

The importance of narrative: helping students make sense of what they're learning

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BACKGROUND

The Flipped Classroom (FC) pedagogy is firmly based on active learning that has long been recognised as being conducive to deeper learning with well-documented increases in student learning outcomes (Hake 1998). Now that the Khan Academy, EdX and Coursera have established the use of online technology to deliver content, this delivery method can be used to reimagine engineering education. At The University of Queensland (UQ) in 2012, a compulsory project-based first-year course was flipped (Reidsema et al. 2014) in response to the need to integrate theory and practice, drive deeper conceptual understanding of engineering fundamentals (Prince 2004), and to actively engage a large (N = 1100) cohort.

The course achieved mixed success: course evaluation showed that whilst students were intellectually stimulated and learnt a lot, they believed the course was not well structured and that details had not been made clear to them. In actual fact, the course was highly organised and had been based on considerable work that mapped the various concepts, embedded authenticity in terms of projects and assessment, and prioritised active learning. However, analysis of students' anonymous comments showed that they had struggled not only with owning their learning, as would be expected from students engaging with their first experience of a flipped class, but also with making sense of content in terms of its relevance and connection with the course objectives. It was determined that developing a course narrative with the students could translate into improvements in their perceptions of both poor organisation and unclear course goals.

PURPOSE

Analysis of the 2012 student responses clearly showed the need for a course intervention that:

- provided relevance to the online content;
- helped students make sense of the content 'modules'; and
- in keeping with the course teaching paradigm, achieved the above using FC techniques.

DESIGN/METHOD

In 2013, a series of workshops that hinged on active collaborative learning were embedded across the first ten weeks of semester. These workshops were designed to help students make sense of what they were learning in the context of Project Based Learning (PrjBL) and provided a narrative that worked on many levels: course content, teamwork, project management etc.

External, independent observations were made during the semester, and this in conjunction with the formal institutional course evaluation implemented at the end of semester were analysed to see if students still had troubles with the relevance of content, and the organisation of the course.

RESULTS

There was a significant positive change in terms of students' perceptions of course organisation: from 2.16 to 2.87 on a 5-point scale. Similarly there was a positive change in the rating given to the clarity of course details: 2.79 to 3.29. In addition, observation of the workshops and analysis of open-ended comments concerning the course showed that students had constructed their own narrative and thus managed to make sense of what they were learning. As course content, content delivery, and assessment were not changed, these findings can be attributed to the introduction of the workshops.

CONCLUSIONS

FC design must address the development of narrative to allow students to make sense of what they are learning. With the correct design and the incorporation of the student voice, students can be facilitated towards a shared co-construction of the narrative and this is in keeping with the ownership of learning necessary for effective FC pedagogies.

KEYWORDS Flipped Classroom, Collaborative Learning, Ownership Of Learning

Introduction

It is internationally recognised that technology is enabling us to change the way we deliver education and that this change is accelerating. The advent of the Khan Academy, EdX, and Coursera have set the pace of these new technologies to great acclaim and success in the provision of Massive Open Online Courses (MOOCs). Our top students now use MOOCs in addition to, or as a substitute for, the resources that we supply. This has put increasing pressure on higher education institutions to address the value proposition for on-campus tuition. In the words of the Vice Chancellor of Deakin University, “[institutions] will be left behind unless they embed the opportunities of the Internet in their culture and in the way they enhance student experience.” (Anon 2013)

The Flipped Classroom (FC) approach is one response to this challenge. It replaces the traditional lecture with collaborative active learning on campus and students access the content that would have been delivered by the lecture, online in their own time and space. The lecturer becomes facilitator and the student becomes the owner of their learning and the learning process. This process has been shown to be conducive to deeper learning (Brown 2012) and higher engagement (Reidsema et al. 2012) but there is an important aspect of the traditional lecture that can easily get lost in this approach: that of the narrative. A narrative in this context can be simply defined as the story that allows the student the opportunity to identify with the course and its learning objectives in some way. It is a structure of representation consisting of a mix of meaningful elements threaded together in sequence (Eng et al. 2008) and is essential in establishing a shared understanding with students on what is relevant and consequently fundamental to achieving the intended course learning objectives. Narrative is based squarely on a constructivist theory requiring the negotiation of meaning; without this students can easily get overwhelmed by the new FC model with demands that they construct their learning from online materials prior to arriving on campus. Within the traditional lecture-based curriculum, the lecturer orchestrates continuity between modules/ topics and in doing so can narrate the students’ passage through learning objectives, connecting them in such a way that relevance (and to some extent the scope of work) is clearer. This may not be as easily achievable by a facilitator whose role may be narrower and primarily concerned with helping learners deepen their understanding of the online content within a much wider set of course learning objectives. Different types of learning activities carried out in disparate settings, can easily seem incoherent to a student.

