FORMING GROUPS TO FOSTER COLLABORATIVE LEARNING IN LARGE ENROLMENT COURSES

Gwendolyn A. Lawrie[a], Kelly E. Matthews[b], Lawrence R. Gahan[a]

Presenting author Kelly E Matthews (k.matthews1@uq.edu.au)
[a]School of Chemistry & Molecular Biosciences, The University of Queensland, Brisbane Qld 4072, Australia
[b]Tertiary Education Development Institute, The University of Queensland, Brisbane, Qld 4072, Australia

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ABSTRACT

Assessed group tasks are becoming more prevalent in large undergraduate courses as a means of creating active, collaborative learning environments that foster student engagement and build team-work and communication skills. However, introducing group work presents challenges around task design, implementation, management and marking that differ significantly from individual-based assessment tasks. This paper focuses specifically on the role of team formation in collaborative learning tasks, which is situated in a broader, on-going study of interdisciplinary scenario-inquiry tasks in large enrolment science courses. A mixed-method design, based on grounded literature, examined student perceptions of assessed group tasks from two student cohorts completing a task under similar conditions with separate group formation criteria. Initial findings indicate that deliberately formed students groups are preferable to randomly formed groups, influencing student perceptions of group work and their subsequent learning outcomes. Results are interpreted within the context of current literature on group formation and collaborative learning. Implications for forming groups within collaborative learning tasks are presented, along with recommendations for further research.

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INTRODUCTION

Large (>1000) 1st year classes pose a challenge to instructors who aim to enhance learning in cohorts where diversity in learners' abilities, interests and backgrounds is a common occurrence. In order to overcome this diversity many instructors have introduced collaborative learning tasks. The introduction of such tasks is based on literature which recommends reform in course design using high impact learning practices to enhance engagement (Kuh, 2003) and the promotion of active learning (Prince & Felder, 2006). Collaborative learning environments offer the opportunity for students to develop shared understanding of concepts (Kagan, 1992; Johnson, Johnson & Smith, 1998; Smith, Sheppard, Johnson & Johnson, 2005; van den Bossche, Gijselaers, Segers & Kirschner, 2006). Further, there is strong evidence that effective collaboration promotes mutual knowledge construction through shared discourse resulting in increased performance (van den Bossche et al., 2006). There is also acceptance that these learning environments are social constructs where the group function depends on interpersonal relationships and individual values (Gillespie, Rosamond & Thomas, 2006; van den Bossche et al., 2006). The effectiveness of a group is not guaranteed by simply putting people together and, with this recognition, successful group practices have been recommended (Felder & Brent, 2001; Smith et al., 2005). Insights into the factors which promote positive interdependency in groups as they reach solutions or formulate new ideas are still emerging as are tools to evaluate these processes (Summers, Beretvas, Svinicki & Gorin, 2005). Indeed there is strong evidence that group formation, and the role of the instructor, are critical in the success of collaborative learning (Gillespie et al., 2006). Students' perceptions of the learning in collaborative groups relate to the attitudes and values of their team members in terms of academic aspirations, respective contributions and task outcomes. However, most literature studies report quantitative data gained from studies that explore group processes, perceptions and engagement in small to moderate class sizes (< 200) (Phipps, Phipps, Kask & Higgins, 2001; Smith et al., 2005). The paucity of qualitative studies offers the potential to provide new insights into collaborative learning processes (Coll & Chapman, 2000).

In this study we report the evaluation of a collaborative learning activity in large general chemistry classes through a mixed methods approach. This paper represents part of a larger, on-going study

into the effectiveness of interdisciplinary scenario-inquiry tasks (IS-ITs) as a means of enhancing students' engagement and appreciation for the interdisciplinary nature of science whilst also catering for the overwhelming diversity of learners' academic abilities, interests and motivations in first year. An integral element of this study is fostering collaborative learning as students work in teams of four over an eight-week period to complete the tasks. This paper focuses on the process of developing those student teams and is based on the following research question:

How will student perceptions toward collaborative learning and their own learning gains be influenced by group formation within an on-going assessment task (IS-ITs)?

