SMC&PA Submission 8
Received: 2 April 2013

Dear Inquiry Members,

Please accept my submission as an experienced teacher of Senior Mathematics in Queensland (15 years), as a moderation panel member (2 years), and as a current Assistant HOD (Maths) at [redacted]

I fully support the concerns raised by Professor Peter Ridd (whom I do not know personally).

Summary of my submission:

- A significant number of Queensland teachers do not support our assessment system in Maths, Physics or Chemistry.
- Our assessment system is unnecessarily complex, inefficient and open to cheating.
- The syllabus 'standards' for assessment are vague and are interpreted differently by different teachers and panels.
- Huge amounts of time are wasted on debates about standards, the administration of processes, etc. all of which distracts us from the bigger picture (of improving teaching and learning).
- Our assessment processes in these subjects are demonstrably invalid and unreliable.
- A valid assessment system in Mathematics will only exist when assignments are abandoned altogether, and only when a student's final result is determined by external exams based on a precise curriculum.

Addressing the Terms of Reference

'ensuring assessment processes are supported by teachers'

I submit that assessment processes are not supported by teachers of Maths, Physics and Chemistry. On the contrary, there is widespread and deep frustration. I saw this for myself when I attended a mass meeting of Maths/Science teachers at the Mansfield Tavern on 16th June 2012. Almost all of the teachers present at that meeting (150 – 200) voted for major reforms to the current system. Meetings with similar results were held in other cities.

In my 15 years of teaching senior mathematics in Queensland, I have met relatively few mathematics teachers who support the concept of school-based assessment, and fewer still (less than

five) have supported the use of multiple criteria and grading by 'feel' instead of using simple percentages.

The *complexity* of our system causes unnecessary confusion and persistent frustration to teachers, students and parents. Most 16 to 17 year olds and their parents are not able to understand all the tables of standards, nor can they understand how the final results are accumulated. Even I, more familiar with the workings of our assessment system than the average person, could not understand how my own children were graded in senior mathematics at their school (nor did my children). Yes, I could have pressed the school with even more questions if I were prepared to risk antagonism at my children's expense, but ultimately I had to trust that the school was grading properly.

The common catchcry you hear in situations like this is 'just refer to the standards' but this is pointless because, as you will see for yourselves, the standards are vague and practically meaningless.

Valid and reliable systems are transparent and easy to understand. Ours is not one of those systems.

Our assessment system is *inefficient*. The most obvious examples of this are: the mass duplication of assessments across this state in all subjects (we don't have a culture of sharing much either), the countless man-hours wasted in understanding, explaining, and administering a non-marks assessment system, and the time involved in ranking students for the OP calculation.

It is at this point that I must stress the cruel irony which is that while our assessment system effectively bans using numerical marks, the QSA conveniently allows itself to use numerical marks when they grade the QCS test (see Attachment 1 for evidence that the QSA uses numbers, weightings, etc. to grade the QCS Short Response Paper).

Another irony and inefficiency is during our rush to complete the final round of grading towards the end of the year (teachers new to our system nearly faint when they're told grading needs to be done within a couple of days) where, once all the grading is completed, this is immediately followed by an intensely stressful period of trying to rank hundreds of students fairly, supposedly without numbers, and all within the tight deadline set by the QSA. Meanwhile, our Victorian and NSW colleagues are relatively free to concentrate on teaching and learning (either by using their time to prepare for their classes next year, or to do Professional Development, etc.)

'student participation levels'

I would submit that population increases in Queensland need to be considered before accepting any arguments about increases or decreases in student numbers in particular subjects.

I would also submit that students are not always spoiled for choice. Just because students choose a particular subject, it does not necessarily follow that they support the way that subject is assessed (and in most cases, students simply don't know any different).