This paper describes the evaluation of an initial attempt at flipping a large (1100 student) first year compulsory course where the ensuing student response provided an opportunity for an intervention that could best be described as the introduction of a ‘narrative framework’. The comparison of the first iteration of the course where narrative and hence meaning was absent to the second offering of the course is given. It should be noted that the primary aims of this course were not centred on deepening content knowledge but rather on building and developing professional engineering competencies such as integrating theory and practice.

The need for a narrative

The FC is underpinned by collaborative learning and in order for this to occur there must be a learning partnership between students and between students and facilitators. There are a number of principles underpinning successful collaborative learning and the construction of knowledge (Baxter-Magolda 2002). These are:

- a validation of the students’ ability to know;
- situating learning within students’ experience; and
- mutually constructed meaning.

In describing the first principle, Baxter Magolda emphasises a number of aspects including “solicit learner perspectives”, ‘trust their judgement’ and ‘respect their beliefs’. These are important design considerations for constructing project-based learning where students must

refine their understanding of a problem and work towards developing effective solutions. There are also the inquiry-based learning aspects that are inherent in putting pre-learning up online that requires additional cognitive effort from students who tend not to have very well developed scoping skills or critical judgment for evaluating their learning. This principle of validating a student's ability to know is something that is already implemented in most engineering curriculums and in the context of a FC that requires students to work collaboratively without requiring explicit direction from an academic.

The second principle is well established: learning new knowledge requires a meaningful and clear connection to old knowledge. This resonates with situated cognition that holds that "meaningful learning takes place in complex authentic situations, not in isolation" (Seely Brown 1989). Therefore students need opportunities to allow the context of a situation to guide their learning and this is where the need for narrative arises. If the various and often disparate delivery mechanisms employed as part of a FC (e.g. on line modules, project-based sessions, workshops, laboratories etc.) are not constructively aligned in a coherent manner that provides a connection both within the course and within the degree program, both learning and relevance may be lost. If the student does not understand the reason for learning nor where they will need the knowledge or skill in either their later studies or career, the tendency can be to compartmentalise the knowledge as a 'one-off' and to forget it as soon as any connected assessment has been completed (Spiro et al. 1992).

The final principle, that meaning is mutually constructed, requires the facilitator to make learning meaningful by entering into the learning process with students. This requirement provides the perfect opportunity for the facilitator to co-construct a narrative to the various learning modules and objectives. However this need must be cognitively understood and the narrative embedded into course delivery. In addition, co-construction will require the students to have a voice and for that voice to be heard and acted upon by the facilitator.

From the viewpoint of the academic, an engineering practice course might be underpinned by the story of the student engineer as a problem solver beginning (or continuing) their journey towards self-efficacy and ownership of learning. The academic will use various elements that include the student voice to co-construct this narrative: workshops, laboratories, teamwork, and online learning tools. If this is done successfully using FC pedagogy, the students' story might be built around, as in this paper, being an engineering design team charged with the model, test, build and demonstration of their designs.

The narrative case study: ENGG1200

Course details

In 2012, a new compulsory first year course, ENGG1200 Engineering Problem Solving and Modelling (Table 1), was implemented in second semester. It was delivered as a FC partly in response to the need to engage a large cohort of 1200 students and partly as a response to the need to integrate theory and practice to drive deeper conceptual understanding of engineering fundamentals (Dori and Belcher 2005, Prince 2004). Lectures were replaced with large (600 students) active learning workshops facilitating the development of design process knowledge through structured collaborative learning. Technical learning outcomes (engineering materials and modelling/ problem solving) were addressed through smaller active and cooperative learning workshops (90 students), aligned to an in-house custom designed video-based online learning system that provided the required pre-learning.

