The Learning Pathway: Online Navigational Support for Students within the Structured Flipped Classroom

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CONTEXT

First Year higher education marks a stepping stone in student development; many students struggle with the transition to an environment that expects them to take responsibility for their own learning, moving from externally-regulated learning (teacher centric) to self-regulated learning (Vermunt 1988). While this challenge is nothing new, it is a significant adjustment that students are required to make even within traditional didactic teaching-focused curriculums (Entwistle and Peterson 2004). What is exacerbating this challenge for students is the increasing institutional shift towards a more learning-centric curriculum as epitomised by the Flipped Classroom (FC). In the FC, students are provided with online pre-learning activities, such as podcasts, readings, and quizzes that must be completed before attending class. Students have to take responsibility for their learning at the macro- (degree program) and micro- (course) levels. To further increase this level of disorientation for First Year Engineering students, the FC method was applied to a large (1200+ student) team-based multidisciplinary design course that integrated both fundamental engineering materials and structured problem solving knowledge (theory) with open ended hands-on design and build projects (practice).

PURPOSE

The “Learning Pathway” (LP), a structured online navigational interface (Stevens et al. 2008), was designed and implemented to provide students with a clear cognitive visual pathway through the FC. It was designed as a graphical course outline, structured into two primary navigational markers representing “What you need to Know” and “What you need to Do” that aimed to bridge the gap between the online and face-to face environment. The information was displayed in manageable (weekly) chunks in the context of both course learning and assessment activities as well as the design phase of their project (McAlpine et al. 2006). This intervention significantly increased the utilisation of the Blackboard Learning Management System (LMS): the LMS hits per enrolment were more than double that of any other course within the institution. This engagement with the LMS has been taken as an early indicator of success: students who are accessing the LMS are engaging with online material. Institutional formal course evaluations also markedly improved in the areas targeted: student perception of course structure (+33%) and clarity of assessment requirements (+18%).

DESIGN/METHOD

The research into the efficacy of the LP as a Learning Analytics Integration Platform and navigational aid for students, pools expertise from six US and Australian universities. The data includes that from surveys, focus group interviews, formal institutional evaluations and a study of the Blackboard Analytics™ suite of applications. It is being used to understand the ways in which students interact with online resources, self-regulate their learning, and to improve the LP.

RESULTS

The LP is being developed to provide students with an individually-tailored digital map for planning and tracking their learning trajectories. These maps will make student engagement and learning progress visible to both academics and students. As it currently stands the LP indicates to students what they need to know and what they need to do, the next implementation will include ‘How am I going’. This will allow students to track own progress within a course or program, benchmark their progress against peers, and monitor their progress relative to instructor expectations.

CONCLUSIONS

A carefully designed online environment that integrates learning analytics data from multiple sources in a simple, graphical meta-level representation of learning (What you need to know; What you need to do and How am I going?) supports the development of student self-regulation of learning within complex “authentic” FC courses.

KEYWORDS

Learning pathway, Flipped Classroom, First Year, Design

Introduction

First Year higher education marks a stepping stone in student development and many students who come directly from high school struggle with the transition to this new environment which expects and requires them to take responsibility for their own learning (Hillman 2005; McInnes 2001; Trotter & Roberts 2007; Williams 1982). The major challenge for these students is to cope with studying independently and in doing so, develop strategies for self-directed learning.

These strategies are fundamental to success in ENGG1200 (Engineering Problem Solving and Modelling), a compulsory second-semester Flipped Classroom (FC) course aimed at fostering deep learning of engineering theory and practice fundamentals. The FC approach frees time on campus to provide opportunities for students to explore, integrate and apply knowledge and clear up misconceptions. ENGG1200 uses multidisciplinary design projects as vehicles for learning: students are challenged to work in teams to create virtual and physical prototypes. A strong focus on critical reflection and discourse aims to raise the students' perceptions of their learning approach as well as their competencies in engineering fundamentals. Students are required to work independently through online learning modules in their own time, and collaboratively with their team in both facilitated workshops and in the various laboratories to build the required prototypes.

Entwistle and Peterson (2004) have said that first year student conceptions of learning 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. In addition, the ill-structured nature of authentic problems may lead learners to feel ill-prepared and perceive courses as disorganised (Dabbagh & Williams Blijd, 2010). Since prior learning experiences create this expectation, the preceding compulsory first-semester course (ENGG1100, Engineering Design), which also uses authentic multidisciplinary design projects, has been partially flipped to allow students to begin to develop the strategies necessary to own their learning and succeed in ENGG1200.

