A Relational Approach to “Wet Chemistry” Laboratory Learning: A Cultural Transformation Tool

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Extended Abstract

Introduction

The vast majority of us learn; the question is, of course, what we learn (Piaget, 1951). All disciplinal learning requires some content, and hence internalisation of some information or facts is necessary for most forms of study. Irrespective of the cultural context, the tools employed to do this are usually rote learning, memorisation, etc. The use of these tools per se is not necessarily negative (Bond, 1992), but in situations where memorisation of facts becomes the main learning tool, the learners can pay high penalties in terms of problem solving (Samuelowicz, 1987) and lateral thinking abilities, both of which are the premium attributes of science graduates. In higher education, this type of system is termed “lower order” learning (Biggs, 2003). Although in some very logical areas of science and maths there is a degree of paradox (Hing, 2013), in the main the consensus is that “higher order” learning produces better learning outcomes (Watkins & Biggs, 1996) and hence better graduates.

Singapore is a multicultural city-state and has been called a “melting pot” of Southeast Asian culture; historically, it has also had cultural investment from both East and West, particularly from Malaysia, China, India, and Europe. In terms of the Singaporean education system, some aspects of the country’s cultural inheritance, focussing strongly and almost exclusively on content, have not been entirely supportive of higher order learning. Hence, these aspects present a learning and teaching challenge in a university context. This culture shows itself in many ways, and especially so in practical work, where it often manifests as an obsession with marks and the “correct” answer, mindless repetition, less-than-honest reporting of results, (often) no recording of results, effectively group submissions of “individual” work and so on. These behaviours cost students, in that it seems sometimes that there is a lack of understanding amongst them of what they are supposed to be doing and why. As learning facilitators in the Tango (Ragupathi, 2014) which is the learning and teaching process, we need to ask ourselves what exactly our students are learning that will enable them to develop the skills necessary to become independent scientists, and how what we do is enabling that development. Obviously, the way learners and educators dance this Tango can either reinforce or erode the existing culture.

Summary of Approach and Results
This paper describes the results of a series of initiatives on how we are facilitating “higher order” learning in our practical laboratory work, and in particular in one module. (We have chosen practicals for both operational and pedagogic reasons). Some of this work is completed, and some currently in progress. The work has a number of components:

(1) Double Blind Wet Chemistry Practical Exercises
The use of double blinded wet chemistry practical exercises has had three effects:

a. In response to the perennial student question “Is this [their results] OK?”, academic staff are able to truthfully answer “I do not know”, and instead be able to facilitate student development in skills and techniques, i.e. enable them to move on in their learning.

b. Students on the other hand are relieved of the pressure to e.g. get a straight line of a particular slope, and can spend time engaging the actual problem and overall exercise.

c. Greater student involvement in the exercise, which will hopefully lead to more and better student learning.

(2) Feedback Data
The collection and use of feedback data seems to have had three effects:

a. The use of student volunteered feedback data from across the chemistry practicals has allowed for the examination of student expectations, effort and enabled academic staff to determine the the degree to which student ability determines the reality of their expectations (there are caveats in the interpretation here).

b. The use of a single generic feedback scheme to students on all their submitted practicals has certainly triggered conversations on student development of their practical abilities and in some, a clearer recognition of why they do practicals and what they should be getting out of them.

c. The use of regular weekly feedback to academic staff and staff response on potential improvements and difficulties has allowed for the tweaking and tailoring of the operational running of the module.

(3) Help and Guidance Information
The provision of ‘help information’ for students seems to have been beneficial in the following ways:

a. Provision of clear information to students on the expectations of staff, format and requirements of the write-ups, exemplar write-ups and lab notes (data-sheets), enabled some students to put their focus more clearly on the “why” of laboratory work, as well as the development of their laboratory write-ups.

b. Clear annunciation to students of the bases of the assessment and less queries on grades.
(4) Technology

The availability and use of technology, which has two effects:

a. The use of automated (but individualised) “door-keeper” access exercises has helped to meet some safety concerns in the lab. Whether it has actually met the second planned outcome to force students to engage with the practical before they set foot in the lab, hence allowing for better use of labtime, remains to be seen. (We hope in time this material will include driving virtual versions of the instruments that they will actually be using in the practical).

b. The use of an integrated feedback response system has allowed staff to collect weekly feedback from the students, as mentioned earlier.

Nature of Outcomes of the Practicals and Their Assessment

For some of the exercises, there are additional output requirements to the usual three types of practical write-ups, and hence are potentially different for each student. So by being more careful in mapping the exercises to likely graduate destinations, some exercises may require a government report (to the appropriate actual government template), or a lesson, or an environmental impact report, or analytical consultancy report, and so on. It may also be that some of these formats (e.g., government report) will be required to be written with a policy agenda in mind.

The assessment will not be based predominantly on the quality of the results, but will encompass other aspects of the exercise.

After going through these exercises, we observed that particular staff training has been necessary, including graduate teaching assistants (GTAs) involved in these practicals. Such training is crucial in ensuring that the new ‘greater than just results focus’ ethos of this module is effectively carried out, as well as a recognition that different people might be better at delivering the in-lab experience, and others more effective at the assessment component of this module. However, although the number of GTAs has increased, it might be the increase in total hours may be more modest, which is something we will have to look into for future batches of students.

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References