'the ability of assessment processes to support valid and reliable judgments of student outcomes'

Take-home 'Alternative Assessments' (Assignments)

Cheating is rampant. I have investigated and proved many cases of students cheating on assignments over the years. *Proving* that cheating has occurred, however, is incredibly time-consuming and given we can only target the most obvious cases (so as not to become embroiled in protracted wars with litigious parents for example) we often grudgingly turn a blind eye.
The suggestions of using logbooks or continually monitoring the progress of student work etc. is laughably impractical with large and multiple classes.

The significant weighting given to assignments (they amount to about one-third of the students overall result in Mathematics) means that there is a considerable pressure on students to submit quality work. Wealthier students can and do pay for tutors to do their assignments for them. Poorer students are less likely to be able to pay *and nor should they have to even consider it* if we have a fair and equitable education system.

For a teacher to write a quality assignment task takes many, many, hours of work additional to their normal teaching duties. Teachers are loath to spend the time on creating assignments (only to have it cheated on) and so we often recycle assignments from previous years. What are also recycled, unfortunately, are student responses. A brief example: we once re-used an assignment involving our Chaplain's requirements for a wheelchair ramp into the School Chapel. We had a new Chaplain by this stage, yet we still received assignments from some of our students which referred by name to the *former* Chaplain, thus it was reasonably easy in that case to establish that these students had copied assignment solutions *in their entirety* from previous years and had simply neglected to

change the former Chaplain's name to that of the new one. Students are usually smart enough, however, to make enough changes to avoid detection and so we will only ever catch a small percentage of the cheats who prosper under this system.

With the knowledge I have of the subjects, it would have been possible for me to do many of my children's assignments for them as well as for nieces, nephews, etc. The temptation to do this is significant and I submit many teachers do.

The disparity between results of take-home assignments and supervised exams is often obvious when we view completed student profile sheets. I have attached a profile of one of my own students to illustrate (see Attachment 2 – [redacted] This particular student's result in each of his/her four assignments is highlighted in yellow. Regardless of the confusion of letters over the whole page, I trust you can see that this student has performed significantly better in *all* of the take-home assignments (results are highlighted in yellow) than he/she did in the exams (which are all the other letters). For the reasons I outline above I did not pursue my suspicion of cheating, yet I knew very well that this student whom I had taught for two years was not capable of such a consistently high standard of work.

Assignments and Workload

Parents not only pay for tutors to do assignments to get better grades for their children, I submit they also do it to help their children cope with the unreasonable workload. My son coincidently did the same (Maths/Science) subjects I did at school and there is no doubt his workload was much heavier. This increase is directly attributable to assignments and EEI's.

In summary, the use of assignments and EEI's are invalid because:

(1) They are part of a systemic fraud.

(2) They are the main contributor to unreasonable workloads in Senior.

(3) They are of little educational value in their current form.

I submit that we must remove the inequity/unreliability which currently exists in our assessment system and, particularly in the case of Mathematics, we must abandon alternative assessments altogether.

Exams can be fraudulent also. Schools can artificially inflate their results by making their exams as familiar to the students as they wish. If a teacher wants all of the students to pass, yet still have a separation between the first and last student, all the teacher has to do is give them a 'practice exam' which contains 50% or more of the actual exam questions. This occurs to varying degrees in schools and I have been tempted to do it myself albeit for different reasons (explained further below).

While the QSA will correctly say that the QCS test goes some way to rectifying these inflated results for the purposes of calculating an OP, this system nevertheless allows a student from School 'A' to get a pass on their Senior Certificate much more easily than had they gone to School 'B'. This is not fair. Prospective employers do not know the difference when they look at Senior Certificates, thus a system where this can (and does) occur is not a fair or reliable system.

My temptation to adopt the method of providing overly-familiar practice exams has less to do with getting all of my *students* to pass, and more to do with getting my *exams* to pass moderation. Moderation panels are subjective, not objective as we are led to believe. You may have heard evidence already that panels will say School A's assessment package is great one year, but will criticise it the next, even though they may have reviewed the same package of assessment items. I have experienced this absurdity. To counter this, schools adopt the method whereby they make the problems on their exams appear to be more difficult than they really are by ensuring the students are already familiar with some of the questions. By having more difficult problems on the exam paper than would otherwise seem reasonable, the paper is more likely to be deemed by a panel member (who invariably uses a subjective test) to be of an above-average difficulty level. The panel member is therefore less likely to recommend that the school's students be knocked down the ranking ladder because the exams are 'too easy'. Conversely (and perversely) the chances that the students get moved up the ladder because of the apparent 'difficulty' of these (rigged) exams is increased. External exams circumvent this nonsense.

