Group work: horses for courses in first year biology

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Abstract: There are a number of student learning outcomes that are perhaps best achieved in a group approach and others where a group approach is a virtual guarantee that only a portion of the cohort will meaningfully engage in the learning task. We have taken the straight forward approach of ensuring that learning areas with a social interaction component such as 'working in teams', 'team structure and function', 'hazard assessment' and 'peer review' are delivered using group work in a way that allows a direct experience and deep learning of the processes. Other learning areas that focus on individual motor and organizational skills such as microscope usage or microbial plating are taught and assessed with students acting as individuals.

Specific recognition that socially oriented tasks should be taught in a group environment suggests the obvious ideal that the group task be designed to make the most of the group environment. In this paper I examine two such group tasks that were run in first year biology at the University of Newcastle in 2006. The first of these 'The Great Diversity Challenge' was designed to engage students in a deep learning experience regarding their own approach to working in teams along with the basic theory of team structure and function and a team approach to hazard assessment. The second engaged students in the publication and peer review processes and provided personal experience in giving and receiving criticism professionally. Student attitudes to the effectiveness of the approach were assessed using an online survey tool in Blackboard *that included both scale and written responses.*

Introduction:

Effort is usually taken in the teaching of science to stress that real world research activities are conducted within an interactive scientific community. In this context the inclusion of group work in course design is seen as a legitimate and important component of undergraduate courses. Care must be taken, however, to ensure that the inclusion of group work supports the educational experience of students (Davis 1993). This is because additional pressures including a lack of access to equipment or a lack of staffing resources may also be alleviated with a move to group activities which may generate conflicting options for staff.

The application of group work can be counterproductive when used to address resource limitations (Anonymous 2007). On the positive side the use of a group based learning environment may enable student access to limited specialist equipment or expertise that they otherwise would not be able to access. On the negative side, while the students have theoretically had the opportunity of exposure to the equipment or expertise, the reality is that actual exposure to resources will be regulated by the degree of engagement and status of the individual within the group. This entrenches the likelihood of inequality within the course and creates a basis for alienation and disengagement of a proportion of the student cohort – counter to the common intent of trying to increase student enthusiasm in accessing specialist but more limited resources. This highlights that the use of group work to address resource limitations should be treated with care and be considered a temporary amelioration strategy rather than an effective solution.

There are scenarios, however, where group work is perhaps an ideal if not essential teaching platform for learning science (Sharp 2001). Effective social interaction is important for the functioning of research groups and the scientific process in terms of effective peer review. In addition to this, competition for research funding increasingly means that mutual support during the grant review process across an entire field is important for the development and maintenance of reliable funding streams in a competitive funding environment. Learning about alliances, group structures and their application along with skill in group formation and participation is therefore important to the success of a career in modern science and a critical part of scientific education. Personal reflective experience in group formation and participation is arguably the best way to deliver learning outcomes in this regard (Watson 2002). This places the teaching and learning of interpersonal skills within an authentic environment where the value of the skill is obvious and an essential part of the learning task.

This paper reports on two activities specifically developed for first year biology students that use a group learning platform in the teaching of specific social interactive skills associated with the scientific process. As such, reflection and learning of social interaction is integrated into the successful completion of the overall task and places group work within an authentic learning scenario. This encourages students to engage through the group process and supports the development of the whole person within effective social networks (Davydov 1995).

Methods

The teaching of undergraduate biology courses at the University of Newcastle (Australia) has recently undergone a significant restructure via the creation of a series of 'Professional Skills' courses. These courses are compulsory for students wanting to major in the biological sciences and provide the majority of training in the processes of modern biological science practice. The courses are complemented by a range of courses that teach the specific theory of various fields in biology and ecology. The two activities reported here were run as part of the new first year 'Professional Skills' course.

The first year professional skills course ran for the first time in Semester 2, 2006 with the course design being reported previously (Ellem, Dunstan, MacFarlane, Tayler, McLaughlin, Nixon, Patrick and Offler 2006). The course involved 120 students arranged into four classes of approximately 30 students. The number of demonstrating staff was varied from a ratio of 1:8 to 1:30 depending on the task. The majority of demonstrating staff were PhD students although a professional tutor with teaching qualifications was also employed. Demonstrators were specifically chosen for their track record of positive engagement with students. Students were compulsorily obligated to attend four hours of face to face activities per week consisting of a whole course single hour lecture and a class separated three hour practical session. The weekly lectures were delivered by the author and were designed to link the course tasks to wider societal and philosophical issues as well as to provide advice and demonstrations on skills to be learned. Demonstrating staff were paid to attend the lectures.