Despite this, feedback from previous offerings of ENGG1200 has given a clear indication that the majority of students still prefer the traditional kind of engineering course where the subject matter is clearly explained in lectures and where they are told exactly what will be assessed (Reidsema et al. 2014). Designing and developing a working prototype to specification is a highly complex, challenging task and the ill-structured nature of authentic problems may lead learners to feel ill-prepared and perceive courses as disorganised (Dabbagh & Williams Blijd 2010). This makes it all the more important to clearly state expectations and help students recognise structure in what they believe is chaos.

It appears then, that a structured approach is required within the FC that allows students to clearly see the progression of learning objectives, tasks and assessment. However this approach needs to be in keeping with the FC objectives of student ownership of learning and the lecturer as facilitator. The Learning Pathway (LP), a structured online navigational interface (Stevens et al. 2008), was designed and implemented to provide students with a cognitive pathway through ENGG1200. It is a graphical course outline, structured into two primary navigational markers representing 'What you need to Know' and 'What you need to Do' that bridges the gap between the online and face-to face environment and satisfied the first year students' requirement for laid out and well-structured resources. The LP displays information in manageable (weekly) chunks in the context of both course learning and assessment activities, and the design phase of the multidisciplinary project (McAlpine et al. 2006).

This paper serves as an introduction to the LP and provides initial student evaluation of the tool as well as insights into the next stage of development. It should be noted that although the LP was initially designed and implemented for ENGG1200, it is now being used in courses in later years of the engineering degree program and for other disciplines (e.g. Maths, Physiotherapy, and Health) to underpin learning.

The Learning Pathway (LP)

Overview

The LP, accessible via the institutional Learning Management System (LMS) serves as a visual reinforcement of the course concepts displaying information in manageable chunks when it's required in the context of interlinked sequences (Figure 1). The scaffold also visualises an engineering project management approach in terms of the multidisciplinary design projects and this includes using formative and summative tasks as milestones. It allows students to navigate the online resources and encourages them to self-monitor their progress on tasks and activities through active tracking of their progress.

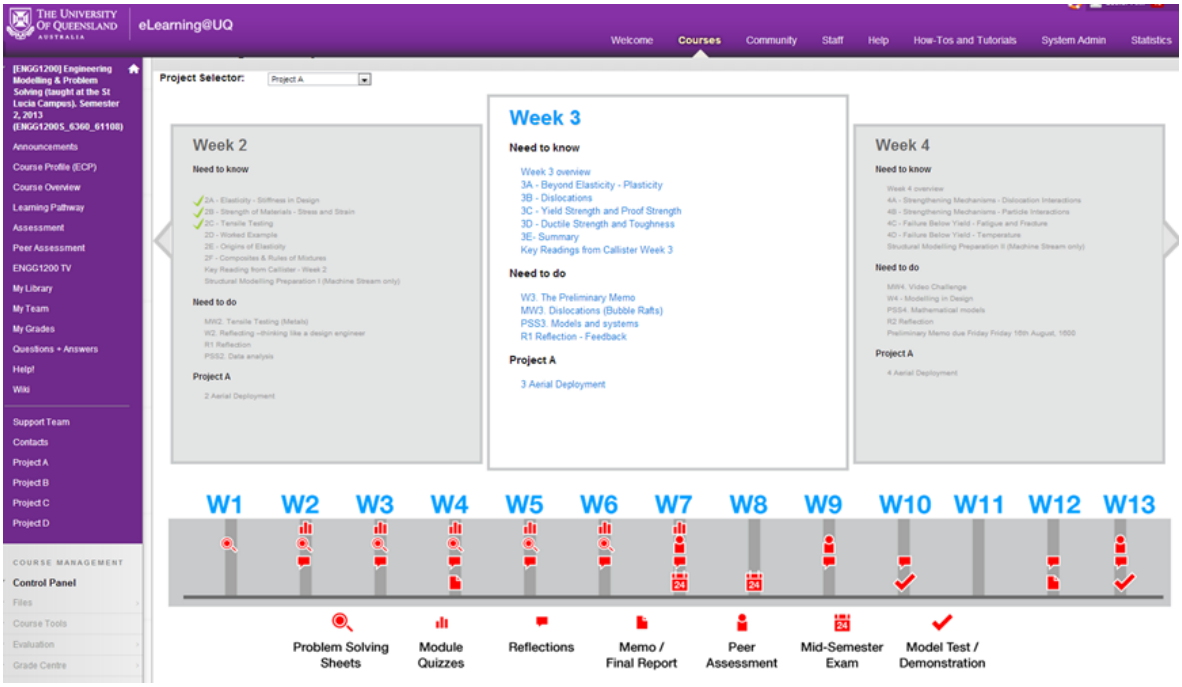

Figure 1: The Learning Pathway (Student View)

