

# CHALLENGES TO TEACHING AND LEARNING PARADIGMS THROUGH FLEXIBLE LEARNING

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## ABSTRACT

The higher education sector is adopting more flexible modes of teaching as a means of improving not only access to programs but also lifelong learning. This paper identifies three shifts in thinking which are significant in achieving an improvement in teaching and learning outcomes through flexible learning.

## INTRODUCTION

A review of the literature on the flexible delivery of programs in universities reveals a vibrant worldwide debate that involves a variety of academic disciplines and educational contexts. Universities around the world are involved in dynamic change as they seek creative solutions in response to a number of educational and structural challenges. These challenges in higher education are, as McKay & Clarke (1998, p 12) point out, predominantly in the areas of de-regulation, increasing competition, and global access to programs; calls for accountability, efficiency and effectiveness; and a stronger emphasis on client needs and lifelong education.

One of the more significant responses to the challenges of lifelong learning is centred on flexible ways of delivering educational programs. The interest in flexible delivery has been aroused by a number of factors such as the increased numbers of learners seeking a tertiary education and the consequent diversity of student populations (Race, 1994), the increased frequency of career changes, the search for equity in access (George & Luke, 1995), the necessity for efficiencies of cost caused by reduced government funding (McKay & Clarke, 1998), developments in the theory of teaching and learning, and as a clear response to the demands and opportunities of the information age (Doyle, 1994).

## FLEXIBLE DELIVERY

There is a plethora of definitions for 'flexible delivery' but, in its broadest sense, flexible delivery involves any flexibility in the way a learning program is delivered, managed, or implemented. Flexible delivery is not simply a distribution technology but is used to refer to a combination of philosophy, technology, teaching strategies, and administrative structures which embrace freedom

from both geographical and time constraints in the provision of educational programs (Taylor et al., 1996, p 6). It is an approach to education that harnesses a range of learning strategies to cater for the differences in learning styles, opportunities, needs and interests, both on-campus and off-campus.

There have been many attempts at understanding what is meant by flexible delivery and how it may be different from understandings of distance and open learning. The definition offered by Taylor et al (1996) is an excellent summary:

"We use the term 'open learning' to refer to an educational philosophy expressed through a move away from traditional face-to-face practices, while 'distance education' is used to refer to a relatively traditional educational delivery system designed to meet the needs of geographically remote students. That is, 'open learning' alludes to an approach which places student learning, needs and choice at the centre of educational decision-making. 'Distance education' refers to practices which allow off-campus participation in educational programs, largely through the provision of print-based resources.

The term 'flexible' is used to refer to practices which utilise the capabilities for learner-learner and teacher-learner interactions made possible through recent developments in communication and information technology to provide increased 'openness' in both on- and off-campus delivery of educational programs ...we use the expression 'flexible modes of delivery' to capture [a] ... combination of philosophy and technology ..." (p 6).

The different interpretations of flexible delivery give rise to different characteristics of flexible programs, but they generally include freedoms in at least some of the following areas:

- modes of teaching (lectures, tutorials, teacher-led, student-led, resource based)
- content (topics, range of level of topics);
- assessment (choices in assessment items, self-assessment, valuing of previous educational achievements);
- location (internal, external, mixed, residential, intensive);
- entry and exit points (semesters, summer/winter, self-paced).

As Nunan (1996) explains, implementing flexibility in the delivery of learning programs "challenge(s) the 'borders' of each educational institution by producing a new market where there is competition and choice" (p 2).

## THE IPSWICH CAMPUS

The 'borders' mentioned above have been challenged by the establishment of the Ipswich campus of the University of Queensland which opened in January last year. The campus is a virtual one if the term 'virtual campus' is understood as Van Dusen (1997) does, that is as "... a metaphor for the electronic teaching, learning, and research environment created by the convergence of powerful new information and instructional technologies" (p 3). The Ipswich campus is a state-of-the-art campus using the latest in educational technology, and the programs offered embrace the new technologies that are available in teaching and learning. It also provides students with a level of technological 'appliances' which is unusual in Australian tertiary education. All students, for example, will have generous access to university-owned computers, extended access to the Internet, and there will be a high level of technological support from experienced technicians.

The campus is being developed as a 'hi-tech' centre but one that also continues to value and support face-to-face teaching by encouraging on-campus attendance, group study activities, and regular consultation times with teaching staff. University publications for the general community have emphasised this point:

"It will not be a virtual campus devoid of people but a place where students can enjoy an energetic exchange of knowledge with teachers and peers... This will be a resource-rich centre of learning" (University of Queensland, 1998, p 1).