Activities and skills were evaluated while designing the course to determine if social interaction were important components. Those that were deemed to include important social components were marked for group work, while those that were for the development of asocial skills were marked for individual work and efforts were made to ensure that sufficient resources could be supplied for individual work. Social interaction and the opportunity for social learning was still encouraged during individual work, however, these key course and skill competencies were always supported and assessed at the level of the individual.

Success of the approach was evaluated by surveying student perceptions at the conclusion of the course using an anonymous but compulsory online survey in *Blackboard* (students needed to complete the survey to enable access to their final quiz). The survey consisted of a number of 1-5 rating style questions as well a number of open essay questions on various aspects of the course including the activities covered in this paper.

Activity 1 – The Great Diversity Challenge

'The Great Diversity Challenge' was an activity developed in 2003 in an effort to foster team interaction and cohort networking. In this activity classes voluntarily competed with each other to develop and maintain a mesocosm for the duration of the semester. To win the class needed to show a combination of intelligent strategy, high mesocosm biodiversity and effective teamwork, culminating in a presentation to the rest of the year. In the context of the new curriculum the activity was altered to act as a basis for teaching the theory and structure of teams as well as safety and hazard assessment. The assessment was also altered so that individual students could score up to a 5% bonus grade for the course via participation, as determined by peer weighting a single class grade.

The launch of the great diversity challenge included a lecture that introduced students to the theory of games and the difference between zero sum and non-zero sum games. The assessment for the challenge was designed as a non-zero sum game in that if students were able to form effective teams and conduct the task they could all win (they could also all lose). The structure and nature on non-zero sum games were discussed along with strategies for success in this environment and linkages with aspects of alliance building and evolutionary theory. Students were also introduced to different organizational models and encouraged to reflect on their pros and cons for different tasks.

The first practical session of the course was used to begin the process of team formation and mesocosm development. Students within the class were allocated seats in alphabetical order to reduce existing alliances and provide a better opportunity for team building. The demonstrator offered their services as a facilitator to the class after making it clear that this role would cease after the first hour of the class. After this first hour the demonstrator would not initiate discussion or activities but willingly responded as a resource if requested by the students. The demonstrator reserved the right to proactively intervene at any time to veto activities regarding matters of safety.

Students were provided with a hazard assessment sheet which provided an experienced framework on the likely sources of risk in the environment and during different work activities. This framework had been used in previous years to assist in risk identification and aids in the engagement of students inbuilt risk avoidance behaviour. Students identified risks, developed amelioration actions and made an individual assessment as to whether it was safe to begin work. Students then discussed and approved the hazard assessments with their team members before approaching the demonstrator for final approval. To highlight collective as well as individual responsibility the demonstrator either accepted or rejected the whole team's application to begin work.

An important part of working effectively in teams is to perceive how your actions are received by the rest of the group. An important part of belonging and self esteem is also the recognition of others that your actions are noticed and valued by other members of your group. In order to facilitate both of these ends a 'Rapid assessment of self and peer contribution' was developed and run for the first time during the initial class session. The assessment was re-run during a number of other team activities during the semester and also after the final presentation and awards ceremony for the great diversity challenge. The final self and peer assessment was used to peer weight the class allocated %bonus received for participating in the activity.

The peer rapid assessment resources consisted of a single A4 assessment sheet that was downloaded and brought to class by each student. The sheet consisted of a blank table with instructions at the top for use. A white board was set up at the beginning of the class with two columns each headed by a question. Students were encouraged to write different words in response to the two questions during the class. The two questions were simply 'What do I value in my team mates?' and 'What do I hope my team mates see in me?'. During the last 30 minutes of the initial class the demonstrator worked with the class to agree on a list derived from the suggestions on the white board and these became the criteria on which contribution would be assessed. Setting up the white board at the beginning of the class was considered to be important as it encouraged students to actively reflect on different behaviours during the group activity. A short discussion was held on receiving feedback and the purposes of feedback before a brain storming session on the nature of a feedback/scoring system for the different contribution criterion and how this may encourage engagement and participation. After agreeing on this feedback/scoring system the students completed the self and peer assessment sheet which was arranged so that each student could give and receive feedback anonymously. Students could then observe how perceptions of their own performance correlated with the perceptions of their peers.

