

## **How Effective is Inquiry-Based Learning in Linking Teaching and Research?**

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### **Introduction**

This paper raises issues the authors are facing as they are engaged on a project to document and share examples of inquiry-based learning (IBL) in four tertiary institutions in New Zealand. The paper begins by giving the background to the rise of IBL as a potentially useful and meaningful way to strengthen teaching-research links and to improve student learning. The paper then continues by raising several issues that have come to light as we embark on this research project funded by the Ministry of Education. We suggest that these issues could be further discussed in the Colloquium.

### **Inquiry-based learning as a way to strengthen teaching-research links**

The use of inquiry as a vehicle to strengthen the teaching-research nexus has been discussed, among others, by the Boyer Commission (1999), Rowland (2000), Brew (2001, 2003), Badley (2002), Kivinen and Ristela (2002), the *Marwell Colloquium on Research and Teaching* in 2004 and Healey (2005a,b). The notion that tertiary teaching and learning should occur in communities of inquiry in which teachers and staff are co-learners has been suggested by many researchers (e.g. Brew, 2003; Le Heron et al., 2006; Rowland, 2000). Justice et al. (2007a) comment that IBL refers to both a process of seeking knowledge and new understanding, as well as a method of teaching based in this process. Thus they see IBL as similar to research, and suggest it is a way to integrate research and teaching as both students and teachers are “compatriots in the search for knowledge” (p2). Inquiry-based learning has thus been advocated as an effective way to strengthen teaching-research links.

Further support for the use of IBL comes from the strong theoretical underpinnings of the approach including constructivism, cognitive research on motivating learners, intellectual development and approaches to learning (Prince and Felder, 2006). However, the research on learning styles gives rise to caution, as many students may be uncomfortable with inquiry approaches and thus need adequate support to make the transition (Healey et al., 2005).

In New Zealand the *Tertiary Education Strategy* calls for “a research culture within which undergraduates learn to take a research-based approach to their lifelong educational development” (Ministry of Education, 2002: 60). The Ministry’s *Statement of Tertiary Education Priorities 2005/7* (Ministry of Education, 2005:7) points out that

the tertiary education system in New Zealand “equips people with the skills, knowledge, attitudes and values ... to think critically and adapt to change”. In particular, it is expected that universities will “develop new knowledge that will inform quality teaching at undergraduate degree and postgraduate levels” (p. 8). This reflects the legislative requirement that research and teaching in New Zealand universities and all degree-granting institutions are closely interdependent and that most teaching in such institutions should be done by people who are active in advancing knowledge. While New Zealand is almost unique in legislating for a close integration of research and teaching, there is evidence (Robertson and Bond, 2005) that relatively little attention has been paid locally to the ways in which that relationship is enacted – at the level of the individual teacher/researcher, at departmental level and at institutional level. Information has been gathered for the purposes of academic audit (e.g. Gerrard et al. 2004; Spronken-Smith et al. 2000) but there has been little attempt to disseminate such information in the form of ‘good practice’.

Inquiry-based learning can thus offer another dimension to undergraduate education as it purports to strengthen teaching-research links by bringing teachers and students together in a community of inquiry, and is inherently learning-centred. In order to promote the use of inquiry-based learning in tertiary education, the authors are embarking on an investigation of IBL at four institutions in New Zealand – the Universities of Otago, Canterbury and Victoria, and the Christchurch Polytechnic Institute of Technology. In each institution three case studies of IBL will detail the nature of each inquiry activity, and teacher and student experiences of the activity. Furthermore there will be a cross-case analysis to determine what underpins effective IBL activities.

## **Issues around inquiry-based learning**

As the authors began this research project several issues emerged. Each of these is briefly discussed below.

### ***1. Defining IBL***

Inquiry-based learning is a contested term – even the phrase itself has many permutations and alternatives (e.g. ‘i(e)nquiry’, ‘guided-inquiry’, ‘undergraduate research’, ‘research-based teaching’, ‘discovery learning’, ‘teaching research links/nexus’ and ‘inductive teaching and learning’). However, despite the different terms, there is a commonality of opinion about what constitutes IBL. We drew on this commonality to provide a working definition of IBL for our research. We see IBL as a pedagogy which best enables students to experience the processes of knowledge creation. The core ingredients of an IBL approach that most researchers are in agreement with are:

- learning stimulated by inquiry, i.e. driven by questions or problems
- learning based on a process of seeking knowledge and new understanding
- a learning-centred approach to teaching in which the role of the teacher is to act as a facilitator
- a move to self-directed learning with students taking increasing responsibility for their learning and the development of skills in self-reflection

- an active approach to learning.

The central goal of IBL is for students to develop valuable research skills and be prepared for life-long learning. Students should achieve learning outcomes that include critical thinking, the ability for independent inquiry, responsibility for own learning and intellectual growth and maturity (Lee et al., 2004).

