Working in virtual groups: Mimicking the real world when assessing student performance

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Abstract: Electronic communication is proliferating throughout industry and academia. Its use is not limited to communications between individuals. Evolving technologies support and facilitate collaboration where individuals and/or team members work in geographically different locations to their colleagues. The challenges of working in such environments are briefly reported in this paper based on work completed by the authors and others. The impact of such approaches is then explored in the context of the delivery of a course to third year distance learning students in the School of Architecture and Built Environment, University of Newcastle, Australia.

This paper outlines the implementation of assessment strategies for students working in a virtual environment. The assessment strategy adopted uses meeting logs as well as peer and self-assessment to provide a multiple perspective assessment. The assessment regime also provides comprehensive formative feedback to assist student participation as effective group members. It facilitates a clear understanding of student’s teamwork performance as well as the individual contributions they have made to the outcome achieved by the group.

Finally the paper reports on a student evaluation of virtual teamwork. Student reaction to virtual teamwork was generally positive, and several benefits and challenges were identified.

Keywords: Groupwork, assessment, evaluation.

Introduction

The successful adoption of technology and its effective application is often reliant on individual’s core or personal skills as much as on their technological competencies. The range of applications which facilitate virtual collaboration highlights the need for effective core skills. Within a pedagogic environment, it is also important to create a research/teaching nexus where research outcomes inform what is done in the “classroom” in both content and the way it may be delivered.

Set within this context, this paper explores the delivery of an industry-focussed course to a cohort of distance learning Construction Management students. The paper briefly describes
the requirements of our accrediting bodies, and the needs for our students to develop core skills, such as communication and teamwork. These requirements draw on investigations we and others have conducted into communication in virtual teams as part of a Co-operative Research Centre for Construction Innovation (CRC CI) funded project. The implementation and assessment of both face to face and distance learning teamwork within the course are also discussed. Finally, the results of a student evaluation of virtual teamwork are presented.

**Professional Accreditation**

Accreditation bodies are at one with many Universities in recognising the need for graduates to possess a range of generic attributes. Some of those required by professional institutions include communication and collaboration. For example, Engineers Australia requires graduates to demonstrate:

- an ability to communicate with engineering, the team and the community at large; and
- an ability to function as an individual and as a team leader and member of a multi-disciplinary and multi-cultural team (Engineers Australia Accreditation Board, 2005)

Similarly the Chartered Institute of Building requires that graduates:

- demonstrate communication skills;
- demonstrate IT skills; and
- demonstrate the ability to work with others (Chartered Institute of Building Accreditation Panel, 2005)

Opportunities to develop communication and collaboration skills exist in team based industry projects. The course in question requires students to work in teams to prepare an estimate, tender, tender construction program and cashflow forecast for a construction project. Teamwork is inherent in these activities because the volume of work involved is considerable. Furthermore, in an industrial setting these tasks are frequently completed by teams. Having students complete teamwork projects such as this is not new. What is novel is providing these opportunities to distance learning students.

The complexities of merging virtual teamwork strategies into curricula remain largely unexplored in the Construction Management discipline. Literature provides an understanding of the protocols followed within groups when members interact face to face (Riedlinger, et al. 2004; Lurey, & Raisinghani, 2001.; Salas, et al. 2000).

Embedding activities with supporting assessment frameworks has not had a long history and requires further development and evaluation. The hesitancy to embed assessment strategies into curricula has been due to concerns about equity and the ability to discriminate between the students’ performance in a team context. The question of rewarding a non-performing team member has always been a concern.

**Effective Collaboration**

The strategies implemented in this teaching activity are founded in research undertaken as part of a CRC CI project entitled “Team Collaboration in High Bandwidth Environments” (Bellamy, Williams, Sher, Sherratt and Gameson (2005)). This research explored recent developments in networked three-dimensional virtual worlds, as well as high bandwidth
communications technologies, which have the potential to dramatically improve collaboration in the construction industry. The aim of this project was to investigate the generic skills used by individuals and teams when engaging with these technologies. The outcomes of the research project identified the generic skills which support collaboration as:

1. **Leadership**
   Leadership is important because it decides the balance of relevant skills and contributions required from team members. Team leader(s) need to be able to create teams which identify the important ‘social links’ between team members (Baird et al, 2000).

2. **Co-ordination**
   Co-ordination and structuring skills are required for team members to work collaboratively in a virtual medium (Lahti, et al., 2004).