METHODOLOGY

The context was a first year Chemistry course containing 1100 students enrolled in up to 40 separate programs. The major programs represented promote a professional career identity, *viz* science, medicine, pharmacy, biomedical science, engineering, biotechnology. A collaborative learning activity was designed to involve students in collaborative groups where they could engage in discourse and identify the chemistry concepts underpinning their assigned topic. This task was initiated in 2008 with adaptations implemented in 2009 as a result of student feedback. In the first iteration, focus groups and surveys were completed to evaluate aspects of the course reform. As a result of the evaluation of the initial intervention, issues were identified relating to the way the students engaged in the task and progressive modifications were made to the task to address these issues.

Groups of four students, and topics, were assigned randomly in 2008. In 2009, more attention was paid to group formation based on grounded theory (Johnson et al., 1998; Kagan, 1992). Thus, in 2009 students were clustered by program so that they were working together both with colleagues with common career aspirations and with chemistry topics relevant to these programs. Heterogeneous groups of four were assembled based on mixed academic ability (Felder & Brent, 2001; Kriflik & Mullan, 2007), with gender dispersed to minimise the number of same gender groups, and distribution of international students to address simultaneous hurdles related to English being a second language and to improve their integration into a new environment (Kavanagh & Crosthwaite, 2007). Significant scaffolding was implemented to shift student perceptions of the assessment in relation to learning outcomes (shifting from conceptual gains to teamwork and creativity). Resources were also provided to help students work effectively in groups and address interpersonal issues if they arose.

The University's ethics committee for research involving human subjects approved ethical clearance for this study. Further, the study was funded by the Australian Learning and Teaching Council. A mixed methods approach was adopted with all data collected via an online survey with Likert scale and open response questions. Given the nature of the research question, surveys were considered to be effective instruments for collecting attitude data from large numbers of students. In this study, student perception is used as an indirect measure of student learning, a common practice in higher education research (Kuh, 2003; Seymour, Wiese, Hunter & Daffinrud, 2000). The survey was based on the work of Seymour et al. (2000) and the design routinely used across STEM disciplines in the US and a recommended approach of the National Science Foundation (SALG, 2010). Students were invited to complete the surveys by email, participation was voluntarily and all responses were de-identified. Reminders were sent to students to encourage participation, however no incentives were offered. Threshold requirements for acceptable survey response rates were achieved across all surveys. The responses were monitored by the central university unit administering the surveys in both years of data collection.

The quantitative and qualitative data were analysed using standard research software (SPSS and QSR NVivo). Descriptive statistics, including mean and standard deviation (SD), are used to describe student perceptions. The magnitude of change from 2008 to 2009 was assessed using Cohen's *d* effect size analysis, which is independent of sample size and is considered a more robust indicator in educational research than significance testing (Thompson, 1998). A value of 0.20 is considered a small effect, 0.50 is considered a medium effect, and 0.80 is a large effect (Cohen, 1992). Recurring themes in qualitative data were identified by two analysts independently and cross-referenced to inductively code emerging ideas. The respective counts were cross-correlated to student responses to quantitative questions in NVivo.

RESULTS

Likert scale responses to the question, *How much did the group learning/assessment task help your learning?*, were cross correlated with open-ended responses to the question, *Please explain how the group learning/assessment task helped your learning?* Several themes emerged but the greatest number of references was to the theme of 'group function'. The results from 2008 and 2009 are presented in Figure 1.

The qualitative data relating to group function used to construct Figure 1 were explored further by subdivision into inductively coded daughter nodes which identified factors such as: peer academic aspiration, familiarity with team members, individual contribution, logistics of interactions, and impact of peer assessment as important.

