12. The second table is counts of students who studied the given subject in the final semester of their Year 12 year – that is, they did not drop out of the subject before the end of the course.

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3. Could you please provide the same data as provided on page 24 of your submission, over a 10 year period (2002-2012) and also include the same data for mathematics A and chemistry?

Year	Subject	Enrolments	Cohort size	Weighted population	Percentage of cohort	Percentage of population
2002	Chemistry	8457	38820	52710	21.79	16.04
2003	Chemistry	8341	38721	52834	21.54	15.79
2004	Chemistry	8429	38471	53737	21.91	15.69
2005	Chemistry	8697	38953	54708	22.33	15.9
2006	Chemistry	8489	39579	56373	21.45	15.06
2007	Chemistry	8582	40887	58097	20.99	14.77
2008	Chemistry	8597	41152	60579	20.89	14.19
2009	Chemistry	8908	43196	61514	20.62	14.48
2010	Chemistry	8483	44652	62082	19	13.66
2011	Chemistry	8918	45681	62803	19.52	14.2
2012	Chemistry	8927	46798	63238	19.08	14.12
2002	Maths A	20626	38820	52710	53.13	39.13
2003	Maths A	21037	38721	52834	54.33	39.82
2004	Maths A	21040	38471	53737	54.69	39.15

2005	Maths A	21374	38953	54708	54.87	39.07
2006	Maths A	21809	39579	56373	55.1	38.69
2007	Maths A	22892	40887	58097	55.99	39.4
2008	Maths A	23357	41152	60579	56.76	38.56
2009	Maths A	24153	43196	61514	55.91	39.26
2010	Maths A	24948	44652	62082	55.87	40.19
2011	Maths A	25582	45681	62803	56	40.73
2012	Maths A	26189	46798	63238	55.96	41.41
2002	Maths B	15952	38820	52710	41.09	30.26
2003	Maths B	15942	38721	52834	41.17	30.17
2004	Maths B	15671	38471	53737	40.73	29.16
2005	Maths B	15894	38953	54708	40.8	29.05
2006	Maths B	15389	39579	56373	38.88	27.3
2007	Maths B	15695	40887	58097	38.39	27.02
2008	Maths B	15419	41152	60579	37.47	25.45
2009	Maths B	15606	43196	61514	36.13	25.37
2010	Maths B	15771	44652	62082	35.32	25.4
2011	Maths B	16007	45681	62803	35.04	25.49
2012	Maths B	16302	46798	63238	34.83	25.78
2002	Maths C	2947	38820	52710	7.59	5.59
2003	Maths C	2937	38721	52834	7.59	5.56
2004	Maths C	3089	38471	53737	8.03	5.75
2005	Maths C	2972	38953	54708	7.63	5.43
2006	Maths C	2909	39579	56373	7.35	5.16
2007	Maths C	3036	40887	58097	7.43	5.23
2008	Maths C	3040	41152	60579	7.39	5.02
2009	Maths C	3131	43196	61514	7.25	5.09
2010	Maths C	3445	44652	62082	7.72	5.55
2011	Maths C	3566	45681	62803	7.81	5.68
2012	Maths C	3783	46798	63238	8.08	5.98
2002	Physics	6692	38820	52710	17.24	12.7
2003	Physics	6659	38721	52834	17.2	12.6
2004	Physics	6919	38471	53737	17.98	12.88
2005	Physics	6630	38953	54708	17.02	12.12
2006	Physics	6470	39579	56373	16.35	11.48
2007	Physics	6719	40887	58097	16.43	11.57
2008	Physics	6579	41152	60579	15.99	10.86
2009	Physics	6690	43196	61514	15.49	10.88
2010	Physics	6635	44652	62082	14.86	10.69
2011	Physics	6654	45681	62803	14.57	10.6
2012	Physics	6804	46798	63238	14.54	10.76

4. Could you provide data for the number of completions in mathematics A, B, and C, physics and chemistry by gender, over the period 2002-2012?

