CHAPTER 5

Innovation in undergraduate Teaching: Student-centred and Research-led learning

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INTRODUCTION

It is a remarkable testimony to the prescience of our academic forbears that most of the thousands of universities created globally during the last 900 years bear a close resemblance to the progenitor of Western Universities, founded at Bologna in the 11th century. There have of course, been some changes during almost a millennium of institutional evolution. New disciplines have developed and been introduced into the academic milieu and, particularly during the last 100 years, universities have embraced the philosophy of such visionary educators as Wilhelm von Humboldt and recognized the discovery, assimilation and application of new knowledge as an integral part of the university mission. By contrast with this growing emphasis on research and knowledge creation, the practice of teaching and the relationship of the teacher with the student have undergone relatively little change through the centuries.

CHANGING ROLE OF UNDERGRADUATE EDUCATION

More that 150 years after the publication of his seminal work, *The idea of a University*, there are few discussions about the role of undergraduate educa-

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tion which fail to invoke the views of Cardinal John Henry Newman. Newman was unequivocal in his assertion that the university should provide an environment in which young men – the days of equal opportunity were still distant – could develop personally and intellectually, acquire a breadth of inter-disciplinary understanding and graduate with a capacity "to fill any post with credit and to master any subject with facility" (Downer, in press). Newman's ideals remain eminently worthy, and an important role for undergraduate education continues to be the development of an informed citizenry capable of rational, independent contributions to public debate and decision-making. However, in addition, the modern university has a societal responsibility to provide a highly skilled workforce who will contribute to economic competitiveness, professionals who can avail of the latest technological advances in the discharge of their professional responsibilities and, increasingly, universities are serving as essential partners of both the public and private sectors in providing career development and lifelong learning opportunities.

This diversity of roles is coupled with an increasingly diverse student population in which there is considerable variation in age, academic background, intellectual ability, interests and aspirations. Such diversity suggests that no single form of pedagogy is universally suitable to satisfy the several roles identified for undergraduate education and the heterogeneity of the student population. Thus, there is a need to reassess the nature of the undergraduate experience in the modern university and the manner in which undergraduate education is provided.

STUDENT-CENTRED TEACHING

In most universities, the teacher continues to be considered as the fount of knowledge with a role to "profess" this understanding to eager, absorbent students. This attitude becomes particularly evident upon reading mission statements from a variety of universities in different jurisdictions. Most place high priority on the attainment of excellence in teaching, but, commendable as such statements may be, they fail to acknowledge that the ultimate goal of education is not excellent teaching, but, rather, excellence in student learning. The teacher-centred bias in much university education is unfortunate and, in its worst and all-too-common manifestation, places the teacher in an authoritarian role delivering factual content and opinion and rewarding students for their ability to reproduce this dogma. Such didacticism leads to superficial learning and it is now recognized that the ideal learning environment encourages and enables students to assume ownership for their learning and allows them to question, interact, test, debate and explore both the process and the content of their learning. Goodwin et al (1991) cite the

1986 report of the Carnegie Foundation on higher education, which states: "The undergraduate experience, at its best, involves active learning and disciplined enquiry that leads to the intellectual empowerment of students."

The challenges of effecting the transition from teacher-centred to student-centred teaching should not be underestimated. Many academics are notoriously resistant to change and will not accept readily a top-down directive which might require considerable effort and the abandonment of a well-tried and trusted modus operandi. The intransigence of faculty is often exacerbated by the hegemony of academic departments which are likely to defend and protect their right to do what they perceive to be best for their particular discipline. Institutional structures may also obstruct the implementation of pedagogic change with inflexibilities in such factors as disciplinary compartmentalisation, scheduling and course prerequisites, contributing to a litany of "bureaupathologies" which hinder innovation and change. In spite of these inherent difficulties, there is little justification for the retention of a less than effective status quo and, therefore, universities must examine the appropriateness and effectiveness of current pedagogic practices.