The course provides students with an open-ended design problem that brings together all of the learning objectives and students work in teams to generate both virtual and physical prototype solutions. The delivery details are shown in Table 2.

As per the 'Timing' in Table 2, the course was 'front-ended' with content offered early in semester and the last weeks of semester were devoted to student teamwork with no formal contact sessions.

Table 1 ENGG1200 Overview

Element	
Learning Objectives (Abridged)	<ol style="list-style-type: none"> Materials I: describe atomic/ micro-structural chars of materials; explain elastic modulus/ composite moduli; describe mechanisms for plastic flow in metals/ strength enhanced micro-structure. Materials II: describe/ analyse stress-strain response, determine effect of temperature and time under load, choose materials based on properties. Problem Solving: solve engineering problems using f/work; sketch, define scope; propose model, incl. variables/ constants/ assumptions/ sensitivities. Modelling: Produce flow chart; use Matlab to solve; verify model; validate results; use Creo; create CNC tool path; produce 2D working drawings. Design: Use design thinking/ reflexive practice to plan/ implement/ design. Manufacturing: Use knowledge of manufacturing/ materials to prototype. Communication: build on ENGG1100 lessons; develop writing coherence/ rationale; master graphics, data, and word processing software. Team Work: devise/ implement strategies based on critical personal reflections to improve team performance and fast track team development.
Assessment	<ol style="list-style-type: none"> Online material quizzes (6x) - 10%, individual hurdle submission Problem solving book (6x) - 5%, team submission Reflections (5x) - 15%, individual submission Preliminary memo - 15%, team submission Mid-semester concept exam - 20%, individual hurdle submission Prototype demo - 20%, team submission Final report - 5%, team submission
Learning Activities	Workshops; Online modules; Virtual and physical model development/ demonstration
Curriculum Objectives	Theory-Practice integration Ownership of Learning

Table 2 ENGG1200 implementation details (2012)

Method (Timing)	Session type	Objectives (Table 1)	Resources	Space	Assessment
Small team workshops, 90 (Weeks 1 to 6)	<ol style="list-style-type: none"> Materials lab (1 h/w) PBL w/shop (1 h/w) 	1, 2, 8	Worksheets; Tutors; Lab equipment	Flat floor; round tables; 6 students/ table; computers	End of session tutor marking
Online learning (Weeks 1 to 6)	Online	1, 2	Podcasts, Readings, Quiz Tool	N/A	Weekly quizzes; Mid-term exam
Expert lectures (Weeks 1 to 6)	Lecture	1, 2, 3, 4, 5, 6	Guest lecturers – industry, academia	Lecture theatre	None
Tools: Software (Weeks 7 to 9)	Team-based computer lab sessions	3, 4, 5	Tutors; Creo/ MatLab; worksheets	Computer laboratories	Virtual Model Feasibility Package
Teamwork/ Build/ Test (Weeks 10-13)	Student booked machine shop/ electrical lab	6, 7, 8	Handtools; CNC; Test Rigs	Laboratories; undercover outdoor areas	Demonstration Report

Although ENGG1200 was designed as a FC, in 2012 there were 7 lectures that were scheduled with the intention of providing a narrative arc. Each lecture mapped onto the concepts for the week (Table 1: Learning Objectives); the lecturer began the session trying to 'tell' the students the story and was followed by international research experts or industry practitioners who connected the concepts with real world application examples. The attendance at these lectures quickly deteriorated from 90% in Week 1 to 40% in Week 6. That the students were failing to find relevance in these lectures is highlighted by the fully attended Week 7 lecture, which was devoted to mid-term examination preparation.

The other means that was used to provide a narrative was the Learning Pathway (Figure 1). This was a custom-built system, integrated with the institutional learning management system (Blackboard) to clearly show students what they needed to know and what they needed to do in any particular week, and provide links to online resources and modules.