Learning and assessment tasks are hyperlinked to display relevant supportive and procedural information in a timely fashion that helps reduce cognitive load. Hyperlinks open in a scrollable overlay (Figure 2) that can be collapsed to return users to the LP.

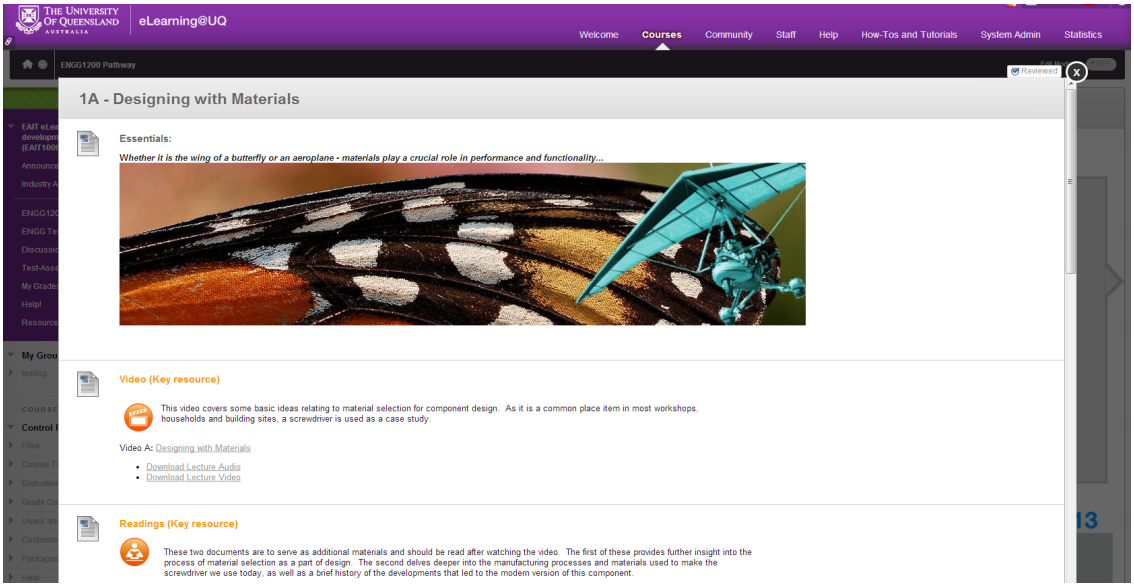

Figure 2: Content overlay

Layout

The LP consists of two main elements: a weekly breakdown of learning activities ('Need to know') and an overview of the assessment tasks students need to complete to achieve the learning objectives ('Need to do').

Weekly breakdowns are displayed as a set of 'flexboxes' to accommodate different screen sizes and different display devices. The set displays the current week in the middle with previous and following week to the left and right to reinforce a sense of continuity. The current week is highlighted and slightly bigger in size to avoid ambiguity. A project selector (upper left corner of the interface) allows students to display their project only. With cookies enabled, the browser remembers a student's selection and progress: a green tick highlights tasks that a student has undertaken or a resource that has been viewed (Figure 3).

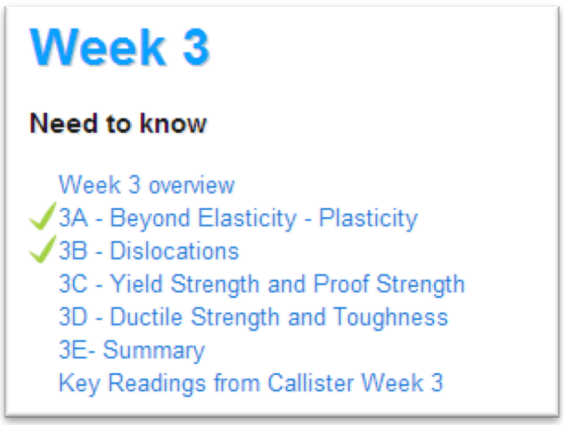

Figure 3: Student progress indicator

The assessment overview is currently a static overview of formative and summative assessment tasks throughout semester. A set of icons characterises different assessment types. Planned features include visualising student's progression towards the learning outcomes.

