Review of Assessment methods for Chemistry – Syllabus 2007

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My experience

I am Head of Chemistry at [redacted] and a member of the Chemistry Discussions group that is very active. I have been a Panellist of Mathematics, but mainly Chemistry since the early moderation days (since 1983), have volunteered for the Trial Pilot of the Chemistry Syllabus (2002 - 2004) and was heavily involved in the Extended Trial Pilot of the Chemistry syllabus (2005 - 2008) and implemented the current Syllabus at [redacted].

Out of the three main areas of focus, **'the ability of assessment processes to support valid and reliable judgments of student outcomes'** is of greatest concern. We find that our student participation levels are fairly constant around 50- 60 for both Year 11 and 12. This means that we timetable for 2-3 classes of Year 11 and 2-3 classes of Year 12 each year. As for 'support by teachers of the assessment process', there are two of us here at the College who work closely and consistently.

1 Work Programs

In reviewing work program submissions in the Sunshine Coat region, I noticed that some schools have 3 assignments and 2 exams in both Year 11 and 12. This then biases the assessment towards the assignment that cannot always validly assess the student understanding and commitment to the task.

Have all work programs across Queensland been checked for this type of bias?

2 EEIs

EEIs can offer students a 'rich' investigation and the ability to achieve across a range of standards, but I question the validity of the assessment task. When a well -designed EEI task is constructed, the reality is that they are time consuming, require a variety of and sometimes costly amounts of chemicals, and consume a lot of student/teacher time and energy throughout the drafting process and final report submission.

If a school term is 10 weeks long, then accounting for school interruptions (like excursions for other subjects, school organized and inter-house events) and the exam block, the resulting time available is more like 8 weeks. Clearly, less time is available if the term were 8 weeks in length. Before the EEI can be started, there must be some face- to -face teaching that occurs to get the theory across. This may take 4-5 weeks. Time remaining for experimentation is now approximately 4 weeks in class time. In my experience, however, many lunch times and after school sessions are made available for students who have experienced difficulties.

With the introduction of Work, Health and Safety regulations in the early 90's, there has been an overhaul of chemicals for use in high school laboratories resulting in a reduction in the variety of chemicals available. So, in order to get variation in student investigations on a selected topic, this can be restrictive. For example, in Year 12 we do 'Developing a Better Battery', which requires initial investigations on the Daniel Cell (using $Zn/Zn^{2+//}Cu^{2+/}Cu$), where the student's select three modifications to improve the voltage and current of their cell. Invariably they use Mohr's salt, iron sulfate, potassium permanganate, hydrogen peroxide or iodine. The task finishes with them testing their 'better battery' to force a reaction to go that would not normally occur for approximately 15 minutes i.e. electrolysis. For a group of approximately 60 students working in a laboratory group maximum of three, variation in the investigation of batteries is restricted.

Parents want their children to do well and will pay for private education and tutors. Throughout the drafting process, it is sometimes difficult to ascertain the extent of contribution of a private tutor. This becomes more of an inherent problem the longer you run the same EEI. Since we have been doing this task for 6 years it is incumbent on me to construct an alternative task. I have joined the 'Scientists in Schools' program and am awaiting a response of how to create a different EEI that contains substantial chemical content and variation, allows for 'A' standards to be achieved, and is relevant and interesting to today's students.

Students are keen to perform and wish to impress. To this end, students write substantial reports, and while they may adhere to the 1500 -2000 word limit for the 'Introduction' and 'Discussion/Evaluation' sections, the whole report with typed procedure(s), data tables, calculations, and appendices are often of the order of 10 000 words

in total or more! This requires an inordinate amount of personal time for the high school student and might I add the teacher who must both draft and correct 'their' work.

So after running a particular well-designed task for a number of years, does the EEI validly assess the student's understandings of the chemistry content? I am not convinced. However, they certainly are aware of how to design a valid experiment.

3 ERTs

ERTs can offer students the chance to achieve across the whole range of standards, but there is wide variation in the demands and expectations placed upon students across the State.

From the Chemistry discussion group e-mails, there was a 2012Year 12 ERT supplied by a teacher from [redacted]. Their topic is 'fuels and thermochemistry'; the students have 4 weeks to complete the task where a research question is supplied. Students are expected to evaluate 3 fuels against 3 criteria. This is in stark contrast to what we expect our students to do in Year 12 on the same topic – thermochemistry. Our ERT is on the use of explosives for a possible case scenario – 3 different scenarios are provided and students choose one, then students evaluate 4 explosives (one which has a mixture composition) against a range of criteria: 5-7 are expected. Both schools are using the idea of evaluation of a chemical for a particular purpose using a decision-making matrix over the same time frame using the same task type, but there is a considerable difference between demands and expectations.

Again, ERTs just as with the EEIs, these need to be altered continually as local tutors (or there may be brothers and sisters who have studied the same subject) get savvy as to the desired requirements of a task. In studying fast, highly exothermic reactions, previously our ERT was a decision- making matrix evaluating rocket fuels for either lift off or orbit for a mission. Soon, we will need to come up with yet another scenario or make considerable changes to our Work Program so as to do an ERT in another contextualized unit. Any major changes to the work program will require review and approval – a process that can take some time.

4 SAs

As teachers in all schools become more familiar with the paper design and categorization of KCU, IP and EC questions there will be better shared understandings of acceptable standards and question types. However, four and bit years since the introduction of the Syllabus in 2007 there is still wide disparity among schools in my local region. **The ability of assessment processes to support valid and reliable judgments of student outcomes** is randomly scrutinized as one year the Panel member maybe AOK with the assessment and yet when the same material is submitted in a following year and a different Panel member reviews the work, the school may get quite different feedback about the 'acceptable' Levels of Achievement obtained and the suitability and validity of the question types.

From the Chemistry discussion group e-mails, there are often requests from teachers around the State for tasks whether EEIs, ERTS or SAs. What bothers me is how you keep the integrity of your assignments and exams safe?

5 General concerns

The current range of textbooks, especially Queensland authorship does not include exemplar KCU, IP and EC questions at the end of Chapter exercises. The end of chapter questions consist of the usual run of mill recall or problem based calculations that have appeared in textbooks since I was a student. This needs to be addressed as I am often asked to supply KCU, IP, and EC type questions for my students – these take time to prepare and I only provide questions that I have rejected for test papers in order to keep the integrity of the exam questions safe.

Concluding statement

What I do like about the Queensland system is the opportunity of the individual teacher to direct, create and write a chemistry course for their students. But my experience of the current Syllabus is that there is great variation in expectations across the Region and it is difficult to keep reinventing assignments to meet Syllabus requirements and maintain the integrity of the assessment piece.