Instructor's considerations for assessing individual students' learning in team-based coursework

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***Abstract**: The effective assessment of individual students' learning in team-based coursework is a complex process which may not be fully understood by academic practitioners, much less mastered. To help bring greater understanding to this pedagogical challenge, this research team developed an ALTC-funded project to investigate current assessment practices in the team-based context and to derive an effective assessment framework. This paper reports the current results of the ongoing data analysis, and includes a discussion of their import: for academic staff offering team-based subjects as well as those interested more generally in the assessment of student learning.*

Background on the Research

The effective assessment of individual students' learning in team-based coursework is a complex process which may not be fully understood by academic practitioners, much less mastered (Waters and McCracken, 1997). In 2009, an international team of educational researchers received an ALTC grant to 1) investigate current practices related to the assessment of individual students' learning in team-based engineering learning environments and 2) design and evaluate an assessment framework for team-based courses which better meets the needs of students and academic staff alike (Author, 2010).

To investigate current assessment practices in engineering team-based coursework, we collected data from academic staff and students at four Australian universities and one overseas university. Three of these institutions offered engineering coursework with a Project-Based Learning approach (PBL) embedded across the curriculum. Two of these institutions offered stand-alone project courses with engineering students learning in teams for all or part of the course. By collecting data from both contexts, we hoped to generate a set of principles that would support the development of an assessment framework that would be feasible and relevant across multiple engineering education settings.

Working within the Design Research paradigm, initial stages of data collection need only flesh out the research context while pointing the way toward the design of an education intervention – in our case, a framework for assessing individual students' learning in team-based courses. Edelson (2007) speaks about the importance of allowing ambiguity to be present during the initial design phases:

> "(T)he design researchers begin with a set of hypotheses and principles that they use to guide a design process. Importantly, these hypotheses and principles are not detailed enough to determine every design decision. In addition, these guiding principles are not followed slavishly if accumulated evidence, specific circumstances, or informed intuition lead the designers to believe they do not apply. In this way, the design researchers proceed through iterative cycles of design and implementation, using each implementation as an opportunity to collect data to inform subsequent design." (p. 106)

Our approach for the elicitation of information to guide the design and development of educational interventions is founded in a constructivist paradigm (Lincoln, 2001) where we sought to build a

holistic perspective of participant's considerations and issues rather than a quantified perspective that sought to represent the considerations of the larger engineering academy teaching in the same context. These considerations and issues would then be used in aid of developing an assessment framework for this learning context.

To this end, we performed open-ended interviews with a total of 26 instructors across the five member institutions. These interviews focused on staff's personal perspectives on assessment in general, their use of assessment in team-based project courses, and typical challenges they faced when assessing individual learning in the team-based learning environment. After these interviews were transcribed, the project officer on the research team conducted a thematic analysis (Boyatzis, 1998) of the transcripts using NVIVO, a qualitative analysis software application.

Findings

The following 14 themes emerged from the analysis of interviews with our participants and briefly describe the considerations they reported as related to their assessment processes. While some readers might be looking for frequency (number of comments or number of participants) within these considerations as an indicator of relative importance, it is important to note that this data collection activity was intended instead to gather a wide range of perspectives on assessment in team-based coursework.

The preliminary consideration themes listed below fall into three basic categories. **Content Considerations** describe general types of learning that the participants sought to assess. **Process Considerations** describe participants' considerations regarding challenging aspects of the assessment process. **Contextual Considerations** include elements that participants describe as external to the assessment process which they experience as adding to the challenge of assessment. Taken together, these preliminary themes begin to build a picture of the innate complexity of the assessment process for individual students' learning in team-based courses.

Content Considerations

Assessing technical knowledge and skills. Team-based project courses offer an important opportunity to combine both technical and professional knowledge and skills within a single integrated learning environment. In terms of assessing technical knowledge, participants reported that written examinations were often seen as the exemplar method of assessment, although some participants also reviewed workbooks and reflective journals. Oral examinations were reported as offering a more fine-tuned opportunity to explore the strengths and limits of a student's technical knowledge.

Assessing professional knowledge and skills. In addition to technical knowledge and skills, participants reported taking professional knowledge and skills into consideration, such as teamwork, working with clients, and the ability to facilitate interactive presentations. Participants sought evidence of student professionalism in their documentation, presentations, by oral examination, and by direct observation of team interactions.

Assessing broad understanding. Student teams often break complex projects into subsections, with an individual student focusing on a single section. While there are many benefits to this approach, one obvious downside is that students may lack a holistic perspective and do not engage substantively with other aspects of the project which are vital to their overall learning. The term "broad understanding" here refers to an individual student's learning in the areas of the project outside of where they themselves have focused on.

Participants reported that the assessment process was a prime "carrot" that can motivate students to build broad understanding in team-based project courses. Participants reported instilling expectations for broad understanding from the beginning of the course and using oral exams at the end of term to explore the multiple areas of a single project. It is important to note that while broad understanding was seen as important by participants, when pressed these participants were sometimes unable to describe concrete standards by which it could or should be measured.

Participants also reported that assessing for broad understanding was an effective way to identify "passenger" students (who have minimal input or engagement with the team project and rely on the other team members to complete it.)