You may also be aware that tutoring businesses do a good trade in Queensland. I have a colleague at my school who runs a busy tutoring business after school hours. She has access to all of our exams of course, including recently-prepared exams (i.e. those yet to be sat by the students). She also tutors students from our school. Several unpleasant instances have arisen over the years whereby it is clear the students who employ her services have gained an advantage over other

students in our school. This is not fair. And because there does not seem to be any conflict-of-interest rules that have any teeth in our system, I would expect that this is not an isolated occurrence in this state. Again, external exams would circumvent this problem.

Assessment *'Standards'?*

Our standards for assessing A/B/C/D/E are unhelpful and vague. To illustrate, an 'A' standard in one of the Mathematics criteria states the student must show:

> *"application of mathematical definitions, rules and procedures in routine and non-routine simple tasks, through to routine complex tasks, in life-related and abstract situations"*

To demonstrate a 'B' standard, however, the student must show:

> *"application of mathematical definitions, rules and procedures in routine or non-routine simple tasks, through to routine complex tasks, in either life-related or abstract situations"*

Do you see, let alone understand, the differences in achievement standard (the replacement of the word *'and'* with *'or'* at two places in the B standard description)? This is an unnecessary, complicated, use of language with which to define levels of achievement, and they are practically useless to grade with.

If we are to seriously compare students against 'standards', those standards need to make sense and be clearly known to all. In other words and for example, what *my* understanding of 'a complex task' is needs to be exactly the same as *your* understanding of what 'a complex task' is. Consistency of this type is impossible given the way our syllabuses are currently worded and assessed. To be truly valid and reliable, standards must be more absolute and (dare I say it) *measurable*. To use a real-world example, in athletics a 17 year old male achieves the World Games qualifying 'standard' for the event of Long Jump if he can jump 7.20 metres. This is an example of a real standard because almost anyone can understand it and it is unambiguous (it would be very difficult for a member of Queensland's assessment–moderation panels to overrule it with his/her subjective opinion). Yet, because we are forced to deal with fuzziness of the kind shown in the brief example above, we seem to be forever tied up with uncertainties and disagreements which in turn waste an enormous amount of time in debates and administration. *And it is all for no academic gain whatsoever*. I have spent much time reading the literature on using criteria/standards

based assessment and I am firmly of the opinion that Professor Ridd's description of it all as '*an experiment on our children'* is entirely accurate.

The current bureaucracy problem has crept in steadily over a few decades, beginning with the academic revolt against external exams which took place in the late 60's. For decades prior, the Maths and Science academics at Universities controlled all of the Maths and Science assessment in high schools, until teachers and the general public decided that the exams they were setting were too difficult and they revolted. Inquiries were set up, recommendations were made, and the upshot of all of this was a big shift in power over to the Humanities academics at Universities. The experimentation then began.

And the education theorists have been quite open about it:

> *"As we are finding out, the theory of a standards-based assessment is disarmingly simple but the practice is extraordinarily difficult. But having got this coveted ball into our court, we are going to see where we can hit it to maximize the good effects."*
>
> *(Review of School-Based Assessment (ROSBA) discussion papers, 1985 – 1987, page 5)*

[Complete article is at: http://www.qsa.qld.edu.au/downloads/publications/research_qbssss_rosba_11.pdf]

Thus a system of assessment standards which are bureaucratic nonsense has evolved in each of the Mathematics A, B and C, Physics and Chemistry syllabuses.

I urge you to recommend major reforms.