The intention of the Ipswich campus is not to simply beam its programs to various sites via the new technologies. From the outset, face-to-face teaching has been recognised as an important part

of the learning process. The infrastructure of this campus, however, is not built around assumptions that all programs are classroom based and teacher centred:

"Flexible delivery does not imply the elimination of face to face contact. However, the need for such contact may be reduced, and its purpose may be less the transmission of information and more the discussion of issues or the resolution of problems" (University of Queensland, 1997, p 9).

Whilst face-to-face teaching has been maintained as an essential component, the traditional lecture and tutorial structure has been heavily challenged in favour of more interactive forms of face-to-face contact.

The growing movement across the higher education sector to adopt more flexible modes of delivery is a means of improving not only access but also teaching and learning. There has often been much rhetoric in Australian university policy documents on the importance of effective teaching, but in recent years universities have been re-establishing the significance of effective teaching as an integral part (with research and community service) of the academic's role. Evidence gleaned from policy documents show that in recent years, universities have begun to shed what many regarded as a generally dismissive attitude towards effective teaching, in favour of research excellence. There are few, if any, Australian universities that are not embracing policies and practices that encourage teaching excellence within a flexible framework. The University of Queensland's *Teaching and Learning Enhancement Plan* (1997) explains why:

"The need to adopt flexible delivery arises for both educational and market reasons. First, research indicates that students' various learning styles are best served by different modes of delivery. Second, students have an increased awareness ...that chalk, talk and textbook are not always the most effective means of teaching. Third, the globalisation of education means that students will soon have access to courses from a multiplicity of providers, both in Australia and overseas" (p 9).

## SHIFTING THE PARADIGMS

Scholars have identified a variety of paradigm shifts which are associated with effective flexible learning and how this may promote lifelong learning. Some of those described by Dolence & Norris (1995, p 4) are shifts towards individualised learning, just in time learning, lifelong learning, and

seamless articulation, all of which are responses to the profound changes in the operations of Australian higher education. This paper identifies three further shifts in thinking which are significant in achieving an improvement in lifelong learning through flexible delivery.

### **Paradigm shift one: from teacher control to student control.**

A central issue in effective flexible delivery is the notion of control. This paper asserts that flexible delivery cannot be effective unless teachers are willing to give up traditional controls over the teaching and learning process in favour of a collaborative framework of inquiry. Flexible delivery generally replaces some face-to-face teaching with opportunities for learning which are resource based. As George & Luke (1995) point out, the role of the teacher changes from being the "primary resource to one of many resources, and from the centre of the delivery to the facilitator" (p 2).

The emergence of flexibility in the delivery of subjects allows the teacher to teach differently; but whilst teachers remain the organisers of learning, flexibility in approach will result in teachers spending less time in preparing lectures and more on preparing self-paced learning materials, facilitating student use of materials, and adopting more skilful ways of assessing student performance.

This difference in teaching however, remains superficial unless teachers refocus their energies from classroom management to classroom facilitation. The task of the teacher is to:

- 1) establish the learning framework which sets up the theoretical and contextual boundaries of the learning exercise;
- 2) integrate the appropriate bodies of literature to locate publications which inform the learning exercise;
- 3) establish the group dynamics which not only allow, but actively promote, collaborative learning and non-competitive participatory practices.

University teachers can no longer see themselves as classroom managers who *control* the process but as classroom facilitators who *lead* the process. The role of the teacher in a flexible program remains essential; what changes is the way the teacher operates.

Lundin (1998) raises an interesting point about the term flexible delivery. He explains that it,

"...implies a one-way direction from provider to learner" (p 6). The new interactive technologies, however, challenge the unidimensional inference of delivery by enabling learners to send as well as receive information. Nunan (1996) provides another insight as to why technology also challenges patterns of control in learning programs:

"Notions of teaching and curriculum contain the idea of order, structure, and sequence in the ways that information becomes part of an intention for learning – technology has the capacity to radically change this situation as information can be available to participants without screening or ordering. The idea of a self-contained classroom in which teachers, to a large extent, control and structure information and communication is made redundant through the possibilities of electronically mediated learning" (p 3).

The new technologies are having a profound impact on the order and structure of educational programs. The ability to choose and initiate gives students more control over their learning, develops skills for lifelong learning, and challenges the hegemony of the teacher.

