Contextualising learning for a real-world university: how an inverted curriculum in the first year can help better student retention

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Abstract

An identified issue within higher education is the high rates of student attrition after the first year, especially in the STEM (Science Technology Engineering and Mathematics) disciplines. To address this issue, it is essential to reexamine and redesign the first year curriculum to engage and retain the students' interests while also scaffolding their learning experience. This session reports on an initiative based on the principles of the "inverted curriculum" within the Bachelor of Technology (BIT) course at the Queensland University of Technology (QUT) that began in 2009 and has resulted in a reduction in first-year attrition rates from 18% in 2008 to 10% in 2009 and 2010 despite a growth in student intake of 15% to 40% in the past two years. We present the process and methods that helped achieve this and initiate a discussion on the innovations that are possible within this concept of inverted curriculum and how it can be implemented.

Introduction

Background

From our experience at the Queensland University of Technology (QUT), and that of others nationally and internationally, we know that it is not always easy to engage and support first year students struggling with their transition to university study. The challenges of adjusting to the first year of any university course are easily overlooked by curriculum designers and academics eager to impart the wealth of their discipline knowledge to a new cohort of students. This often contributes to a significant number of students dropping out after the first year. Previous efforts to ease the students into university study by keeping first year courses relatively easy or a refresher of high-school curriculum have the contrary problem of losing the high achieving students through a lack of interest.

An international body of research into first year experience has been accumulating over the last decade that directs curriculum design to develop course content where a student's personal, social and academic transitions are supported in a more inclusive manner (Nelson et al., 2006) and where the traditional content is supplemented and supported by inquiry-based

and research-based laboratory pedagogies, especially in the STEM disciplines (Science, Technology, Engineering, and Maths) for a more active learning environment (Weaver, Russel & Wink, 2008).

Towards an Inquiry-based Curriculum

Traditional content does not prevent the progress of the superior students, but the majority of students who leave our introductory courses view them as a large collection of disconnected facts that have little relevance to their daily lives and will soon be forgotten.

> *…imagine a young lad, Tommy, who desperately wants to be a professional tuba player. To his delight, he is accepted into a world-renowned tuba school. In Tuba 101, he and 100 others are taught the history of the tuba. Next … they learn tuba theory. … Second year is a bit better… But it isn't until third year… that he is allowed to play some music. Sadly, Lindgren says, Tommy's experience with tuba school, absurd as it seems, quite accurately describes how American college students are taught science. … America's scientists in the making don't sample real science until the final year of their course, if they last that long…* (Gilling, 2010)

There is evidence to show that inquiry-based and research-based teaching can increase student engagement and hence student retention (Meyer, 1993). Hu and others (2002) define engagement as 'the quality of effort students themselves devote to educationally purposeful activities that contribute directly to desired outcomes'. The new paradigm is to actively engage students with both the content, and with one another and the faculty.

The so-called inverted curriculum is one such approach that combines both research-based and practicals-based course design that aims to expose first year students to higher year level hands-on practical experiences, in order to engage the student early while at the same time allowing the students to discover for themselves what traditional subjects they need to understand in order to achieve their goals (Weaver, 2008). The principle of the inverted curriculum is a term borrowed from debates on electrical engineering education (Cohen, 1987) where the student's own motivation to achieve self-declared goals and ambitions contribute to greater proactive learning, leading to a 'progressive opening of the black boxes,' (Meyer, 1997), a somewhat longer but more precise description.

Development and Implementation

Context

At QUT, one such educative model was developed and deployed within the Bachelor of Information Technology (BIT). The BIT is a general degree that covers the breadth of the discipline of information technology. It is based on a long history at QUT of preparing students for IT research and the IT profession. Students within the BIT may study in topics that range from being business oriented (e.g. business process management, enterprise systems), to social interaction oriented (e.g. digital environments), to technical (e.g. network systems, software engineering). The BIT course structure has been reviewed 4 times over the past 8 years. A revised version of the course was offered in 2003, 2005, and again in 2007. In that time however, there had been no radical shifts in the core components of the course. Students' initial experience of the course was the same. Our curriculum changes were mainly

focused on the later years of the course where electives and majors offerings were increased in the hope of capturing the specialist interests of a wider audience. However, the BIT historical attrition rates from 2002-2008 still ranged from 25-35% in the first year classes. While much of the work we had done to support our first year students between 2003-2007 bore some fruit, and the attrition rates had reduced to 17-18% by 2008, we felt we needed to reduce this even further. To this effect, we redesigned the course again in 2007/08 for first offering in 2009.