Some relevant comments to close:

- Satisfaction surveys which the QSA send out do not reach all relevant recipients. For example, attached is a recent survey which I found by accident in cyberspace (see Attachment 3). It certainly did not reach us at my school.
- I respectfully ask you to keep an open mind to any survey evidence you receive which includes the views of teachers from *all* subjects, as opposed to just Maths/Physics & Chemistry.
- Another frustrating issue for mathematics teachers is that our assessment system mandates the jumping around from one topic to another. This education theory is called 'spiralling the curriculum'. Not only do mathematicians rubbish this theory but the QSA has unfortunately neglected to co-ordinate this theory with the authors of the students' textbooks. As a result, schools frequently have to photocopy reams of pages from other textbooks for their students because they are forbidden to follow the order given, *even though the textbooks are published in Queensland!* Worse, if you ask the QSA for some educational reasoning for a spiralling

curriculum, they usually reply with something curt and unsatisfactory such as, 'The syllabus mandates a spiralling curriculum.' End of discussion.

In contrast, a Queensland mathematician (a PhD I have gotten to know from the University of Qld) says this:

> *"Unfortunately, the format of our high school maths syllabus and of its supporting texts, is chaotic by comparison. Rather than following a gradual and orderly development, we find ourselves jumping frequently from one topic to another unrelated topic….What kind of thinking ability will this encourage our students to develop?"*
>
> (Dr Matthew Dean, University of Queensland, quoted in Queensland's *Teaching Mathematics* Journal, March 2010, p.21)
>
> *[see Attachment 4 for the complete article]*

- You may have heard criticism of the external exam system because teachers end up 'teaching to the test'. Yet this is precisely what we are doing now to prepare for the QCS test. The schools I have worked for do at least *four* complete practices of the QCS test before the day arrives in addition to specialised QCS lessons which are timetabled. At my current school, for the two terms prior to the QCS test, all Year 12 students attend two periods a fortnight on lessons which are devoted to how to answer questions on the QCS test.
- You may be aware that concerns have also been raised about the reliability of the OP score itself. This particular issue may be outside the scope of this Inquiry; however, I would offer it as a further example of the lack of transparency in our assessment system. Transparency, I submit, is linked to reliability. I have tried to unearth the exact mathematical procedures followed in order to calculate OP's without success. The QSA website does provide a general overview for the lay person, yet for those who want to try to understand the detailed Mathematics behind it all, it seems unattainable.

Thank you for the opportunity to submit.

Please contact me using the details I have provided if I can clarify any of my remarks or be of any assistance.

Sincerely,

[redacted]

ATTACHMENT 1

1999 QCS Test Short Response paper

*Worth SR paper

Unit	Item No. (pd)	Grade awarded and Code							Worth $\frac{A}{2}$
		A	B	C	D	E	N	O	
1 Pollution	1	3	2	1					1.5
	2	5	3	1					2.5
2 Solar	3, 4	6	4	3	2				3.0
3 Lawson	5	7	5	4	3	1			3.5
4 Patch	6	4	3	2	1				2.0
	7	6	5	4	3	2			3.0
	8	10	8	5	3	1			5.0
	9(1)	7	6	5	4	2			3.5
	9(2)	3	2	1					1.5
5 Space invaders	10	6	4	3	1				3.0
	11	7	5	3	1				3.5
	12	8	6	4	2				4.0
6 Paint	13	5	4	3	1				2.5
	14(1)	6	4	3	2				3.0
	14(2)	3	2	2	1				1.5
7 Spellcheck	15	7	5	4	3	1			3.5
8 El Niño	16	5	4	3	2	1			2.5
	17	7	6	4	3	1			3.5
	18(1)	2							1.0
	18(2)	7	6	4	2	1			3.5
9 Mehitabel	19	7	5	4	2	1			3.5
	20	10	7	5	3	1			5.0

$$\Sigma\left(\frac{A}{2}\right) = 65.5$$

Item and Star-value Distribution

The star-value rates a specific item relative to others in the paper in terms of worth/effort.