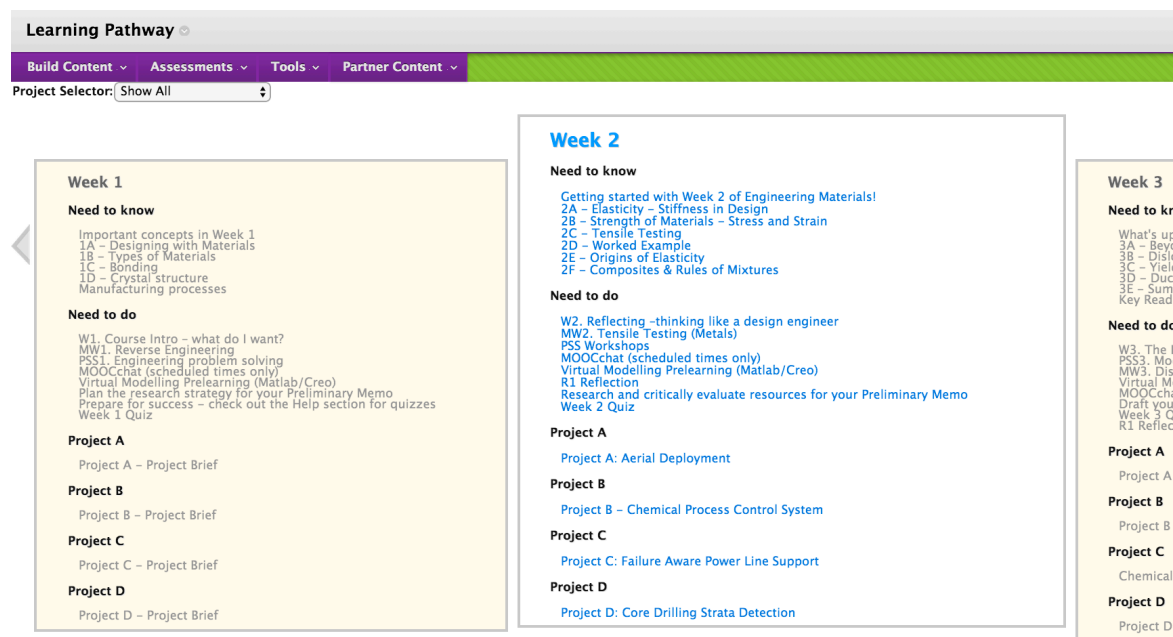


Figure 1 The Learning Pathway

The initial evaluation

In its first year of operation (2012), the course underwent student evaluation using the standard institutional survey instrument (Table 3) that uses a Likert scale where 5 is 'Strongly agree' and 1 is 'Strongly disagree'.

Table 3: Institutional student response survey questions

Item	
1	I had a clear understanding of the aims and goals of the course.
2	The course was intellectually stimulating.
3	The course was well structured.
4	The learning materials assisted me in this course.
5	Assessment requirements were made clear to me.
6	I received helpful feedback on how I was going in the course.
7	I learned a lot in this course.
8	Overall, how would you rate this course?

A significant finding from this evaluation was that there was a mismatch between student expectations and the aims and structure of the course. Students were quite clear that whilst they found the course intellectually stimulating (3.6/5, Q2) and that they learnt a lot (3.5/5, Q7), they found the course to be poorly structured (2.2/5, Q3) and did not have a clear understanding of the aims and goals of the course (3/5, Q1). Question 8 also scored poorly attracting a score of 2.8/5.

Whilst poor scores are often expected the first time a course is run, these scores suggested that somewhere, something had been omitted to the detriment of student satisfaction, and as suggested by the poor attendance at the keynote lectures, student engagement. The result for Q3 could be related to first year student conceptions of learning that align with 'being taught' and having what they need to know clearly stated with resources that are familiar to them laid out and well-structured (Entwistle and Peterson 2004). Their expectation of a 'well-

structured' learning experience are created by prior learning experiences and therefore can be expected to be at odds with the inherent 'ill-structuredness' of the FC.

This failure of this first attempt at constructing a narrative to provide a connection between learning modules and to demonstrate relevance to the students was highlighted in discussions with the students. Students did not perceive the contents of the lectures as relevant to their assessment goals. Those that stayed enjoyed the lectures but they weren't seen as essential to the assessment despite intentionally designing the lectures so that the first part of the period was devoted towards how to successfully complete the reflective writing assessment (worth 15% of the course marks) as well as how to approach the course in order to be successful. Oratory wasn't sufficient. The keynote lectures had not found traction with the students and hence had not communicated the 'ENGG1200 story'.