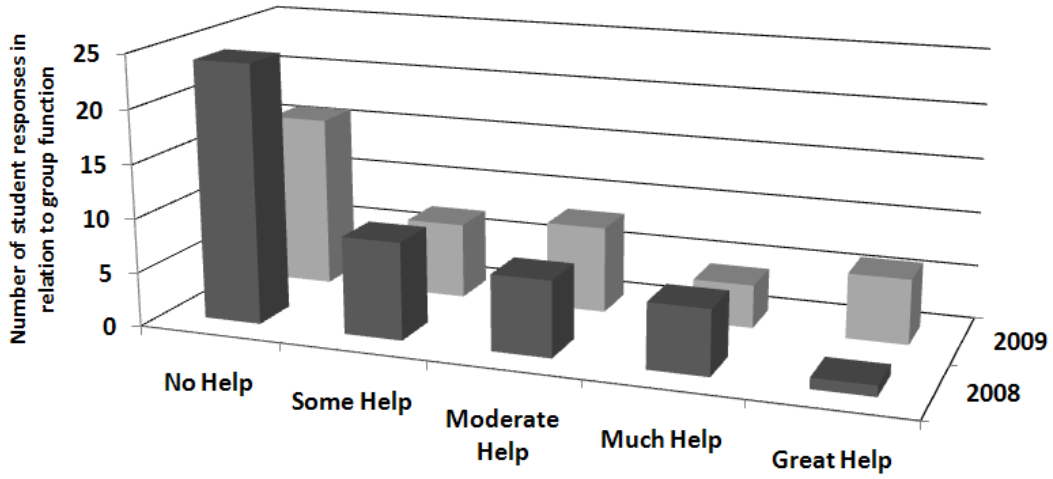

Figure 1: Cross-correlation of Likert Scale responses with open-ended responses to question, 'How much did the group assessment task help your learning?' using a five point, ascending Likert scale on x-axis.

As part of a diagnostic survey to investigate the preparation of students for the 1st year chemistry courses and to identify transitional factors, students were asked, at the beginning of their 1st year, whether they preferred to work alone or work with others on assessment tasks. Post-task data in response to this question were collected as part of the course evaluation (Table 1). In both years, pre/post survey results revealed that student preferences in working alone on assessment tasks became more positive during the semester. However, the effect size is small in both years (Cohen's effect size analysis) indicating that student attitudes to working in group assessment tasks did not alter substantially between 2008 and 2009. The strategy of moving group formation from random assignment to a criteria-based process made little difference to student attitudes.

Table 1: 2008 and 2009 data from diagnostic (delivered in week 1-2 of semester 1) with end of course evaluations (delivered ~ week 13)

	2008			2009		
	Pre-survey mean (SD) N=460	Post-survey mean (SD) N=248	Cohen's d	Pre-survey mean (SD) N=604	Post-survey mean (SD) N=321	Cohen's d
I prefer to work on an assessment task alone*	3.48 (1.06)	3.59 (0.96)	0.11	3.63 (0.94)	3.70 (1.05)	0.07

*Likert Scale: 5 = Strongly Agree; 4 = Agree; 3 = Neutral; 2 = Disagree; 1 = Strongly Disagree

When asked about the contribution of the group assessment task to learning, student data revealed a mean improvement of 0.51 from 2008 to 2009 (Table 2). The Cohen's effect size analysis showed a

small change (d = 0.42) at the high end of the spectrum. However, student confidence in their communication of chemistry concepts as a result of collaborative work is largely unchanged.

Table 2: 2008 and 2009 data from end of semester course evaluation

	2008 Mean (SD) N=433	**2009** Mean (SD) N=323	Cohen's d
How much did the Collaborative Task help your learning?*	2.21 (1.17)	2.72 (1.25)	0.42
As a result of the work you did in this class, what gains did you make in communicating chemical concepts to your peers.**	3.32 (0.96)	3.28 (0.95)	- 0.04

*Likert Scale: 5 = Great Help; 4 = Much Help; 3 = Moderate Help; 2 = Some Help; 1 = No Help
**Likert Scale: 5 = Great Gain; 4 = Good Gain; 3 = Moderate Gain; 2 = A Little Gain; 1 = No Gain

The impact of group work on student perceptions of their gains in skills related to these experiences (Table 3) had a higher mean related to affective characteristics (group building, attitude, social communication and scientific communication skills) than cognitive gains (relevance, problem solving).