Unit	Item	Star-value
ONE	1	*
	2	**
TWO	3	*
	4	*
THREE	5	***
FOUR	6	*
	7	**
	8	****
	9	****
FIVE	10	**
	11	***
	12	***
SIX	13	**
	14	****
SEVEN	15	***
EIGHT	16	**
	17	***
	18	****
NINE	19	***
	20	****

2000 QCS Test Short Response paper

ATTACHMENT 1

Worth SR paper

Unit	Item No. (pd)	Grade awarded and Code							Worth $\frac{A}{2}$
		A	B	C	D	E	N	O	
1 Face	1	5	3	2					2.5
2 Kudamm Clock	2	5	4	3	2	1			2.5
	3	5	4	3	2	1			2.5
	4	7	6	4	3	2			3.5
3 Logic	5	7	6	4	2				3.5
4 Fish and chips	6	5	4	3	2	1			2.5
	7	10	8	6	4	2			5.0
5 Lunar ride	8	7	5	3	1				3.5
6 Babble	9	8	7	5	3	1			4.0
	10	10	8	6	4	2			5.0
7 Ruins	11	8	6	4	2	1			4.0
8 Updike	12	7	5	3	2				3.5
	13	8	7	4	2				4.0
	14	10	8	5	3	2			5.0
9 Archimedes	15	4	3	2					2.0
	16	10	8	6	4	2			5.0
10 Chinese Bells	17	6	5	3	2				3.0
	18	8	5	3	2				4.0
	19	6	4	3	2				3.0

$$\Sigma\left(\frac{A}{2}\right) = 68.0$$

Item and star-value distribution

The star-value rates a specific item relative to others in the paper in terms of worth/effort.

Unit	Item	Star-value
ONE	1	**
TWO	2	**
	3	**
	4	***
THREE	5	***
FOUR	6	**
	7	****
FIVE	8	***
SIX	9	***
	10	****
SEVEN	11	***
EIGHT	12	***
	13	***
	14	****
NINE	15	*
	16	****
TEN	17	**
	18	***
	19	**

ATTACHMENT 2

[redacted]

MATHEMATICS B PROFILE

30/Mar/13

STUDENT: [redacted] 013133 Years: 2010 2011

TEACHER:

ITEM NUMBER / INSTRUMENT		K&P		M&P				C&J	
		MARK	**GRADE**	*	**	***	**GRADE**	**GRADE**	**LEVEL**
Semester One	1. Mid Sem Exam	22	C+	EE	DD	DD		C-	
	2. Extended MAP	35	A+	C	B	AB		A	
	3. End Sem Exam	13	E	D	E	EE		D	
	S1 Result		C				D	C	C
	S1 Rank								S1
Comment									
Semester Two	4. Mid Sem Exam	17.5	B	CD	CC	ABD		C	
	5. Report	19.5	A+	C	BBC	A		A	
	6. End Sem Exam	22.5	C	C	D	D		C	
	Monitoring		C				C	C	C
	Monitoring Rank								S5
Comment									
Semester Three	1. Mid Sem Exam	27.5	C-	E	E	E		C	
	2. Extended MAP	20	A+	CC-	BBC	A		A	
	3. End Sem Exam	7	E+	E+	D	EE		C-	
	S3 Result		C-				C	C	C-
	S3 Rank								S3
Comment									
Semester Four	4. Mid Sem Exam	11	D	E	EE	DE		C-	
	5. Report	26	A	DD	DB	B		C+	
	Verification		C-				D+	C	S2
	6. End Sem Exam	15	B+	ED	D	EE		C+	
	Exit		C				D+	C	S2
Comment									

30/03/2013

ATTACHMENT 3

Queensland Government

Queensland Studies Authority

Syllabuses and resources: Yrs 11–12 Satisfaction survey

The Queensland Studies Authority (QSA) is committed to producing syllabuses and resources that help teachers achieve the best possible outcomes for students. Your answers to the following questions will be used in shaping future syllabuses and resources. Please take a few moments to complete this survey and return it by post in pre-paid envelope by **28 March 2013.**

Please colour in your answers like this ● not ⊠ or ⊘. This will help us to scan the surveys when returned.

