SMC&PA Submission 68
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To: The Education and Innovation Committee eic@parliament.qld.gov.au

Assessment Methods for Senior Mathematics, Chemistry and Physics

Dear Committee Members,

I am a retired teacher who taught physics and chemistry for almost 40 years at Brisbane State High School where I was Science Subject Master and then HOD Science from 1972 to 2008.

Both as a school student, university student, teacher and HOD, I have experienced a variety of assessment regimens from external exams to internal assessments. The latter being characterized by their increasingly cumbersome nature which was exposed in the BSHS setting of large student numbers engaged in science subjects i.e. regularly 300 Physics students and 350 Chemistry students in Years 11 and 12.

Ensuring that Assessment Processes are Supported by Teachers

My experiences with internal assessment in the latter years of my time as a HOD of Science has led me to the conclusion that over a long period the QSA has devised an increasingly elaborate assessment construct that is inequitable, susceptible to manipulation and, in a large school setting, impractical.

A strong argument could be made that, over a number of decades, the QSA has conducted a grand social experiment in the curriculum and assessment of Queensland students. To the best of my knowledge, each new initiative has been introduced after a brief trial, none of which has failed nor been assessed as unsuccessful nor abandoned. In effect, the judgement of the success of each assessment and curriculum initiative has been subject to confirmation bias. More disturbingly, each new initiative has seemingly been introduced without prior assessment by an ethics committee for potentially adverse effects on students and student learning.

Furthermore, teachers receive scant assistance through a small number of exemplars on how to implement new curricula or how to construct assessment items with their corresponding “marking” schemes. The QSA's approach has been that each school must frame its own programs and assessment elements to suit its circumstances and students. This QSA rationale is at worst an abrogation of its responsibility and at best an inefficient use of teachers' time that could be better spent on improving classroom/laboratory delivery of curriculum.

In effect, Senior Chemistry and Senior Physics assessment has reached a tipping point which, for me, is encapsulated in the total abandonment of marks in preference for letters that are associated with criteria paragraphs. How this system of letters can be applied to Mathematics assessment beggars belief. While Mathematics involves symbolism, its foundation and core DNA are numbers. This has a flow on effect to the sciences where mathematics is the “language” of Physics and Physical Chemistry.

Student Participation Levels

My experience with the evolution of school-based assessment has seen successive attempts to re-frame the assessment in Physics and Chemistry so that it increasingly aligns with the assessment regimen used in the Social Sciences such as History and Economics. This has ramifications for what students experience in the assessment of science beyond school at tertiary institutions.

I'm aware of the failings of a top-down approach to education but the current system is not the answer. What students experience in school totally under prepares them for what they will experience in their tertiary studies. Universities still use marks in Chemistry and Physics assessment, do not have draft experimental reports reviewed before final report submission and do not have assignments in undergraduate Chemistry and Physics courses. Projects do not feature significantly in undergraduate science courses which are designed to build the foundational knowledge, process skills and experiment techniques for students to engage in the science paradigm either within industry or in a post graduate degree.

Far worse is that within the current Senior Science curricula, students are under-prepared for the academic rigor of Chemistry and Physics university courses as they lack the foundational knowledge, processes and application skills across a wide range of science theories and elements. Since the 1970s, the breadth of high school Chemistry and Physics courses has shown a steady decline that started with the implementation of school-based assessment and has accelerated in recent years with the latest QSA initiatives.

But it doesn't stop there. Students who do not progress to tertiary studies are under-prepared for what they will experience in their working life. In the business world, if students are assessed, their managers and supervisors will not be using letters. The first contact most students will have with assessment by numbers will be when they sit for their learner's license pursuant to gaining a driving license from the Transport Department.

Underpinning the evolving change-in-assessment rationale in Chemistry and Physics is the belief that student numbers will increase in Chemistry and Physics because the assessment is 'more student friendly' as it involves assignments and projects. This flies in the face of subject selection based on students' projected career paths, aspirations and interests in the sciences per se. To equate any increase in student numbers in the Senior Sciences with evolving changes in assessment techniques is disingenuous given Queensland's rising population and changing career opportunities that help sway student subject selection.