The Redesign

The old structure of the Bachelor of Technology (BIT) at Queensland University of Technology consisted of a common first year of 8 units undertaken by all students, a major consisting of 6 units taken in the second and third years of the degree, 2 additional project related units in the final year of the degree, and 8 general electives. The degree could be visualised as a pyramid starting in first year introducing students to the range of technical aspects in IT and then narrowing down to focus on preparing students to become professionals in at least one major. As the course material becomes more focussed on topics of interest to students, most students enjoyed their studies more. The final year project units covered general project management material and allowed students to demonstrate their cumulative learning through a capstone project. The degree also included an optional industry placement scheme where students undertook a year of full-time professional work between the second and third years of their degree.

In contrast, the new structure of the BIT, implemented in 2009 and still evolving, tries to provide a structure that engages students by making the introductory material interesting, relevant and engaging through real-world examples and applications, while still trying to provide a basic set of foundational knowledge and skills required by all IT professionals. The first semester in the new structure provides an introduction to IT that takes an integrated approach to teaching course material showing students how IT is changing the world. A large cohort of industry experts come in and showcase their work and potential career paths. This provides a clearer context for the technical content of the degree as well as raising student awareness of the breadth and depth of the profession. Students are then able to select technical aspects of IT of interest to them to study in more detail in their second semester. The second and third years of the degree provide the opportunity for students to gain specialist knowledge and skills, including more direct contact with researchers and research centres within the university, as well as having a stream of core units designed to help students to understand and select future pathways. Contact with real-world researchers and hands-on research projects both inspire and motivate the students. Students still have 8 general electives, but in a key change, are now able to start taking these electives from the second semester of their first year, where they can choose and design projects that interest them personally. Students are still able to demonstrate their cumulative learning once again through a capstone project and still have the option of undertaking a full-time industry placement during their studies.

In practice, this means that the students first use powerful tools and components as clients for their own applications, often ineptly at first, and then progressively lift the hood to see how things are made, make modifications and improve their outputs by adding their own extensions. This encourages reuse and repurposing of applications, and the progression is from the consumer side to the producer side, but focuses from the start on powerful and possibly large examples, where the student's see for themselves the importance of the traditional content and how it eventually leads to professional practice. In a way, the

traditional academic content then becomes a bridge between the first-year conceptual project and the final contextual goals beyond undergraduate education, be they in industry or research, and hence more meaningful to the students.

Impact

There is no large-scale evaluation of the effects of research-based curricula on student success. However, some case studies indicate that an inquiry-based curriculum helps students develop a deeper understanding of the field they are working in, show increased confidence in their ability to do and understand science, gain skills in interpreting results, and learn about the construction of scientific knowledge and the use of evidence to support assertions. In our experience at QUT, the redesign of the BIT course that began in 2009 has resulted in a reduction in first-year attrition rates from 18% in 2008 to 10% in 2009 and 2010 despite a growth in student intake of 15% to 40% in the past two years. Anecdotally, our industry hosts for student work, and employers have indicated there have been no adverse effects in graduate outcomes; in fact they may be improved.

Questions/Issues for the audience

- What do you consider the benefits of an inverted curriculum approach?

- How could the inverted curriculum approach be improved?

- In what ways could you utilise the inverted curriculum approach for your practice?

Session Outline

Presenter (10 minutes): Overview of the rationale for the inverted curriculum and how it is being applied at QUT.

Paired discussions (10 minutes): Participants to consider one or more of the following:

- Issues which may arise from the terminology.

- The potential value and anticipated issues with developing this approach in their own institutions.

- Ways to monitor implementation.

- Ways to evaluate the success or otherwise of adopting such an approach.

Presenters and whole group discussion (10 minutes): Draw together the ideas from the participants and discuss potential solutions to any issues that have arisen during discussion.

The session will address the following conference themes directly or indirectly:

- Institutional innovation and the FYHE

- Scaling up curricular and co-curricular approaches

- Strategies for supporting wider participation in HE

- Intentional FYHE to Capstone experiences

Acknowledgements

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