1. How satisfactory do you consider the senior syllabuses and resources developed by the QSA? (● ONE only)

Very satisfactory	Satisfactory	Unsatisfactory	Very unsatisfactory	Never seen or used
○	○	○	○	○

2. Rate your level of satisfaction with each of the following (● ONE only)

	Very satisfied	Satisfied	Unsure	Dissatisfied	Very dissatisfied	Never seen or used
How satisfied are you with the clarity of the syllabuses?	○	○	○	○	○	○
How satisfied are you that you can develop quality learning programs/courses of study from the syllabuses?	○	○	○	○	○	○
How satisfied are you with the clarity of the Study Area Specifications (SASs)?	○	○	○	○	○	○
How satisfied are you that you can develop quality learning programs/courses of study from the (SASs)?	○	○	○	○	○	○

3. Which of the following recently released syllabuses are you using? (● ALL that apply)

Authority Syllabuses

○ Business Communication and Technologies (2012)

○ Hospitality Studies (2012)

○ Information Technology Systems (2012)

○ Study of Society (2012)

External Exam syllabus

○ Punjabi (2012)

Thank you for taking part.

Please return the completed survey in pre-paid envelope supplied.by **28 March 2013.**

Queensland Studies Authority, Floor 7, 154 Melbourne Street South Brisbane. PO Box 307 Spring Hill Q 4004.
Phone: (07) 3864 0299; fax: (07) 3221 2553; email: office@qsa.qld.edu.au; website: www.qsa.qld.edu.au

ATTACHMENT 4

Queensland high school mathematics needs a back-to-thinking revision.

by

Dr Matthew Dean

Dec 2009

Twenty years ago, high school graduates entering university could pass the Leo Howard Test. Now they struggle with differentiation, trigonometry, algebra and even adding fractions. We find now, that students are aware of these topics but have little confidence or ability with them, and that first year university students are struggling to pass even watered–down courses: they may study the first year material, but they lack the mathematical foundation to be able to implement it.

Let us consider the pedagogical changes which we have adopted in our high school mathematics over the last twenty years. We have

1. introduced a spiral rather than orderly sequence of topics,
2. replaced final and comprehensive assessment with frequent small assessment items, and removed emphasis from skill development,
3. introduced writing tasks into mathematics,
4. emphasized statistics, modelling and graphics calculator use and
5. changed to a complicated, criteria based assessment.

In this essay we review these changes and their effects on our students' confidence and thinking.

ATTACHMENT 4

1. An orderly syllabus

The most popular textbook throughout known history begins with simple, familiar ideas and develops carefully and consistently by sound logical reasoning toward its final conclusions. It has been the standard for 2000 years.
It is Euclid's *Elements*.

The reason this text has been so popular is not because people value points, lines and triangles, though these are useful concepts. Rather, the popularity and importance of Euclid's *Elements* is due to the orderly quality of the exposition:

- every step is sound.
- all the parts fit together, and
- each part builds upon the next in a logical fashion, so that
- the final conclusions of the work hold true with the same certainty as the initial postulates.

In antiquity, the Greek schools valued the training of geometry so highly that they posted above their doors the phrase

Let no one come to our school who has not learned the geometry of Euclid.

For 2000 years, Euclid's *Elements* has been the standard of perfection for human reasoning. The field of mathematics has developed emulating this standard. No other art or science has offered the human mind this quality of reasoning.
Thus, mathematics is the backbone of the sciences, technology and engineering.
Like a strong frame, proper mathematical training, such as based on Euclid, offers the human mind an ability to think clearly, consistently and with certainty. These are valuable qualities for any walk of life.

Unfortunately, the format of our high school maths syllabus and of its supporting texts, is chaotic by comparison. Rather than following a gradual and orderly development, we find ourselves jumping frequently from one topic to another unrelated topic. Working through Euclid's *Elements* engenders a feeling of calmness and confidence. But our present high school courses offer constant distraction.