Therefore although much thought had been given to the course structure, students perceived a poorly organised offering with unconnected learning opportunities and objectives where it appeared that the coordinator had left them to find a pathway through the assessment tasks.

The second iteration

The second iteration of ENGG1200 created more and better opportunities to communicate the narrative of the course including an elaboration of the expectations and rationale of the unfamiliar FC structure. Guest lectures were replaced with a spine of active collaborative workshops running across semester complete with templates, online resources were reorganised to clearly show where students should be up to and to provide easier resource access, and online communication tools were used. These changes are discussed below.

Collaborative workshops

The collaborative workshops effectively replaced the keynote lectures that were run in 2012. They were designed to effect two levels of narrative: providing relevance and continuity to the various learning modules, and that of the meta-level requirements of the FC. They concentrated on the 'design process' as the integrating spine of the story in contrast to the lectures which were based around concept/ content themes: Design thinking, Innovative materials, Simulation, Manufacturing, and Modelling in CAD. Table 4 details the workshop themes and the narrative aims.

Each of the workshops was delivered twice to 600 students at a time and was facilitated by 2 Level D academics and 3 Postgraduate tutors who were also project leaders. No lectures were given in the session (in fact no lectures were given throughout the semester); if content was necessary a 5 to 10 minute podcast was put online and flagged as pre-learning necessary for the session. The students were seated in groups of 9 at round tables and this allowed the session to be active and collaborative as evidenced by the high student: staff ratio. The sessions were well attended with over 90% of students attending throughout semester; this was in distinct contrast to the keynote lectures of 2012. What was evident, and was remarked on by students, was that the massive 600-student workshop had its own attraction as a social networking event.

Templates

Templates were used in the workshops as a tool for focussing discussion and thinking that set the task and required students to draw on their knowledge and experience to complete. They were constructively aligned to major assessment deliverables and ensured that the trigger questions and exercises stimulated and guided learning toward specific outcomes. Their value in underpinning collaborative discussion and meaning making was shown by a photocopying failure one week whereby 25% of students did not receive a template. Even though the exercises could easily have been carried out using a blank sheet of paper, the students without a template did not engage in the session and caused hitherto unseen disruption of the workshop by their failure to collaborate in each of the exercises.

Table 4 Collaborative workshop themes

Week	Theme	Narrative objective
1	Course introduction (Template)	To allow students to work their way through the course in terms of content, assessment and delivery. To get students to cognitively understand that the FC mode requires them to take ownership of their learning.
2	Reflecting – thinking like an engineer (Template)	To familiarise students with reflecting – an individual assessment. To reinforce the ownership of learning requirement.
3	The preliminary memo (Template)	To ensure all team members are aware of the requirements of the preliminary memo – a team submission. To get students to cognitively take charge of the design problem that they need to solve.
4	Design: project specific concepts and issues (Template)	To show how learning objectives are combined in the design problem. To allow students to collaborate on early design solutions and raise any issues early.
5	Matlab or Creo (Template)	To allow students to make an informed choice between modelling behavioural or structural aspects of design. To demonstrate the connection between the two learning objectives.
6	Tracking the project I (Template)	To provide a project management framework. To connect assessment with learning objectives.
9	Team mentoring (Based on a peer assessment)	To provide support to teams that are experiencing dysfunction. To provide technical and time management advice as necessary.
11	Tracking the project II (Template)	To provide a project management framework. To demonstrate how learning objectives have been met and are being utilised.

Templates were handed out at the beginning of each workshop session, collected for assessment (0.5% each), and fundamental to ensuing team activities and/ or assessment. An excerpt from a typical template is shown in Figure 2. This template was used to underpin the preliminary memo, the team-based assessment report that requires amongst other things a design problem scope, and evidence of project management.

Part 1. Beginning to scope the project (Brainstorm as a table)

Overall project goal:

Sub-goal 1	
Sub-goal 2	
Sub-goal 3	
Sub-goal 4	
Sub-goal 5	
Sub-goal 6	

What do we know/ what data have we been given?