Indeed, in that universities have a responsibility to ensure that available resources are deployed optimally to achieve the institutional mission, it is appropriate for them to consider if the commonly deployed, current pedagogy of lectures, note-taking and content-based examinations makes the most effective use of the contact time between the teacher and the student, and if it achieves an optimal learning environment. The traditional, content-based lecture can be justified in an era or situation in which books are scarce or expensive, but this is not the case in most universities today. Ready access to information is a feature of the modern educational environment with electronic databases, web-based learning programmes and CD-ROMs complementing traditional library resources. Consequently, most of the relevant content is available to students outside the lecture room and in a form that is often more comprehensive and understandable than in a formal lecture. If students are made responsible for at least some of the content before they enter the classroom, the interaction between the student and the teacher will be more productive, with the student transformed from the role of receiver to that of developer of knowledge. There are mutual benefits to this type of student/teacher relationship because, as most scholar/teachers will readily admit, students provide valuable challenges to entrenched hypotheses, offer fresh insights and contribute to enhanced understanding by both partners.

Such reforms would, of course, change the role of the university professor who, traditionally, has served principally as the provider of information. In student-centred teaching, the professor assumes a much more complex role located on the boundary between information and understanding. Good

teachers have always fulfilled this function, but, in order to take full advantage of the opportunities presented by the information age, all teachers should assume the role of guides, mentors and facilitators who enable students to make the transition from factual content and information to true understanding and wisdom.

RESEARCH-LED TEACHING/PROBLEM-BASED LEARNING

Coupled with the need to move towards a more student-centred learning environment is the emerging concept of research-led teaching and learning. The Report of the Boyer Commission on educating undergraduates in the research university, *Reinventing undergraduate education*, recommends that research-based learning should be the standard form of undergraduate education in research universities.

Research-led teaching can embrace several pedagogic strategies, which are closely related to each other and are not mutually exclusive. In an extreme form, ongoing research activities are placed at the core of the undergraduate curriculum. Professors describe the research questions that are being addressed and introduce students to the underlying concepts required to understand the scope, nature and direction of the research. In upper-level courses, the material may be based entirely on the professor's personal research programme, whereas, in introductory courses, a broader range of research topics is usually required to ensure holistic exposure to the discipline.

Frank Rhodes has reported a variation of this approach in describing the teaching of an outstanding professor of engineering who presents students with practical problems and then proceeds to help them discover and understand the solutions (Rhodes, 2001). There is now an established field of pedagogical endeavour and innovation which can be encapsulated in the term "Problem-Based Learning" and which incorporates the values and orientations associated with research-led teaching. Indeed, in that not all universities have strong research programmes, the problem-based approach is more appropriate in many situations.

The utility of the approach and the manner in which it is applied varies greatly between disciplines, but the benefits, which occur, are generally acknowledged to include:

- the approach can be applied to any discipline and tends to transcend disciplinary boundaries by identifying problems and then applying knowledge from different disciplines to achieve a solution;
- in research intensive environments students are exposed to the excitement of cutting-edge research and are exposed to dynamic, committed researchers;

- students are encouraged to question, understand and become involved in the resolution of real-life issues;
- active participation in the resolution of problems is more likely to imbue learners with passion and enthusiasm for the subject;
- students develop skills associated with creative problem-solving.

In addition to its impact on curricular content, research-led teaching can influence also the way in which students are helped to appreciate the research method with emphasis placed on research methodology and the ways in which knowledge is accumulated in a particular discipline. This leads, ideally, to the type of student-centred, enquiry-based learning described in the previous section. Indeed, as envisaged in the report of the Boyer Commission, undergraduate students should, wherever possible and appropriate, be involved in the research process progressing from a role as junior members of a research team in first year to one which is equivalent to that of a first-year, post-graduate student by the final year. Irrespective of whether they proceed to graduate school or not, the research-based or problem-based learning experience will provide them with analytical and problem-solving skills which will be valuable in professional life and as thoughtful, informed citizens. Furthermore, in that the approach often involves group projects, students acquire team-working and communication skills which are increasingly deemed by employers to be of great importance.

UNDERGRADUATE TEACHING IN RESEARCH UNIVERSITIES

In the light of the foregoing discussion, it might be expected that some of the best examples of research-led teaching would be found in the TIER 1 Research universities of the United States. These are defined as universities which "offer a full range of baccalaureate programmes, are committed to graduate education through the doctorate with 50 or more doctorates graduated annually and give high priority to research with annual research income of $40 million or more." (Boyer Commission, 1999)