What kind of thinking ability will this encourage our students to develop?

ATTACHMENT 4

2. Developing significant thinking ability

Book One of Euclid's *Elements* consists of a few initial remarks followed by 48 carefully sequenced propositions. Each proposition is deduced in about five to ten deductive steps from either previous propositions or from the initial remarks. Thus this book contains long chains of deductive reasoning.

The ability to creatively think through long chains of deductions to arrive at a conclusion can be developed in good mathematics courses. This significant thinking ability does not come easily however, and lots of practice is required. Students should begin with simple problems and build gradually up to those requiring many steps to solve.

Like developing the ability to play beautiful music on a piano, much practice is necessary. The required practice is often considered to be too routine, pointless or boring. But those who attain the final goal can report that it is all worth the effort.

A good mathematical training develops the ability to carefully think through long problems. The main benefits of this are

- self confidence - assurance in one's ability to think, and
- freedom to apply this ability independently, rather than needing to be constantly tethered to an external authority.

By adopting our present high school syllabus, we have failed to provide an opportunity for students to develop this ability to think through long chains of deductions. We have done this by

1. frequently jumping from topic to topic,
2. providing too few practice problems on the standard topics
3. removing final, comprehensive examinations, and replacing them with frequent, small assessment items

Unfortunately we have listened to the voices which regard skill development as something too routine or old-fashioned. Our result, is that a generation of Queensland students vaguely know about various mathematics topics, but lack the confidence and ability to actually work within these topics. Our result is that a generation of students lack the confidence and independence which accompanies significant thinking ability. We are now dumb, listless consumers instead of capable, thinking producers. We have not done the practice required to play beautiful music.

ATTACHMENT 4

3. Subject Integrity

Learning to write coherently is valuable for everyone. Very few would oppose the teaching of writing in high school English. However, putting writing tasks into mathematics is as appropriate as calculating derivatives in the middle of Hamlet, or playing the tuba while running a marathon, or mixing chemicals while watching an opera. If writing is handled adequately in English, it does not need repetition in an unrelated discipline. On the other hand, if English is not teaching writing properly, then the English syllabus requires some rethinking (and rewriting).

A balanced curriculum does not focus on one discipline to the detriment of other disciplines. We now have writing tasks in mathematics , physics and chemistry while students' mathematical ability is suffering.

The supposed justification for the absurdity of putting writing into mathematics is that 'scientists need to write'. While scientists do write, writing is not the characteristic feature of their work. The characteristic feature of science is sound thinking – an ability which is developed by doing mathematics.

Popular technology readily assists us with spelling and grammar, but it does not make our thoughts coherent or well sequenced. It does not help us think soundly through a problem to a solution. This ability is developed by doing mathematics. Thus, with the rise of technology, good mathematics courses, are as important as ever.

ATTACHMENT 4

4. Proliferation of Topics

(a) Statistics

Statistics has been expanded in high school mathematics. Much of statistics is very difficult and will remain a mystery to students unless they first study university level analysis. Presenting mysteries for students to believe in, may have value, but does not develop confidence or thinking ability in the same way that mathematics does. On the easier, descriptive statistics, it seems to me that we are spending a lot of time in high schools learning very little.

(b) Curve Fitting

Another topic which now receives unusual emphasis in our high schools, is that of curve fitting. That is, fitting data points to lines, polynomials, log, exponential or trig functions. This is referred to as *modelling,* bearing a resemblance to the modelling work of physical scientists.

Curve fitting is only one of hundreds, if not thousands of numerical problem types which face scientists and engineers (see, for example, the lists of numerical algorithms in the NAG library or in Numerical Recipes). Curve fitting is not an important enough problem to receive undue emphasis. It is more important for students to develop confidence and thinking ability by becoming proficient in the established basics of geometry, algebra, trigonometry and calculus. This is also the shortest path to accurate modelling.