Activity 2 – Scientific writing and peer review

The publication and peer review process is an essential tool to the process of science. This process encompasses a number of possible social interactions during different phases which may range from inspiration, experimentation work, collaborative analysis and writing. The essential social process though is during publication and the inherent peer review.

In this activity a designed ecological experiment was supplied to students who worked as groups to collect the data in the field (after conducting a hazard assessment). Students had previously conducted a literature review for the same subject and were provided resources in the form of a template for the writing of a scientific paper. The students attended a data analysis tutorial and wrote their papers as sole authors using a collective class data set. Each class was divided into 'Journals' with students acting as editors. The journals were given space on the class *Blackboard* site and papers were submitted electronically to the allocated journal. The editorial teams for each journal reviewed the manuscript and posted a reply on *Blackboard*. Each student was directed to provide feedback to at least two submitted papers as part of the process. The central task of this part of the process was to ensure that all papers complied with the journals 'instructions for authors' which consisted of formatting, layout, referencing and overall quality criterion before being passed on to the next round of peer review. Authors were allowed as many submissions as possible within the allocated time in which to have their paper reach the required journal standards.

Papers that were regarded as up to standard by the journal were signed off by the journal editors and assigned for 'peer review'. In this case the peer review consisted of a 15 minute personal consultation with a demonstrator who went through the report with the student and assisted with the perspective, approach and understanding in the paper, as well as picking up on any issues that made it through the editorial process. Students were then given time to make changes before their final electronic submission to *Blackboard* and *Turnitin* (plagiarism detection assistance software). Marks were available for each stage of the process with grades being forfeit if the time hurdles for each stage were not met. Grades were awarded for passing editorial scrutiny as well as the quality of editorial reviews and the final submission.

Results and discussion

On the whole students responded positively to group work. More than 83% of the students felt that the course had helped to build their team and personal interaction skills (12.5% neutral and 4% negative). Twenty three students (19%) of students voluntarily suggested team work when asked to nominate their favourite aspect of the course. It is clear that a small number of students (4%) did not engage well with the team approach, however, the underpinning reason for this is unclear. In future years the inclusion of a self analysis of personality type (e.g. Myers Briggs) and it's adaptation to learning styles may aid these students in finding ways to engage positively with the program (Sharp, 2003).

There was a deal of support for the social networking aspects of the great diversity challenge. The activity worked well as an ice breaker and appeared to facilitate the rapid development of lasting friendships and networks – 'The team work emphasis which was used from the very first day was good' and 'I made alot[*sic*] of friends and had the opportunity to meet alot[*sic*] of talented people. In my other classes people don't interact as well with one another and dont[*sic*] take the opportunity to get to know each other aswell[*sic*] as we have in biol1003'. The peer directed nature of the activity reduced the reliance and power structure associated with demonstrators and in accordance with Damon and Phelps (1989) assisted them in building relationships with students 'Enjoyed teaching hazard assessment – along with great diversity challenge is good opportunity to get to know student with greater inherent equity in process.'.

Students felt that the hazard assessment process worked well with 81% of students feeling that they were more aware of potential work place hazards and occupational health and safety issues (18% neutral). The great diversity challenge was recognised as a good model with which to teach these skills 'It was a great experience for team work and safety hazard knowledge[*sic*]'. Despite these positive reviews from students, staff identified some pervasive issues in the implementation of group responsibility. A combination of a relatively innocuous appearing activity (i.e. go and collect some specimens on campus grounds) and inbuilt trust that academics would not have planned a dangerous experiment meant that students saw the hazard assessment paperwork as simply a hurdle that had to be completed in order for them to get out of the lab and doing the real work. The basic assumption that the work was safe prior to the initiation of the hazard assessment was the antithesis of a safe approach and often required some focussing words from the demonstrator. It was a relatively common occurrence that teams approached a demonstrator for final work approval with a number of the team members indicating a reasonable possibility of death or extreme injury in their hazard assessment if they were to begin work. That their team members allowed this to happen showed that individual and collective responsibility for safety did not register in the first instance. That being said – demonstrator mediated reflection on their hazard assessment performance and their failure to take responsibility for their actions within the activity was powerful teaching tool. Students were brought face to face with their unquestioning trust in figures of authority and the inherent safety risks this entails. Future adjustments to the activity will include more interaction between staff and students while preparing their hazard assessment and a less confrontational review by staff of the hazard assessment quality. This will re-enforce the concept that the hazard assessment is to support the students in terms of safety rather than getting past the demonstrator approval hurdle.