Year	Subject	Gender	Semester 4 Completions
2002	Chemistry	Female	3363
2002	Chemistry	Male	3635
2003	Chemistry	Female	3366
2003	Chemistry	Male	3580
2004	Chemistry	Female	3222
2004	Chemistry	Male	3701
2005	Chemistry	Female	3442
2005	Chemistry	Male	3637
2006	Chemistry	Female	3480
2006	Chemistry	Male	3440
2007	Chemistry	Female	3339
2007	Chemistry	Male	3586
2008	Chemistry	Female	3403
2008	Chemistry	Male	3393
2009	Chemistry	Female	3593
2009	Chemistry	Male	3412
2010	Chemistry	Female	3388
2010	Chemistry	Male	3250
2011	Chemistry	Female	3623
2011	Chemistry	Male	3488
2012	Chemistry	Female	3643
2012	Chemistry	Male	3551
2002	Maths A	Female	10596
2002	Maths A	Male	8371
2003	Maths A	Female	10659
2003	Maths A	Male	8675
2004	Maths A	Female	10637
2004	Maths A	Male	8506
2005	Maths A	Female	10772
2005	Maths A	Male	8517
2006	Maths A	Female	11037
2006	Maths A	Male	8466
2007	Maths A	Female	11356
2007	Maths A	Male	8885
2008	Maths A	Female	11093
2008	Maths A	Male	8633
2009	Maths A	Female	11390
2009	Maths A	Male	9136
2010	Maths A	Female	11693
2010	Maths A	Male	9720

2011	Maths A	Female	11999
2011	Maths A	Male	9950
2012	Maths A	Female	12307
2012	Maths A	Male	9998
2002	Maths B	Female	5858
2002	Maths B	Male	6870
2003	Maths B	Female	5747
2003	Maths B	Male	6692
2004	Maths B	Female	5562
2004	Maths B	Male	6516
2005	Maths B	Female	5783
2005	Maths B	Male	6400
2006	Maths B	Female	5555
2006	Maths B	Male	6247
2007	Maths B	Female	5443
2007	Maths B	Male	6425
2008	Maths B	Female	5414
2008	Maths B	Male	5910
2009	Maths B	Female	5467
2009	Maths B	Male	5949
2010	Maths B	Female	5475
2010	Maths B	Male	6284
2011	Maths B	Female	5490
2011	Maths B	Male	6523
2012	Maths B	Female	5708
2012	Maths B	Male	6788
2002	Maths C	Female	794
2002	Maths C	Male	1818
2003	Maths C	Female	791
2003	Maths C	Male	1776
2004	Maths C	Female	802
2004	Maths C	Male	1851
2005	Maths C	Female	783
2005	Maths C	Male	1725
2006	Maths C	Female	814
2006	Maths C	Male	1688
2007	Maths C	Female	814
2007	Maths C	Male	1781
2008	Maths C	Female	843
2008	Maths C	Male	1744
2009	Maths C	Female	878
2009	Maths C	Male	1803
2010	Maths C	Female	959

2010	Maths C	Male	2053
2011	Maths C	Female	1023
2011	Maths C	Male	2102
2012	Maths C	Female	1090
2012	Maths C	Male	2270
2002	Physics	Female	1547
2002	Physics	Male	4136
2003	Physics	Female	1576
2003	Physics	Male	4019
2004	Physics	Female	1632
2004	Physics	Male	4058
2005	Physics	Female	1584
2005	Physics	Male	3896
2006	Physics	Female	1579
2006	Physics	Male	3821
2007	Physics	Female	1540
2007	Physics	Male	3988
2008	Physics	Female	1597
2008	Physics	Male	3788
2009	Physics	Female	1596
2009	Physics	Male	3817
2010	Physics	Female	1475
2010	Physics	Male	3923
2011	Physics	Female	1452
2011	Physics	Male	4016
2012	Physics	Female	1447
2012	Physics	Male	4218

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5. Could you please explain the difference between the enrolment figures provided on page 24 of your submission (Table 2, 'enrolments' column), and those available on your website (www.qsa.qld.edu.au/617.html), titled 'Subject enrolments and levels of achievement'?

The data in Table 2 shows only Australian citizens and permanent residents, whereas the data on our website include international students who are studying in Australian schools on temporary visas.
