

Short Communication

Blending learning: a Novel Assessment Strategy Enhancing Student Learning from Practical Work in the Laboratory

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Abstract

In this communication we report on a 'blended' form of assessment combining the positive aspects of a laboratory investigation, including practical skill acquisition, data reporting and social interaction, with the application and authenticity of a case study encouraging students to deepen their learning from laboratory activities.

Keywords: assessment, practical work

Introduction

Adams (2009) recently published a review highlighting novel ways to enhance learning in the practical laboratory. The review was inspired by growing concerns that "we must move away from 'spoon-feeding' students during interminable, repetitive and boring practical classes that have highly predictable results". Currently, many students carry out practical work in large cohort groups, reportedly following a 'recipe book' approach. This leaves many asking why the experiment was performed and how it fits into the wider academic context (Hodson, 1993, cited in Hofstein and Mamlok-Naaman, 2007). In turn some academics feel that practical reports, although based on an engaging task, have somewhat lost their way as tools to deepen students' approach to learning. Interestingly, third year students who find themselves in smaller cohorts with more time available to develop their laboratory work into a specialist project find practical work engaging and supportive of a deeper understanding of the topic (Exley, 2000).

The use of case studies has become increasingly popular with educators as a mechanism through which to combine learning with assessment (Davis and Wilcock, 2003). In this article the term 'case study' is used to describe a learning and assessment strategy which is created "explicitly for discussion and (which) seeks to include sufficient detail and information to elicit active analysis and interpretation by users with differing perspectives" (Merseeth, 1991). Case studies are flexible: a range of key skills can be embedded in the task including group work and independent study; data analysis and interrogation as well as critical thinking. The acquisition of critical thinking abilities in undergraduate students has been the subject of a substantial body of research. It is widely recognised that critical thinking is a high level intellectual activity that goes beyond the acquisition of knowledge. Critical thinking enable individuals to problem solve intuitively, make appropriate inferences, predict outcomes and reflect on and evaluate their decisions (Halpern, 2003; 1999). Interestingly, Chaplin (2007) reports that the acquisition of critical thinking skills may be difficult to achieve in a bioscience context, given the inherent complexity of the low order, factual information that initially have to be mastered.

Assessment is an important mechanism through which to direct and enhance student learning (Snyder 1971). It would seem natural to assume that practical reports provide a useful mechanism through which to direct learning in bioscience students. However, as Prosser and Trigwell (1999) highlight, assessment does not always lead to the learning outcomes that we anticipate as educators. It perhaps follows, in the current HE context that practical report writing may not enhance students learning in the intend manner. Instead, the use of practical

reports as a learning tool may foster a surface approach that develops from an inherent failure to understand the practical scenario.

After reviewing the literature it became apparent that learning from practical work could be enhanced through an assessment task that varied from the traditional laboratory report. With the aim of developing a more engaging and challenging experience, based on enquiry (Adams, 2009) rather than prescription we piloted a novel practical learning experience with a group of bioscience students. Students were required to develop a piece of contextualized writing, based on practical data, following a six week laboratory block which was themed to generate the 'feel' of a specialist project. We report here that students enjoyed the applied nature of the assignment and felt that the experience gave them the opportunity to develop a deeper understanding of the subject area.

The intervention

The intervention has been trialed over two academic years in a specialist bioscience course; 14 students were involved in the first pilot and 30 in the second. At the outset, the academic tutor identified a number of seminal journal articles, each focusing on the nutrient composition of a particular food type (nuts). Every student on the module was sent one of these papers two weeks before the first class session, each paper was sent to two students in total. In the class session students who had been sent the same paper were 'matched up' and asked to spend 30 minutes talking about the key findings of their paper; at the end of the time each pair was asked to relay a summary to the whole group. Students were encouraged to focus on the methodology and key findings of their article. To enable the students to concentrate on the discussion the tutor acted as a scribe to ensure that the comments of all members of the cohort were recorded, in the process constructing a report detailing all of the seminal papers produced by students, for their mutual benefit and to fully contextualize the case problem. At this point 'case study' assessment was introduced; students were asked to critically evaluate the statement 'just because nuts are fatty does not mean they are bad for our health'. Students were required to prepare a 2,000 word report; assessment criteria for the report are shown in Table 1. At the outset it was made clear that the assessed piece was a synthesis of laboratory practical data and published literature. Students were required to acquire and incorporate laboratory data to support their argument having carefully balanced this against the published literature. The work of Stein *et al.*, (2006) identified the skills that must be considered when assessing the capacity for critical thought; these are incorporated into the assessment criteria for this task detailed in Table 1 below.

Practical work was carried out over the following six weeks. Students worked as a pair for the duration of the two hour sessions using readily available protocols given to them in advance. Week-by-week practical laboratory sessions were accompanied by post session, problem based enquiry tasks that were emailed to each member of the cohort. Details of the practical activities, and the associated problem based enquiry tasks, are detailed in Appendix 1.

At the end of the practical work, in the second trial year, students were asked for their opinions of the intervention using personal response system (PRS) technology facilitated by a series of clicker questions. Their responses were individual, without discussion with their peers and were collected anonymously to protect the identity of the students and ensure the expression of unbiased opinion. The questions are included in Appendix 2 and summary data are detailed in Table 2 below. Twenty six students were present in the session and were issued with the handsets, the specific number of respondents to each question is shown in the Table 2 below. In the main only one of two students omitted to answer a particular question, anecdotally this related to tardiness of response or difficulty with the handset. This study was approved by the appropriate ethics committee.