Unfortunately, analysis of the performance of undergraduate students in research-intensive universities suggests that the potential identified above is often not realised, and the learning productivity in some cases compares unfavourably with that in other types of third-level institutions (Kuh & Hu, 2001). Clearly in some instances, the universities surveyed had not adopted a research-led approach to teaching, whereas in others, it is likely that research "stars" had negotiated contracts with no or minimal undergraduate teaching responsibilities and delegated their teaching to post-graduate students or post-doctoral fellows whose primary goal is to do research and publish. This all-too-common occurrence reflects the erroneous perception that teaching

and research are independent activities which compete for faculty time and resources. Rather, as Elton (2001) points out in his consideration of von Humboldt's 1810 monograph, university teaching "involves a joint endeavour between the teacher and the learner in a common search for knowledge". Indeed, based on his reading of von Humboldt, Elton (2001) suggests that this is what distinguishes a university from a school with the latter teaching only closed and settled bodies of knowledge, whereas university teaching, learning and research have, as their common outcome, the discovery of new knowledge and understanding. In the modern university, teaching, learning and research are part of a continuum of enlightenment and, should not be considered as separate, unrelated activities.

The finding that there is not necessarily a direct link between a strong research university and a good undergraduate-learning environment (Kuh & Hu, 2001) belies commonly accepted academic dogma. Elton (2001) has explored the basis for the mythology, and concludes that many of the studies which purport to demonstrate a positive correlation between research and teaching/learning were simplistic and lacked objectivity. For example, assessments of the quality of teaching are often conducted by highly respected researchers who consider good research performance to be evidence of good teaching (Elton, 2001).

Clearly it is naïve to expect that every good researcher will be a talented, inspiring teacher or, indeed, that only good researchers can be inspiring teachers. However, most successful researchers have a great enthusiasm and passion for their subject and the splendid examples established by such notables as Richard Feynman at Caltech and Carl Sagan at Cornell suggest that, whenever possible and appropriate, students should be provided with opportunity to learn from the best researchers on campus. Under such circumstances research-led teaching can greatly enhance the undergraduate learning experience.

RELATIONSHIP BETWEEN STUDENT-CENTRED AND RESEARCH-LED TEACHING

Although the foregoing account argues for adoption of a student-centred, problem-based approach to third-level teaching, it is recognised that teachers and students differ in their ability to deliver and respond to different forms of pedagogy. Therefore, as indicated previously, no single teaching strategy is optimal for every situation and every personality. Such variables as class size, sophistication of the student body, strengths and weaknesses of the teacher and the nature of the discipline will all determine the effectiveness of the teaching approach and the learning experience.

Even within a single course, a variety of pedagogic strategies may be used, but the overriding philosophies of student-centred, research-led teaching and learning should be central to the process. Figure 1 presents a matrix which illustrates the consequences of over- or under-emphasis of either strategy.

Figure 1. Consequences of over- or under-emphasis of student-centred and research-led teaching

		STUDENT CENTREDNESS	
		LOW	HIGH
RESEARCH FOCUS	HIGH	Incomplete coverage Faculty Inaccessible Learning has low priority	Content at cutting edge Inspirational teachers Students fully engaged STUDENT CENTREDNESS
	LOW	Impoverished content Uninspiring teachers Students and teachers disengaged	Content often bland and second-hand May lack rigour Lacks evidence

- *High Research Focus and Low Student Centeredness*: This scenario represents the extreme situation that is often criticised in research universities. High institutional priority is attached to research productivity and internal reward systems fail to recognise adequately the importance of individual contributions to the learning process. Consequently, professors invest little time in their teaching responsibilities, often "talk over the heads" of their students or delegate assistants to deliver lectures. An additional constraint arises when the curriculum is heavily biased towards the particular research interests of the professor and, as a result, some important curricular elements receive inadequate coverage. The overall result is a poor learning environment which frustrates students and denies professors the benefits of student insight into research questions.
- *Low Research Focus and High Student Centeredness*: The heavy emphasis placed on the learner is generally appreciated by students and, as a result, this approach often generates excellent student evaluations of teaching. Furthermore, in some situations, the strategy can be used effectively to enable students to acquire understanding of basic, underlying concepts and to stimulate interest and a desire to learn more about the subject. However, the material delivered is, at best, second-hand, often out of date, and the student is not exposed to the frontiers of disciplinary knowledge. The overall consequence is often a lack of rigour and intellectual challenge for the student.