3. **Feedback**
   Abilities to provide feedback are important skills for team members. This is crucial because large amounts of information need to be validated (Baird et al, 2000).

4. **Interpersonal Relationships**
   The way in which team members collaborate can impact on a team’s ability to form a satisfactory product. In addition, social collaboration appears to play an important part especially when researching and determining limitations.

5. **Team skills**
   Trust is not easily created in a computer-mediated environment, especially when team members have no prior experience with others. The commitment of others fosters trust, but this trust may not reach its highest level until the end of a task (Jarvenpaa and Liedner, 1998).

6. **Communication**
   Virtual communication presents challenges. A number of factors constrain these interactions, for example:
   - A lack of visual cues (such as facial expressions) as well as a lack of auditory input (where intonation, e.g. sarcasm, might influence understanding). Even when visual cues are used (e.g. using video conferences or web cameras) team members’ abilities to communicate using non-verbal interactions (such as body language) can be inhibited (Hoyt 2000).
   - Technology does present some advantages when communicating over distance as they often allow more focused and concise information exchange between team members (Gabriel and Maher, 1999; Maher et al 2000), and assist team members keeping to their task (Cleland and Ireland, 2002).
   - In addition Baird et al’s (2000) found that the virtual environment may not foster skills such as feedback. Furthermore, Williams and Cowdroy (2002) note that communication is easier if team members have previously worked together.
   - Synchronicity is also an issue as virtual teams can operate in both synchronous and asynchronous environments. For example, virtual team members may interact in real time (i.e. via video conferencing and web chat programs), or through email or electronic bulletin boards (where there are delays between sending and receiving communications) (Maher, Simoff and Cicognani, 2000).
   - One of the major objectives of our CRC CI project was to determine whether the communication techniques used in co-located settings work effectively and efficiently in virtual settings. Research has shown that teleconferences may result in
fewer social interactions between team members (Gabriel and Maher 1999) as well as difficulties in sharing visual information (Gabriel and Maher 1999; May and Carter 2001; Poltrock and Engelbeck 1999).

Successful collaboration relies on the abovementioned skills and we embedded appropriate learning outcomes into our “Construction Integrated Project” to allow students to develop them.

The Construction Integrated Project

This section describes a course delivered to third year students. It is completed on a project basis with students working in groups simulating construction companies. On-campus students work face-to-face, whilst distance learners work virtually. Each group aims to win a tender for the completion of a building in competition with other groups. Submitting the lowest bid does not necessarily result in the highest marks being awarded. Other factors are also considered, such as the level of detail which students have worked to, commercial acumen, originality and teamwork. This mirrors recommended industrial practice, which advocates that projects are not awarded on price alone. Rivalry between groups is generally intense. This course allows students to draw on the knowledge, skills and understanding they have accumulated in prior courses, and in their work experience.

Assessing students’ work is a fundamental and pervasive element of teaching and learning, and a potentially powerful means of driving their continuous improvement. Assessment is a complex, multi-faceted process, having the primary purpose of motivating, directing and enhancing student learning. Depending on the circumstances, assessment also serves other purposes, including:

- helping to ensure that educational standards for on-campus and distance learning requirements are appropriate and maintained;
- determining whether course objectives have been achieved;
- allowing certification that program requirements have been completed;
- providing feedback for the improvement of teaching to teachers and teaching units;
- identifying high achievers against preset standards; and
- identifying students in need of additional support.

When assessment is conceived, designed and implemented in a robust manner, it achieves all these purposes. This teaching initiative incorporated approaches that assess not only the product (i.e. the estimated costs for the building project) but the process students engaged to deliver their submission. Inherent in the latter is assessment of teamwork.

Considerations for assessing groups

Group assessment may be used for a variety of purposes, for example: as a process for teaching interactive working techniques, for enhancing students' understanding of course content, for improving access to scarce resources and as a method of collective assessment. To ensure the outcomes of group assessments are equitable and credible, one or more of the following mechanisms for allocating marks are recommended:

- **Shared Group Mark** - A group submits one assessment item and where it is impossible to make a distinction between the efforts of individuals, all group members
receive the same mark. A proportion of the mark is also allocated for an individual's group planning papers or an individual paper analysing the group process.