Technology

Our university uses Blackboard 9.1 and this LMS does not accommodate the desired interface layout. Initial approaches using the 'Lesson Plan' tool to implement a content folder with curriculum information proved unsatisfactory and therefore the LP was built using JavaScript.

However, for the tool to be easy to use by both academics and support staff, it needed to be integrated with Blackboard, scalable and easy to maintain for future course offerings. The LP is therefore based on LTI standards (IMS Global Learning Consortium 2013) and this permits users to connect to the LP via Blackboard and to customise their sites.

Approach

The research and development currently being undertaken into the efficacy of the LP as a Learning Analytics Integration Platform (LAIP) and navigational aid for students, will pool expertise from six US and Australian universities. At present, the fledgling LP has only been used for the two first year courses (ENGG1100 and ENGG1200), and a second year mechanical engineering course. Intensive evaluation through surveys, focus group interviews, student reflections, formal institutional evaluations and a pilot study of the Blackboard Analytics™ suite of applications have been undertaken in ENGG1200 and it is these results that are presented here.

Results and Discussion

Use of the LMS

Utilisation of the Blackboard Analytics™ suite of applications has been problematic with data interpretation requiring a level of background knowledge that is still being acquired. For example, the data shows millions of 'hits' on the site but further investigation showed that these hits were not unique visits but rather a count of mouse clicks to other pages whilst on the site. To ensure that the data is not incorrectly interpreted, the word 'clicks' will be used instead of 'hits' in this paper.

The ENGG1200 Blackboard site was the most active for Semester 2 2013 across the institution; Table 1 shows the overall clicks for ENGG1200 and also for the pharmacy course that was the second most active course. The table also details the engagement with the four most visited sections of the LMS.

Table 1 Use of the LMS (Semester 2 2013)

	Number of clicks	**Number of students**	**Clicks/ student**
ENGG1200 (Overall)	2 473 544	1185	2087
Pharmacy (Overall)	72 471	64	1132
ENGG1200	**Number of clicks**	**Number of users**	**Clicks/ user**
Groups	10 948	1089	10
Content	2 315 325	1187	1951
Announcements	122 703	1229	100
Student gradebook	16 291	1085	15

It is clear from the large number of clicks/user for the Content section that students are engaging with online material and therefore taking responsibility at the micro-level.

Student reflections in ENGG1200

Evidence from student reflections (Reidsema et al. 2014) suggests that the LP had been a successful support for students and helped them to manage their learning. Table 2 shows a sample of student reflections at the beginning of ENGG1200 (Week 2) and compares them to reflections by the same student at the end of ENGG1200 (Week 12).

Table 1 Student reflections on the LP

Student	Prior to ENG1200 (Week 2)	End of ENGG1200 (Week 12)
A	*I personally struggle with planning and organisation and am already finding it rather difficult to stick to deadlines.*	*The thing that helped me the most … was the Blackboard Learning Pathway. Being able to view the information relevant to that current week, set out in a well-structured manner was very helpful.*
B	*It is more difficult to organise a group because some tasks can only be completed after other sections have been finished.*	*I feel <that> the learning pathway on blackboard helped us to plan when to complete work as it contained all the due dates necessary in the one place.*
C	*In terms of organisation and planning we've found it difficult to pin point commencement and completion dates … because we aren't sure when we'll be able to actually accomplish them, based on what knowledge, and resources are required.*	*I thought the 'Learning Pathway' was a good help and that the 'You need to know' and 'You need to do' were especially helpful for time management.*
D	*It's week 2 and I am feeling quite overwhelmed and anxious about engg1200. Looking through the learning pathway on blackboard has revealed a mountain of work that is required of me every week and I am worried that I will fall behind.*	*The BB learning pathway helped outline the week's goals which made it easier for me to complete tasks on time.*

The early reflections clearly show uncertainty and anxiety with respect to organisation and planning with the word 'difficult' appearing in three of the reflections relating to deadlines. These fears of failure or poor performance can result in reduced student motivation and disengagement from the learning environment altogether (Martin, 2013). It is therefore pleasing to see adaptive behaviours, such as planning, time management and goal mastery, emerging from the final reflections through the support of the LP.