Inquiry-based learning can go from a rather structured and guided activity, particularly at lower levels (where the teacher may pose the questions and give guidance in how to solve the problem), through to independent research where the students generate the questions and determine how to research them. Furthermore, IBL can occur at a range of scales within the curriculum from a discrete activity through to the design principle for the whole degree.

The relationship between IBL and problem-based learning (PBL) has not been well defined. Most researchers acknowledge an overlap in the approaches, but have difficulty distinguishing. Researchers at McMaster University used the type of question to distinguish - often PBL focuses on questions to which answers already exist while IBL often requires primary research to determine possible answers - and PBL has a shorter timescale (one class to a few weeks), while IBL can be for a sustained period (McMaster University, 2007). Spronken-Smith et al. (2007) used the notion of collaboration to distinguish. While IBL can be done in collaborative groups, PBL is usually done this way. As a guide, it appears that PBL is a more prescriptive form of IBL, and thus PBL is seen to be a subset of IBL, and both IBL and PBL are subsets of active learning (Figure 1).



Figure 1: The relations between inquiry-based learning, problem-based learning and active learning (Spronken-Smith et al., 2007).

## **2. Distinguishing IBL courses/activities**

Given the rather broad framing of IBL described above, it is a challenge to articulate how an IBL course differs from a traditional course. We are sure that many lecturers would argue that they use IBL activities through, for example, laboratory or project work. In an attempt to tease out the criteria for an IBL course we came up with a possible check-list using the following categories:

always     usually     sometimes     rarely     never

- Are there open-ended questions that lead to the formation of defensible answers?
  - Are tasks focused on areas that have more than one possible outcome?
  - Do students work through the process of constructing knowledge?
  - Do the questions challenge students?
  - Are teachers there as co-learners?
- Are there elements of student choice in selection of questions, context of application and/or methods of inquiry?
- Does the course or activity specifically use IBL approaches and processes?
  - Is there teaching of the research process?
  - Are relevant transferable skills taught?
- Is there constructive alignment of outcomes, teaching method and assessment?
- Is there a transparent assessment scheme?
- Do students reflect on the process of constructing knowledge?
- Is there a move to self-directed learning and increased responsibility?

For these questions we anticipate that most purported IBL courses or activities would incorporate several of these criteria but recognise there may be considerable variation.

## **3. Evidence for better outcomes in IBL**

While there is a growing literature that evaluates PBL there is a lack of such studies for other IBL activities. Certainly in the IBL literature some studies are purely descriptive with little effort to fully evaluate the impact of the IBL activities on students' learning and teachers' teaching and research. Many studies give patchy anecdotal evidence for improved learning while some triangulate evidence using a range of quantitative and qualitative sources, and a few studies involve careful comparative analyses to demonstrate in a statistical sense, how learning in an IBL framework differs from traditional teaching (e.g. Justice et al., 2007b; Berg et al., 2003). Several studies concur in terms of IBL producing improved student learning in terms of student engagement, academic achievement and higher order learning outcomes (e.g. see review by Prince and Felder, 2006). Students may have difficulty adjusting to the approach and in coping with group dynamics when collaborative learning is employed (e.g. Plowright and Watkins, 2004). Also there is a perceived higher workload associated with IBL (e.g. Justice et al., 2002). Teachers, too, can reap benefits from using IBL through the integration of teaching and research, increased enjoyment and interaction with students, their induction

into a wider community of practice of innovative teachers and the rewards gained from improved student engagement and academic achievement (Spronken-Smith, 2007). However, teachers can also struggle with adjusting to the approach.

#### **4. Does IBL strengthen teaching-research links?**

There is little doubt that IBL can improve learning outcomes, but few studies have aimed to determine if the teaching approach can in fact strengthen teaching-research links in terms of the stakeholders. Most studies report on student experiences of the approach, but few probe how students perceive the teaching-research nexus. Even fewer studies probe teacher experiences and for most the focus is on teaching, although some attempt to explore the links between teaching and research. Given that IBL is advocated as a way to integrate teaching and research, evaluation of IBL should question teachers about impacts on their teaching and research, as well as question students about their learning.

#### **Summary**

This paper has given a brief background of the rise of inquiry as a theoretical way to improve student learning and strengthen teaching-research links. The patchy evidence suggests that IBL can improve outcomes for students but it is uncertain if IBL strengthens teaching-research links for either teachers or students. The key questions that have emerged are:

1. How to define IBL and distinguish between IBL and PBL?
2. How to distinguish IBL from 'traditional' activities?
3. How to provide evidence for better learning outcomes in IBL?
4. Does IBL strengthen teaching-research links?

While some ideas and research have been described in response to the first three questions, issues still remain. Finally, there is a need to gather data to address (4) to determine whether and under what circumstances, inquiry can offer, as Badley (2002:451) suggests, a "really useful link" between teaching and research.

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