- **Group Contracts** - A group assessment item may have a number of distinct components, and in this instance group members develop a contract between themselves specifying the component for which they are responsible. Marks may be awarded for each separate component or for the project as a whole. The group allocates, within the confines of the overall mark, individual marks on the basis of each members' contribution.

- **Peer Assessment of Contributions** - Criteria are established for the key competencies students are expected to demonstrate. The assessment item is marked according to these criteria and then, within the confines of that mark, group members are asked to determine the relative contributions of each member and allocate marks to individuals. Evaluation of the group process, via discussions between teaching staff and students, ensues on:
  - the distribution of work among group members,
  - the way members of the group interacted
  - the use of resources

- **Individual Marks** - Group activities may be set as assessment items for which each member submits an individual response, and receives unique marks. To assess each individual's contributions, marks may also be assigned on the basis of a viva or a set of examination questions on the content and process associated with the assessment item.

### The assessment process adopted

Assessment was conducted by students themselves, their peers and their lecturers. Each student assessed themselves and the other students within their team on defined criteria (see Table 1). The five key skills associated with team participation were assessed. The methodology developed to support students in the evaluation of both their own and their peers was informed by the methodologies proposed by Habshaw (in Gibbs, 1995) involving:

- Detailed instruction and discussion of the process prior to implementation.
- Process should be trialled before full implementation.
- The topic chosen for study should be new to all students in the group as to remove any notion of advantage.
- There should be no free choice for individuals allowed within the topic, the outcomes should be specific.

The assessment approach selected conforms to our University’s requirements for administering group projects. In particular, the relevant University policy (2006) states that lecturers should ensure that “the contributions of individual group members are taken into account in final marks for the group assessment”. Furthermore, when students assess their peers, the policy requires staff to “provide mechanisms that increase the likelihood that students are able to judge by the same criteria”.

This approach has been used since 2004 with distance learning students. Whilst a similar approach has been used to assess on-campus students, no data for these cohorts are available.

### Setting up team work environments

Team working skills do not develop simply with the formation of students groups and letting them perform group assignment. Team work learning environments need to be well designed, implemented, managed and evaluated. The methodology employed to measure teamwork
effectiveness was piloted in a first year Construction Management course (Williams and Gajendran (2004)). Peer assessment ratings (see Table 1) were required from each student. In addition, meeting logs were maintained using a log template and documented the activities and decisions made by the team. The log was submitted at the end of the course and provided evidence and validation of students’ performance of tasks as well as proof of the methodology applied by the group. The log assessment also provided a basis for student feedback. These assessment components were used to evaluate the group process. With this multiple perspective assessment approach it is possible to clearly identify the performance of an individual as well as providing confidence for the students that there is a system in place which supports the evaluation of their individual performance. The process also provides a framework which is consistent with an industrial context.

The product of the student’s work was also assessed. A significant part of the assessment, as defined in the assessment component weighting, was based on presentation of a final group report and to a lesser extent, on student learning journals. The report provided evidence of critical thinking, problem evaluation and solution, research and evaluation of the literature.

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1. **Participation in group meetings/discussion**: Ideally a student should participate in and contribute to group discussions. The contributions should reflect a familiarity with the issues at hand and be thoughtful and constructive.

2. **Degree of preparation for group meetings/discussions**: Ideally a student should have prepared for the group discussion by reading around the area for discussion in addition to their allotted task. They should be keeping abreast of where the group is in terms of discussion and direction.

3. **Fulfils responsibilities allocated at group meetings**: Ideally a student should responsibly fulfil any tasks assigned at group meetings and report on this activity at the next group meeting or date assigned by the group.

4. **Communicates well with the group**: Ideally a student should communicate their thoughts and ideas in a clear concise scientific manner. Communication can also take the form of diagrams small presentations handouts use of the white board or other aids.

5. **Makes a positive contribution to the group dynamics**: Ideally a student should contribute to the harmony of the group. They should encourage an atmosphere of intelligent discussion where all points of view are heard. They should not dominate the discussions or be argumentative; nor should they overly sidetrack the group by injecting issues not directly relevant to the task in hand.

**Table 1: Self / peer assessment of teamworking skills**

**Evaluation**
An on-line evaluation of teamwork was conducted for Semester One, 2006. Students were asked to respond to statements by selecting a response on a Likert scale. The sample size was small, with 14 out of a class of 18 students responding. Whilst the number of students polled is modest, some of the results provide strong indicators of preferences and challenges.