Table 1 criteria for assessing the final report

Criteria	Mark for this criteria	What we are looking for with this learning outcome taken from Stein <i>et al</i> 2006
Critical evaluation of frequent nut consumption and lipid profile in human subjects.		<p>Identify inappropriate conclusions.</p> <p>Identify evidence that might support or contradict a hypothesis.</p> <p>Identify new information that is needed to draw conclusions.</p> <p>Separate relevant from irrelevant information when solving a problem.</p> <p>Analyze and integrate information from separate sources to solve a complex problem.</p> <p>Recognize how new information might change the solution to a problem.</p> <p>Communicate critical analyses and problem solutions effectively</p>
Evidence of background reading		Depth and breadth of material appropriate to inform all aspects of the report
Critical assessment of the role of nuts as a component of a 'portfolio' diet		<p>Analyze and integrate information from separate sources to solve a complex problem.</p> <p>Recognize how new information might change the solution to a problem.</p> <p>Communicate critical analyses and problem solutions effectively.</p> <p>Identify new information that is needed to draw conclusions.</p> <p>Separate relevant from irrelevant information when solving a problem.</p> <p>Identify evidence that might support or contradict a hypothesis.</p> <p>Identify inappropriate conclusions.</p>
Accuracy, analysis, interrogation and interpretation of laboratory data using appropriate summary data tables		<p>Learn and understand complex relationships in an unfamiliar domain.</p> <p>Use mathematical skills in the context of solving a larger real-world problem.</p> <p>Interpret numerical relationships in graphs and separate those relationships from inferences.</p> <p>Separate relevant from irrelevant information when solving a problem.</p>
Key Skills including: Appropriate academic referencing Originality Academic writing including spelling and grammar		

Table 2 Participant experience of blended assessment intervention ($n=26$)

Students were invited to respond to a series of questions shown in Appendix 2. There were five possible responses ranging from strongly agree to strongly disagree. In the question relating to 'students following the schedule without understanding there were only three possible responses: always, sometimes, never'.

		Response					Total
		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
1	Read around the subject before practical	1	3	3	10	8	25
2	Practical work is a good way to learn	7	9	3	2	2	23
3	Practical work is a better than lectures	5	7	3	4	5	24
4	Case studies are a good way to learn	7	10	0	3	4	24
6	Better understanding when pracs focus on one topic	6	11	2	3	2	24
7	Feel less rushed with prac series	8	9	2	1	3	23
8	Developed an more indepth understanding from prac series	5	10	2	5	2	24
9	Sustained effort is fairer	4	6	6	4	4	24
		Always	Sometimes	Never			
5	Follow the schedule without understanding	5	14	5	NA	NA	24

Conclusion

The responses to clicker questions, shown in Table 2, demonstrate several key points. Firstly, students in this study did consider practical work to be a good way to learn, with 16 respondents agreeing with this statement. However, the majority did not tend to read around the subject area ($n=18$) before attending the practical which may explain why the majority also reported that they followed the schedule without understanding on some occasions ($n=19$). Using the focused, sequential practical activities, supported by problem based enquiry, the majority of students reported feeling less rushed ($n=17$) and also feeling that they had developed a deeper understanding of the topic ($n=15$). Interestingly, the issue of 'fairness', and its relationship to sustained effort, was the question that divided the cohort most notably. McDowell (1995) has previously reported that students value assessment more when it is perceived to be associated with extended effort rather than linked to the surface approach that is often fostered by examinations; it could be argued that a single laboratory practical could also lead to such a surface approach. The response to this question, around fairness and sustained effort, may relate to students personal attitudes to attendance rather than being a direct comment on this intervention. It would be useful to explore further with students whether the specific benefits of the intervention are related to the students own level of engagement. We might anticipate that those who attend every session and are fully engaged in their studies develop their skills in a manner more akin to a research project. Sustained effort would therefore be key for these students. Those who attend less regularly may benefit from the linearity of the approach simply because they have more time to 'catch up' but never develop the same level of control as their more engaged peers.

The students' comments, demonstrated in Table 2 in responses to questions 1 and 6, affirmed the benefits of a case study approach underpinned by practical work. Specifically, students commented that they had developed a deeper understanding (58% claimed they did) as a result of the nature of a continuous series of practicals. Anecdotally, many students commented

that they had found the practical work enjoyable, but at the same time were clear that the associated case study assessment had been more difficult than other tasks. In particular, they had spent longer preparing their submission because of the need to integrate the data with the published literature.

For an assessment strategy to be successfully adopted it follows that the staff must also see the benefits of the intervention. As a teaching team we felt that this approach addressed some of the concerns about student engagement and facilitated the development of a 'specialist project' suitable for use even with larger class sizes. Linking back to the students comments, the integration of laboratory data with published material was evident in all students work and by definition this required students to take a deeper approach to learning and critical thinking; in our experience this level of interrogation is less readily apparent in more prescribed laboratory reports. As a final point of note, from a cohort of 43 students, we had no cases of plagiarism. This task would therefore have the additional benefit of effectively designing out plagiarism which is a further benefit for both staff and students.

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