(c) Technology

Software and hardware come and go so quickly, that the current technologies will almost certainly not be used in another ten years. A good mathematics course however, will always be worth studying, as it not only introduces the unchanging language of the physical world, but also develops the thinking ability of ones own mind.

(d) Advanced Topics

In the last twenty years wonderful topics such as differential equations and group theory have appeared in high school mathematics. By stretching students thinly across too many topics, students end up being vaguely aware of many topics, but lack the ability and confidence to work with any of them, even the basics.

ATTACHMENT 4

5. Complicated Assessment

A principle of modelling is *Ockham's razor*. It is the principle that

the simplest explanation or strategy tends to be the best.

If we apply Ockham's Razor to the task of assessing mathematics ability, the obvious choice is

a mark out of 100.

Percentages are immediately understandable to everyone. Any other choice of assessment system, whether in numbers or words, will be less familiar, less simple and require explanation.

Over the last twenty years, teachers, students and parents throughout Queensland have wasted a lot of time and effort struggling to understand the complicated assessment systems we have adopted. The opaqueness and lack of consistency of our present assessment system

- discourages students from studying hard to improve their performance,
- wastes very many hours of every maths teacher's time, taking them away from helping students learn,
- excludes parents, and tutors from their appropriate roles in students' learning and
- lends itself to corruption.

Instead of applying Ockham's razor to mathematics assessment, we unfortunately, listened to the fashions of pedagogy and are suffering under their weight and absurdity.

ATTACHMENT 4

Conclusion

Through studying a good mathematics course, students can develop the ability to think clearly and consistently, develop a confident and independent mind, and become familiar with the language of the physical world. A good mathematics course demands much practice, and builds in an orderly way from simple to complex problems.

Queensland high school mathematics is not such a course. Our high school graduates' lack of confidence and ability in thinking, is attributable to the chaotic, cluttered and superficial nature of our high school syllabus. Its main obstructions to significant thinking development are the proliferation of introduced topics (including writing tasks, and overemphasis on statistics, curve fitting and certain technology), the consequent lack of emphasis on basic skill development (geometry, algebra, trigonometry and calculus), and the overly complicated and unreliable system of assessment.

ATTACHMENT 4

Appendix

1. What role does thinking (and mathematics) play in reality? and
2. Why is this question important to high school mathematics?

Those people who regard thinking as something separate from reality, will imagine that mathematics is largely useless, and will instead be drawn exclusively to activities like data collection, in their approach to science. Whereas, those who recognise the role that thinking plays in reality will value mathematics far more.

When seeking to understand reality, the activity of thinking is generally overlooked, even though it is a natural part of our enquiry. Before any thinking is done, our senses reveal to us a chaotic multiplicity of sensations, colours and tones etc (which we shall call *percepts*). When thinking steps in, it matches the appropriate concept to each percept and further connects concepts to each other. Percepts, on their own, form the dumb outer shell of reality. The concept connections to these percepts provided to us by thinking, make life understandable, meaningful, and bring us closer to the core of reality.

Even though thinking plays such an important role, the practice of designating the perceptions of our senses as *real*, and the perceptions of our mind as *not real*, is a common misconception. Upon further reflection, we recognise that the stream of sense percepts we experience, is only part of reality. The other, much greater part of reality is given to us by thinking.
How is this observation relevant to high school mathematics?

Mathematics is thinking about the numerical and spatial aspects of reality. As shown above, the realms of number and geometry provide the most effective training ground for developing thinking. Those who regard thinking as separate from reality will imagine that mathematics is not part of reality and therefore useless. Those who understand the role of thinking in reality will recognise that training in thinking is the best thing they can do.

For example, those who imagine thinking is separate from reality may use the terms *abstract* and *abstraction* to suggest that thinking (and mathematics) draw us away from reality (into abstractions), while those who recognise the role of thinking, know that thinking makes us more familiar with reality.

More examples of this overemphasis on percepts and lack of emphasis on thinking in our current pedagogy are the over-emphasis on data collection, curve fitting and statistics, and the removal of practice in algebra, geometry and trigonometry.