It is an unfortunate reality that assessment in schools acts as a filter in so far as assessment instruments expose inadequacies in students abilities and talents. Ameliorating the impact on student sensibilities by altering the Chemistry and Physics assessment instruments and techniques that remove the use of marks is misguided, It postpones the inevitable reality check and narrows the window of opportunity for students to change to subjects more aligned with their capabilities and talents. If that reality check occurs in a first year university science course, the result is disastrous. Better that it occurs in the first term of a school senior science subject.

<u>The Ability of Assessment Processes to Support Valid and Reliable Judgments of Student Outcomes</u>

The removal of external exams was supposed to relieve the stress levels of students, amongst other things. The reality is far different with peak stress periods being spread across two years of Chemistry and Physics education. This is not limited to two subject areas but in concert with assignments across all the Senior subject areas exacerbates the stress levels experienced by students. Even determined students with great organizational skills are not immune from unintended or unplanned events in their own lives and family

situations. While the QSA has procedures in place for such eventualities, the probability of a life event coinciding with an assessment period is greatly increased by the continuous assessment environment that is currently in place.

Thus all students will at some stage have to work long hours to meet assignment deadlines. Extensions of deadlines will bring them into conflict with the commencement of new theory work or another round of assessments in other subject areas. The upshot is that students emulate others and to meet assessment deadlines will miss schooldays to complete assessment items. Which brings up the issue of ownership of Chemistry and Physics assignments that are not prepared within or limited to the classroom, computer room and laboratory. Ideas expressed within assignments are rarely original or totally the student's own work. At best, a student's assignment is an interpretations of someone else's research or work and, at worst, rearranged plagiarised sentences.

It is my opinion that the QSA considers erroneously that Physics and Chemistry are like the Social Sciences and can be studied through assignments. The QSA is wrong. Physics and Chemistry are governed by physical science laws, almost all of which can be expressed mathematically and hence have no corollary in the Social Sciences. Having students carry out assignments as a means of learning about the laws and theories of Physics and Chemistry is an inefficient and ultimately ineffectual use of student time. It is naïve to believe that assignments will enable students to see the nuances of science laws and theories, and where they fit into science history. Assignments will not give students a good grounding in Physics and Chemistry. As a parallel issue, there is a naivety to believing that standards can effectively replace marks for each individual assessment item within an assessment task in Physics and Chemistry.

The current assessment mode is iniquitous because, when teachers converse with students and parents over student assessment, most parents do not have a grasp of the vocabulary that is used and have difficulty coping with the complexity of the application of criteria. Its assignment tasks are iniquitous for a number of reasons relating to academic ownership. For those assignments carried out without direct supervision, either totally or in part, there is manipulation by some students, with parental support. The work that they submit is not totally their own. Some students have access to parental expertise and resources beyond those of their peers which gives them an unfair advantage over their cohort.

Conclusions

We have a de facto external exam in Queensland, it's called the Core Skills Test. The progression from school-based assessment to an external exam in Chemistry, Physics and Senior Mathematics is not all that difficult. The existing structure of QSA Review Panels lends itself to (a) having the external exams marked within each school according to QSA assessment schemata, (b) schools submitting samples of “marked” or assessed exam responses to Review Panels for confirmation of assessed levels of student achievement , etc.

Assessment techniques used in the Core Skills Test have now filtered down to the classroom where they are inappropriate and unnecessarily time consuming in the areas of Chemistry, Physics and Mathematics. In fact, the use of letters for each and every assessment item within an assessment task conflicts with the very culture of the Physical Sciences and Mathematics. For that reason, techniques for assessing the Social Sciences do not translate to being appropriate for assessing the Physical Sciences and Mathematics.

Assessment has grown to the extent that it is now the tail that wags the dog. A time-demanding assessment program has the effect of reducing the amount of time students can engage in the actual study of Chemistry and Physics principles and theory. Worse, the reviewing and “grading” of student assessment pieces takes teachers away from lesson revision, preparation and planning. The QSA's assessment policy has had a deleterious impact on teachers' lesson delivery and teacher-guided student experiences in the classroom. Little wonder that some students do not engage in the Senior Sciences and Mathematics.

The current situation with Senior Science curriculum is that schools, under the direction of the QSA, are abandoning their responsibility to prepare students for successful tertiary study in the areas of Chemistry, Physics and Mathematics. The QSA is complicit in creating unnecessary problems and stresses for students entering university degree courses and TAFE diploma courses with compulsory Chemistry, Physics and Mathematics units.

Sincerely,

Leon Perry