What are the assumptions that we need to make?

Figure 2 Template excerpt (Week 3)

Student response to the use of templates has been positive:

- *[templates] get you to think for yourself instead of just mindlessly copying down text from a screen* (Student 2013); and
- *I liked having a workshop where we worked through templates instead of having a lecture because it was more helpful and easier to concentrate.* (Student 2013).

Online tools for communication

In keeping with FC pedagogy, the course narrative should be co-constructed. To facilitate this, and to allow for the student voice to be heard and acted on, more opportunities for discussion/ collaboration were created, including:

- an ENGG1200 Facebook page that was joined by 65% of students and that fostered discussions between academics, tutors and students;
- a slew of short (5 minute) YouTube tutorials created by course staff whenever they identified a need and dubbed 'ENGG1200 TV'; and
- a Q&A tool specifically created to replace the unwieldy Blackboard discussion page with a user-friendly site based on Reddit and Stack Overflow (<http://stackoverflow.com>).

The second evaluation

Figure 2 compares the results for 2012 with those from 2013 based on the standard institutional course evaluation survey questions (Table 3). For nearly all of the questions, 2013 shows a significant improvement, but it is obvious that the challenge of how best to communicate the course rationale in ways that make sense to students has not been completely addressed.

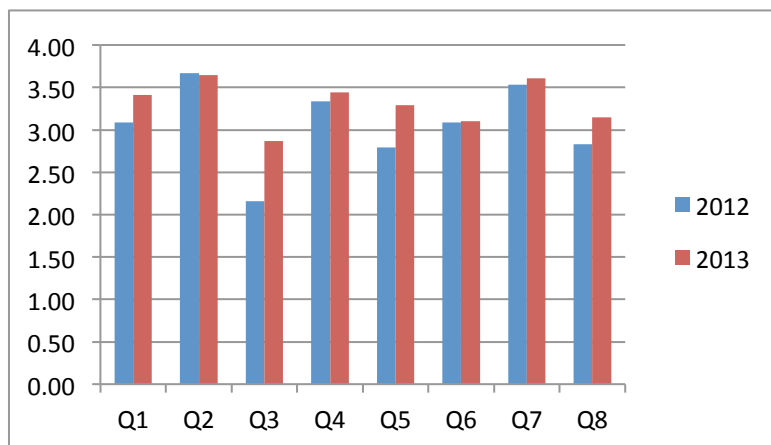


Figure 3: Evaluation of ENGG1200, 2012 and 2013

Q3 shows the largest difference between years and this suggests that the effort to include a narrative that linked learning objectives and gave a meta-level view of the requirements of the FC was successful. This was also seen in the comments an open-ended question on the survey that asked 'What did you most like about this course?':

The "own your learning" concepts I've found to be invaluable even at the early stage of university, and working with other students in a group. (Student survey response, 2013)

[ENGG1200] really makes you push yourself to be organised and keep on top of everything that needs to be done. This really does wonders to advancing your own personal responsibility, especially when you couple this personal responsibility with the responsibility you have to your team. (Student survey response, 2013)

Another open-ended question asked students to make suggestions about what needs to be improved in the course. Evaluation of this feedback showed an appeal for clearer information about what students needed to learn pointing to the fact that the meta-level narrative had been heard but that more effort was required in linking learning objectives:

I understand the importance of doing self-learning and I know that I am responsible enough to do this so I do not feel that it was my own self-discipline that was the problem. I believe that the course could have been structured better to help students to learn materials. ... someone needs to be able to clearly highlight what we need to learn, tie it all together in a structured way ... (Student survey response, 2013).

Conclusions and Recommendations

An opportunity for the co-construction of a narrative linking learning objectives, assessment and pedagogy was embedded in a FC. It comprised a series of collaborative workshops with templates to guide discussion, and online tools, that allowed for the student voice for better communication between facilitators and students. Evaluation showed that inclusion of a narrative improved both relevance and meaning for students in terms of the course objectives and the FC objective of ownership of learning.

Providing a narrative may not be something that is immediately recognised as fundamental to a FC but if it is not addressed, students may have trouble achieving learning outcomes.

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