Assessing design thinking. For the purposes of this paper, design thinking is being defined as the chain of reasoning within individuals and team which leads from problem identification to solution development and evaluation. Participants in this research project sought to assess students' design thinking 1) as a key engineering skill, 2) as a method for assessing multiple competencies including technical knowledge and skills, teamwork, and broad understanding, and 3) as a method for identifying passenger students (who would fairly poorly when asked to describe the rationale for design-related decisions.)

Participants reported that written evidence (such as a report or a written exam) was limited in its ability to reveal design thinking, with reflective journals offering at best a limited perspective. Several participants used oral examinations to explore and assess design thinking, often with an emphasis on decision points in the design process.

Process Considerations

Determining individual contributions to team products. Participants in this study frequently described a need to determine which students worked on particular aspects of a team product such as a report or a presentation. This was seen as an important aspect of assessing individual students' learning. In addition, participants framed this need in terms of "fairness for students," referring to it as a method for identifying passenger students.

To better determine individual students' contributions to team products, participants variously reported doing the following: direct observation of teams, supervisory meetings with teams, requiring explicit attribution in presentations and documents, requiring the submission of team meeting minutes, and creating "milestone" assignments throughout the term that can be for both individual students and their teams.

Assessing a team's dynamics and the impact on individual students' learning. Participants in this study recognized that the quality of team interaction could have a significant impact on individual student learning. To better understand team "health", participants used direct observation, observation in supervisory meetings, and peer assessment to look for positive team interaction as well as power imbalances and significant differences in contribution.

Assessing international students. Participants expressed concerns about assessing international students within their courses in terms of varying levels of English language skill, possibly mismatched expectations about classroom behaviour, the need for local knowledge (i.e., Australian standards), and prior experience with hands-on labs. Participants varied in their response to these concerns, ranging from instructors holding international students to less rigorous standards to instructors expecting international students to demonstrate knowledge and skills at equal level with domestic students. Many participants talking about this consideration, however, simply described the situation as "difficult" without articulating how they themselves responded to it.

Use of formative assessment opportunities. Many participants in this project recognized that formative assessment opportunities offered at strategic points across the term were necessary to keep teams "on track" toward the completion of the team project with its embedded learning goals. Formative assessment opportunities included reports (such as design briefs or requirements reports), shorter written assignments (such as status reports) and presentations. A few participants used only summative assessment measures which were implemented at the end of term, suggesting that they repeatedly offered students and teams formative guidance throughout the term.

Assessing against learning outcomes/objectives. Participants varied widely in their experience of and engagement with assessing against learning outcomes, with some participants implying that the course learning outcomes were tangential to their teaching practices, including assessment. When discussing learning outcomes, participants also described some frustration with learning outcomes

about professional skills, with these instructors suggesting that there was a "mandate" to focus on the technical aspects of the course.

In addition, participants reported uncertainty about their own interpretation of the learning outcomes, suggesting that taking a team teaching approach can create opportunities for instructors to refine their understandings of the learning outcomes through discussion with team-mates.

Balancing teaching and assessment. Several participants used language suggesting that teaching practices were separate from assessment practices. These participants reported that time spent on assessment was taking away from the time they could be delivering course content.

Contextual Considerations

Number of students in course. Participants spoke about the relationship between course enrolment and quality of assessment, suggesting that larger student numbers lead to both a decrease in the number of opportunities for students to present evidence of their learning and a decrease in the sophistication of the feedback being offered to students. In some cases, team interaction was seen as a corrective factor with the belief that team members can offer each other important and useful feedback in an ongoing manner across the term.

Number of academic staff involved in delivering a course. Those participants who delivered their courses as part of a teaching team report two considerations in terms of assessment in team-based courses. One consideration was variability among team members in terms of experience with and understanding of the assessment practices within the course. Where variability is great, the need to train the teaching team added to the overall workload for the course. Another consideration reported was variability in the interpretation of student evidence within the teaching team. This consideration again speaks to one difficulty in outcomes-based teaching in the teaching team context: building a shared understanding of 1) the learning outcomes themselves and 2) what counts as student evidence for mastering a particular outcome.

Familiarity with team-based pedagogies. This project included participants who taught in dedicated team-based programs using Project Based Learning (PBL) as well as participants who employed team-based formats within a more traditional lecture-based curriculum. Some participants in this project were relatively new to teaching team-based courses while others were mentoring instructors who were new to this teaching context. In both cases, participants spoke of limitations related to inexperience with the team-based context on assessment quality.

Familiarity with course. Similarly, participants reported that relative inexperience with a course could affect the design and implementation of assessment items as well as interpretation of the resulting evidence.

Conclusions and Next Steps

These preliminary findings illustrate the complexity of the assessment process for engineering instructors in the team-based setting: multiple types of learning to be assessed, often limited understanding of both the assessment process and the team-based learning environment, and contextual considerations that affect participants' ability to engage in the assessment of student learning in team-based coursework.

These findings served as an important foundation for building our conceptual model by identifying areas where instructors may lack knowledge or experience in terms of assessment, identifying their beliefs about assessment and its role in the teaching process, and identifying areas for improvement in these participants' approach to outcomes-based teaching.

Currently we have constructed our conceptual model, used that model to create a set of assessment practices we are calling a strategic assessment framework, and we are piloting our strategic assessment framework with engineering educators at the four Australian universities in this research project. We gathered information from professionals working in the actual target context at the beginning of the process, and now we are again gathering information from academic staff as they implement the

assessment framework in the engineering classroom, helping to provide "real world" grounding for this research project.

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