- *Low Research Focus and Low Student Centeredness*: university teaching which fails to embrace either of the two concepts is, invariably, impoverished in content and uninspiring in delivery. The material presented is usually outdated, little opportunity is provided for discussion and student creativity is stifled. Such courses fail to stimulate student interest and, indeed, generate much of the criticism that is directed against the quality of undergraduate education in universities.
- *High Research Focus and High Student Centeredness*: This clearly provides the optimal learning environment with engaged students involved in the excitement of cutting-edge research or resolution of real-life problems and professors benefiting from the insights and fresh perspectives of students.

PROMOTION AND IMPLEMENTATION OF AN OPTIMAL LEARNING ENVIRONMENT

The learning environment envisaged above differs from that found in many modern universities and, therefore, change is needed in order to achieve this ideal. Unfortunately, the implementation of change is difficult in any workplace and, within a traditional academic environment, is likely to be particularly problematic. Any proposal to switch, even partially, from a familiar, trusted form of teaching to one that is less certain and more demanding of faculty time and institutional resources will inevitably raise concerns and generate resistance. Therefore, a careful implementation strategy is required.

A key factor in the successful implementation of change within organisations is strong leadership, and the introduction of pedagogic change in a university requires absolute commitment to the process on the part of each member of the senior executive team. However, experienced university leaders recognize that the best way to effect new initiatives is to be "pushed by faculty in the direction that you want to go". Accordingly, an essential element in the implementation strategy will be to identify faculty champions, with a passion for teaching and research, who will welcome the opportunity to participate in efforts directed towards the development of a culture of student-centred, problem-based learning. Ideally, these champions will represent a variety of academic disciplines and will infect colleagues with their enthusiasm for the new approaches. The efforts of the faculty champions must be strongly supported by the academic and administrative leadership of the university in a variety of tangible and highly visible ways. These include:

- *Resources*: One of the factors that contribute to the continuing practice of professors lecturing to large classes is that it offers an inexpen-

sive, cost-effective method of "educating" undergraduate students. Student-centred teaching is more costly, requiring greater investment of faculty time and infrastructural support. Institutions wishing to undergo transition from traditional to student-centred, research-led teaching must be willing to commit additional funding to the teaching/learning enterprise. Such investment delivers a clear message to the academic community about the institutional resolve to effect the change. Parenthetically, it is an interesting reflection of institutional priorities that substantial monies are often made available to facilitate new research initiatives, whereas few funds are set aside to encourage innovations in teaching and learning.

- *Rewards*: The reality of promotion and tenure decisions in most modern research universities is that faculty who excel in research and neglect their teaching responsibilities will tend to be favoured over excellent teachers with modest research accomplishment. In that change is most readily achieved when there are obvious benefits associated with its implementation, it is evident that institutions must ensure that there are clearly defined incentives available to those who embrace and contribute to the process of change. This does not mean that professors should be rewarded for neglecting research in favour of teaching because, as indicated previously, in a true university the two activities are closely related and, indeed, part of a continuum of discovery. However, commitment to excellent teaching must be considered a prerequisite for promotion of academic staff in the same way as research productivity.
- *Support for Teachers*: The challenge for faculty who are undertaking the transition from traditional methods of teaching to student-centred, research-led strategies of learning is considerable and requires that they be provided with appropriate support. They will need time to restructure courses and they require access to professional pedagogic counsel. Institutional commitment to the process of change can be demonstrated also by the establishment of a teaching-resource centre and by the organisation and promotion of an ongoing series of workshops and seminars on relevant topics. The overall impact of such a supportive professional development environment will raise the profile of teaching within the institution and encourage faculty participation.
- *Support for Learners*: Most students entering university directly from secondary school and mature students who were educated in a traditional academic environment will not be prepared for student-centred, problem-based pedagogy. They will require remedial, transition courses to enable them to benefit fully from the learning

opportunities presented. Tutorials and modules, which explain clearly the learning process and what is required of the students should be offered with such essential skills as use of databases, time management, working in teams and report-writing also emphasised to complement the disciplinary learning process.

CONCLUSION

Universities serve essential societal roles in the education of an informed and responsible citizenry and as a source and repository of knowledge. Both roles are of pivotal importance for national competitiveness in the Knowledge Age and, therefore, it behoves universities to ensure that best practices are followed in the execution of these missions. The current paper argues that effective learning is best achieved if it is directed by the interests and curiosity of the student and if it is founded on current, frontier research issues.

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