- 78% of students agreed / strongly agreed with the statement “I learned more about estimating, tendering and cost control by working in a group than I would have done by myself”.
- Students were ambivalent about the disruptions caused by working in virtual teams as 43% agreed / strongly agreed with the statement “Working in a group with other distance learning students created problems which disrupted my learning”.
- Similar reactions were made to the statement “Our team found it difficult to work together because we were not able to meet face to face” with 64% of students disagreeing / strongly disagreeing.
- Students overwhelmingly agreed with the statement “Team members shared a common understanding of what was required” as everyone agreed / strongly agreed.
- Students were divided about how formalised their working procedures were. 43% agreed with the statement “Our team did not have fixed procedures for working together - we made them up as our work progressed” whilst 57% disagreed / strongly disagreed.
- Students felt strongly that the course had developed their virtual teamworking skills. 93% agreed / strongly agreed with the statement “The course helped me to develop virtual teamworking skills (e.g. computer usage, e-communication)”. 
- Students were able to develop trust in others they had not worked with before. 71% disagreed / strongly disagreed with the statement “Working in a virtual team made it difficult for me to develop trust in my team-mates”.
- Students were unsure about the impact geographic location had on their team. 47% agreed / strongly agreed with the statement “Managing our team’s activities was made more difficult because we could not physically meet each other”.
- Overwhelmingly students agreed with the statement “The teamwork tasks (logs and self / peer assessments) encouraged collaborative learning”. 93% agreed / strongly agreed with this statement.
- Similarly students agreed with the statement “The learning challenges were suited to collaborative learning” with 93% agreeing / strongly agreeing with this statement.
- All students agreed / strongly agreed with the statement “The (course) tasks encouraged real-life application of knowledge and skills”.
- 86% of students found the way in which BlackBoard (the Internet based learning management system used by our University) allowed them to share information with fellow group members was useful / most useful.

Students were also asked open-ended questions. When asked to identify what was most valuable about the course, 64% of the students identified various aspects of teamwork. Their comments include:

- The most valuable thing is what can be achieved when ideas, experiences of several individuals can be put together to solve a problem (and) achieve positive results / solutions.
• Having the opportunity to work in a team situation with a helpful communication tool such as Blackboard. It was great to see how other students approach different aspects of university life and work.
• Learning to program activities and distribute activities between team members. Understanding how different people perceive the problem and how they think it should be responded to.
• Working in a virtual team was beneficial. Practicing communication and working in a group type environment was totally beneficial. It gave me an idea how other people are actually working in this course, how much drive they have and the level of work they are submitting.
• The most valuable thing for me about this course was being able to get other people's opinions and ideas, bouncing stuff off each other, getting support from team mates and generally feeling like you weren't working on your own as opposed to other (courses) where you submit an assignment on your own.
• Teamskills e-teams building / communicating across the Asia / Pacific region.
• Learning how to work in a group that was unable to meet face to face was a big challenge as we all lived in different areas and we all had different ideas and opinions, but we managed to solve all the problems together after evaluating the issues as a group. I also learnt how to make more use of communication tools such as emails and Blackboard that I had previously only used several times and found the group discussion board and file exchange the best way to communicate to team-mates.
• Creating the logs, as a form of producing the meeting minutes for our telephone hook-ups over the phone… led us to formulating a team directive that gave all members direction on what they were responsible for and when we wanted to achieve these goals.
• Gaining different ideas and approaches from the group members, experience in high rise buildings.

Concluding comments

The ever-increasing usage of electronic communication is impacting on industry and education. The new medium imposes risks and opportunities that practitioners need to be aware of. From a pedagogic perspective, there are lessons to be learned from research of industrial practice. It is an imperative to create a research / teaching nexus and implement research outcomes into “classrooms”. This not only adopts current best practice but also introduces students to environments that reflect the world of work. Moreover, such experiences also provide them with and appreciation of the role of and the relationship of research to the world of work.

Effective delivery of distance learning courses which incorporate virtual teamwork are challenging to devise, implement and manage. The “Construction Integrated Project” achieved these in an effective way by adopting strategies that were readily accessible to students and, in addition, emulated current industry practices. It became apparent that students did at times find virtual collaboration testing in much the same way as industry practitioners do. It was interesting to note that students recognised the importance of the skills involved in collaborative participation. What became apparent was that they valued highly the opportunities that this project presented for their learning.

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