The course had strong support from students regarding learning the scientific writing process with 81% believing that their written communication skills had improved as a result of the participation in the course (16% neutral, 2% disagree). The peer review process was also supported with 79% believing it was a valuable teaching tool for scientific writing (14% neutral, 6.5% disagree). When asked to record their most valued part of the course 41 students (34%) voluntarily suggested the report writing and review process – 'the most valuable part was the lab report peer review section, recieving[sic] feedback from various people was extremely helpful and encouraged me to do my best.' and 'Peer review and demonstrating staff review. I learnt alot[*sic*] more about how to write a good lab report and consider my final report to be a huge improvement from my original. I was very happy with my final report.'

While the vast majority of student responses to the peer review process were positive there were a small number of students that professed difficulties with the process. These issues were mainly in regards to the quality of feedback that they received from other students during the journal editors phase and a lack of confidence that they had anything to offer during this process – 'Peer review was poor – i[sic] found it to be a case of the blind leading the blind' and 'If it had worked well then it would have been a good experience, but my group was slack as and I ended up having to organise someone from another group to look at mine!' From a demonstrator perspective the activity was a positive experience 'Did not increase or decrease workload for staff but improved outcomes for students. Giving feedback before final mark more effective and satisfying as it is worked on by student and can see consequent improvement.' There were some issues with bad advice from student reviewers although demonstrators 'Usually identified quickly by conflicting advice from reviewers'. Demonstrators also reported 'Big problem where peer review left to the last minute – delayed whole down stream processes.' In future years more marks will be allocated to the peer feedback portion of the activity in order to reflect the idea that to provide good feedback it is important to engage with the material and understand it yourself. This therefore represents a high level skill that is valued and rewarded. Exemplars will also be provided of what constitutes and helpful, neutral and unhelpful review and student perceptions of reviews of their own work will be taken into account as part of future assessment.

The lack of feedback questioning the use of teamwork showed that the approach taken to group work within the course made the benefits and purpose of teamwork obvious to students. Any issues students did have with the use of a group based approach to learning (which were few) were associated with feelings that they were not getting the most from their team work experience rather than that group work was not appropriate. This supports the role of group work as a teaching tool for skills that require social interaction and argues that this is a powerful and appropriate mode of teaching in these circumstances.

References

Anonymous (2007) *Teamwork Toolkit: Advantages and disadvantages of using teamwork*. http://www.griffith.edu.au/centre/gihe/griffith_graduate/toolkit/teamwork/teach01.htm

Damon, W. and Phelps, E. (1989) Critical distinctions among three approaches to peer education. *International Journal of Educational Research*, **13**, 9-19.

Davis, B.G. (1993) *Tools for teaching – Collaborative learning: group work and study teams*. Jossey-Bass, San Francisco.

Davydov, V.V. (1995) The influence of L.S. Vygotsky on education theory, research, and practice. *Educational Researcher*, **24**, 12-21.

Ellem, G.K., Dunstan, H., MacFarlane, G., Tayler, R., McLaughlin, E., Nixon, B., Patrick, J. and Offler, C. (2006) *Design of an enquiry-based 'Practical Only' course for the teaching of Basis Skills in 1st year Biology*. Uniserve Science Poster Presentation.

Sharp, J.E. (2001) Teaching teamwork communication with Kolb learning style theory. *31st ASEE/IEEE learning frontiers in education conference*.

Sharp, J.E. (2003) A resource for teaching a learning styles/teamwork module with the Soloman-Felder index of learning styles. *33rd ASEE/IEEE learning frontiers in education conference.*

Watson, P. (2002) Innovative teaching, teamwork and generic skills in the university environment. *Celebrating Teaching at Macquarie conference publication* http://www.cfl.mq.edu.au/celebrate/index.htm.