Table 2 contains the reflections from four students out of a cohort of almost 1200; these reflections were not atypical. Themes that emerged from the reflections included:

- the challenge presented by the FC and the authentic learning tasks and assessment;
- the seemingly overwhelming number of tasks;
- that the LP was a crucial intervention at the beginning of the course;
- the LP helped students adapt and successfully manage their development as learners; and
- that the visual representation of the course requirements was instrumental to planning for (and achieving) success in the course.

Course evaluation

Students evaluated ENGG1200 via an online institutional survey. While the LP was not a specific item of any question in this survey, a number of students were positive about the support the LP provided when answering open-ended questions with comments similar to those in Table 1.

Table 3 shows the responses to questions that asked how difficult they had found the various challenges of ENGG1200. In each case, around half the cohort found it 'Very easy' or 'Fairly easy' but 20 to 30% still found each of the challenges to be 'Fairly difficult' or 'Very difficult'. Initial investigation of the 20 to 30% shows a lack of engagement with the technology on their part and a persistent expectation that they should be taught in a more 'traditional' manner.

Table 3 Survey responses (%, N=??)

How hard was it to:	Very easy	Fairly easy	Unsure	Fairly difficult	Very difficult
- be organised and take responsibility for your learning	15	45	20	16	4
- track down information for yourself	6	44	24	20	6
- use information technology and apply computing skills	14	35	21	21	9

The survey also asked students what they perceived the major learning outcomes from the course to be. The top ranked outcome was 'the ability and opportunity to work with other students' however 'being able to organise and be responsible for their own learning' was the second highest with 64% of students indicating it was a major course outcome. This is an indication that the majority of students made the transition to self-regulated learning.

Conclusion

The learning pathway is an online navigational tool that provides a visual representation of what students need to know and need to do each week to stay on track. It serves as a scaffold to make the concepts and curriculum of a course transparent for students by organising resources and tasks in a way that learners can "see" a pathway to achieve the learning objectives.

The findings from the evaluation of the use of the LP in ENGG1200 highlight two major points:

- students engaged more frequently with the LMS throughout semester and thus with the course's online material; and
- students found the LP an important support tool for successfully navigating their way through all the requirements of ENGG1200 and its FC mode of delivery that required ownership of learning.

This has significance for not only first year engineering students but also students across other disciplines that are transitioning to the unfamiliar FC learning environment.

This significance was tested at a recent institutional workshop that sought to disseminate the LP to later years in engineering and to other disciplines. Interest was high and a number of academics that attended the workshop are currently implementing the LP in their courses:

Provided knowledge and access to a tool that will be very helpful in guiding students through my course that has been re-written based on an integrated (flipped) learning approach. (Academic, Faculty of Health Sciences)

REFERENCES

Dabbagh, N. and Williams Blijd, C. (2010). Students' Perceptions of Their Learning Experiences in an Authentic Instructional Design Context. *Interdisciplinary Journal of Problem-based Learning, 4*(1).

Entwistle, N. and Peterson, R. (2004). Conceptions of learning and knowledge in higher education: Relationships with study behavior and influences of learning environments. *International Journal of Educational Research, 41* pp. 407-428.

IMS Global Learning Consortium, (2013). Retrieved August 8 2014 from http://www.imsglobal.org/index.html

Martin, A. (2011). Courage in the classroom: Exploring a new framework predicting academic performance and engagement. *School Psychology Quarterly, 26*(2), 145-160.

McAlpine, I., Reidsema, C. and Allen, B. (2006). Educational design and online support for an innovative project-based course in engineering design. In: Markauskaite, L., Reimann, P. and Goodyear, P., Who's Learning? Whose Technology?. *23rd Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education, Sydney, Australia,* (497-507). 3- 6 December 2006.

Reidsema, C., Kavanagh, L. and Jolly, L. (2014). Flipping the Classroom at Scale to Achieve Integration of Theory and Practice in a First Year Engineering Design and Build Course. *Proceedings of the 121st ASEE Annual Conference and Exposition, Indianapolis, IN,* June 15-18, 2014.

Stevens, R., O'Connor, K., Garrison, L., Jocuns, A. and Amos, D. (2008). Becoming an Engineer: Towards a Three Dimensional View of Engineering Learning. *Journal of Engineering Education*, *97*(3), 355-368.

Vermunt, J. (1998). The regulation of constructive learning processes. *British Journal of Educational Psychology*, *68*(2), 149-171.

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