Table 3: Survey items developed to explore group function characteristics in 2009

Thinking about your involvement in group work, how much would you agree or disagree with the following statements?*	N	Mean (Std Dev)
I have developed a positive attitude to group work	325	3.33 (1.04)
As a result of group work, I have improved on my group building skills	324	3.49 (0.96)
As a result of group work, I have improved on my scientific communication skills	325	3.42 (0.95)
As a result of group work, I have improved on my social communication skills	325	3.35 (0.98)
As a result of group work, I have improved on my problem solving skills	325	3.29 (0.96)
The collaborative research task has helped me to identify the relevance of chemistry to my discipline area	324	3.11 (1.13)
To what extent did your previous chemistry studies prepare you for working with other students collaboratively	314	3.34 (1.13)

*Likert Scale: 5 = Strongly Agree; 4 = Agree; 3 = Neutral; 2 = Disagree; 1 = Strongly Disagree

DISCUSSION

Collaborative student-centred learning activities offer instructors an effective strategy to address issues in diversity in learning and interests amongst students in their courses. This pedagogical approach is strongly supported by literature studies (Felder & Brent, 2001; Kagan, 1992; Johnson et al., 1998; Smith et al., 2005). It is important, however, to recognise that student attitudes and perceptions are dependent on their learning context. The present study, based in the context of a large 1st year cohort at a single institution, is part of an on-going research project to enhance student engagement and represents a focussed exploration of the role of group formation in collaborative learning. It is acknowledged that, while group formation is an essential aspect of collaborative learning, it is only one aspect of the complex, dynamic processes that characterise group work.

The principal group formation variable explored in this study was the transition from random group formation of all students to the formation of structured groups either within single programs (eg BSc, Pharmacy, Biomedical Science) or in professionally aligned clusters of programs (eg Medicine & Dentistry, Business & IT). This decision was guided by the belief that collaborative communication and discourse would be enhanced in groups of students who shared common career paths. Attitudes towards group work were explored by asking students to reflect on whether they preferred to work individually on assessment tasks before and after their collaborative task. The experience of working in a group on an assessment task did not appear to have a significant impact on student preferences (Table 1) with a minor positive shift in the means observed.

In exploring the impact of the collaborative task on students' perceptions of their learning, there was a small positive shift in 2009 relative to 2008 (Table 2). The cross-correlation of the quantitative and qualitative data (Figure 1) also revealed a positive shift in attitude to collaborative work, with the number of references to group function as a positive impact on learning gains increasing in the year that structured group formation was implemented. In contrast, increased confidence in communicating

chemical concepts to their peers was not reflected by students. This outcome was unexpected given the intentional alignment of the topics to students' career paths through grouping by program of study in 2009. Further exploration of the relationship between perceived relevance of the topics and learning gains is underway.

Van den Bossche et al. (2001) reported that the success of collaborative work relies on two primary perspectives, cognitive and social. Overall, the combination of quantitative and qualitative data in this study revealed that the impact of group formation could be classed in one of two domains: affective factors (relating to reliance on contribution and attitudes of other individuals) and cognitive factors (learning gains, academic outcomes and perceived relevance). Comparison of the means of student perceptions of their gains in skills related to collaborative work also mirrored these two domains with gains in affective characteristics (group building, attitude, social communication and scientific communication skills) rating higher than cognitive gains (relevance, problem solving) (Table 3). Parallel insights into group work have been identified previously where negative perceptions about working with others differed to positive perceptions of group skill gains (Phipps et al., 2001).

Many literature studies recommend the need to set the expectations of collaborative work and provide supporting resources for students. In 2009, students were explicitly informed of the link between skills gained by working in a collaborative environment and the professional expectations of employers. This information was supported by data gathered through a survey of employers of chemistry graduates earlier that year. 90% of employers (N=21) indicated that they highly regarded the attribute of working in groups/teams as a professional skill.

Overall, evidence was found that structured group formation had a positive impact on student attitudes and learning outcomes and important insights were gained into student perceptions of the factors that influenced their learning gains. The data revealed that a criteria-based group formation approach, as opposed to a random assigned approach, had more of an impact on student learning outcomes from collaborative assessment tasks than it did on student attitudes towards working in groups for the same tasks. Student attitudes and perceptions supported published reports that socio-cultural factors strongly influence their learning gains in collaborative work.

Effective group formation is not simply deliberate dispersal of students amongst groups. The balance between social and cognitive factors has emerged as important and, in the 2010 iteration of the collaborative task, students have been given the option to select both their group members and the topic that they research. It is evident that through a mixed methods evaluation and the integration of quantitative and qualitative data, greater insights into the role of group function in collaborative learning gains can be revealed.

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