### **Paradigm shift two: from teaching focus to learning focus.**

Flexible delivery reconstructs educational practice in terms of student learning rather than teaching (George & Luke, 1995, p 2), hence shifting the emphasis of responsibility from the teacher to the learner. The paradigm shift that lifelong learners need to achieve is that they must accept far greater responsibility for their learning. They can no longer be passive, allowing the educational process to impact on them, but they must be actively involved in the process so that the learning process remains focused on their personal and vocational needs. As McKay & Clarke (1998) explain, "A major theme in the development of educational technologies has been the degree of interactivity that has emerged..." (p 9).

The key notion in flexible delivery is not the notion of flexibility itself, but the notion of 'choice'. Flexible delivery provides students with a choice in many of the key aspects of a learning program, (e.g. content, mode of delivery, entry and exit points), thereby increasing learner control by providing this choice (Nunan, 1996, p 2). Lundin (1998) suggests:

"Whereas previously universities used to be able to dictate entry requirements, entry times, sequencing of curriculum components, content of curriculum components, timing and mode of

delivery and assessment requirements, this is no longer possible in the deregulated educational marketplace. Learners can now choose from a range of providers and negotiate these elements of their learning" (p 7).

Equally significant is what students learn. Students involved in flexible programs at the Ipswich campus are encouraged to learn not just subject content but also how to learn, both independently and collaboratively. As George & Luke (1995) propose:

"This focus on the learning processes introduces a new dimension to the design of educational experiences; it requires outcomes in information literacy to be coincident with those of the subject content" (p 5).

Higher education programs which were once dominated by fixed content are recognising the importance of process because of the speed with which some content becomes outdated in the workplace. Workplaces are increasingly recognising the need to employ fewer content experts in favour of people who have the information and processing skills to source information when required. Flexible delivery should facilitate deeper learning, transferable skills, and critical thinking, which are essential for lifelong learning. As George & Luke (1995) note:

"Implied in the notion of flexible delivery is an approach to learning which depends on a range of enabling skills and understandings, some of which are specific but many of which are generic across the curriculum" (p 2-3).

The philosophy of flexibility adopts a learner-centred approach to educational design and delivery and allows students some measure of control by inviting them to accept responsibility for learning outcomes.

### **Paradigm shift three: information literacy as the new essential**

The impact of new information technologies on education has been well established in recent educational literature and, in particular, on the delivery of flexible learning (George & Luke, 1995; Nunan, 1996). The availability of sophisticated technologies which are useful in educational contexts is enabling universities to meet the challenges of the contemporary era (McKay & Clarke, 1998, p 13) and skilling learners for lifelong technological adaptation. This view is well supported, and Nunan (1996) explains that:

"New ground rules for education are being created by the convergence of low-cost, high-speed computing ... and high-capacity, low-cost mass storage that transform both information flow and personal communications" (p 1).

A key characteristic of flexible learning programs is that they are heavily resource based, with materials provided in a variety of formats, but increasingly in electronic format (e.g. CD ROMs, Internet, Bulletin Boards, E-mail, etc.). The implications for information literacy are significant because students will be able to gain the benefits of flexible programs only if they can use the technology and interrogate electronic resources (George & Luke, 1995, p 3). So students must shift their thinking to embrace information literacy, no longer as an optional skill, but quite central to successful learning.

The implementation of initiatives in flexible delivery is often linked with impressive educational technologies. A distinction needs to be maintained, however, between the 'medium and the message'. McKay & Clarke (1998) point out:

"The technology provides a basis for delivering an educational program, but it is still the pedagogical elements of the educational program that provide for the effective learning experience of the student" (p 9).

Flexibility does not necessarily imply the high use of technology, but the *appropriate* use of technology. It facilitates upgrades of materials and the exchange of dialogue between teacher and student, and between student and student. It is best viewed as an essential tool which allows learning materials to be dynamic and easily accessed, but it remains the medium, not the message.

The three paradigm shifts outlined above, that is, from teacher control to student control, from teaching focus to learning focus, and from ambivalence to information technology to an acceptance of information literacy as the new essential, are suggested as indispensable prerequisites for flexible learning programs to be successful. The Ipswich campus of the University of Queensland has made a commitment to not only offer flexible learning programs but to encourage students to consider these paradigm shifts and to support them in developing the necessary skills, attitudes, and commitment to lifelong learning.

## CONCLUSION

Flexible delivery has as many different meanings as it has applications. This paper proposes that flexible initiatives in education provide enormous opportunities for developing skills in lifelong learning. But as George & Luke (1995) say:

"The challenge to universities is to reconceptualise the institutional structures and work practices of staff in order to reform the educational environment in ways which are student centred, resource rich and which make use of the technologies available for distribution and access" (p 5).

These improvements must be well supported by responsive administrative infrastructures and new technologies, but the improvements will be minimal and superficial if there are not meaningful changes in key teaching and learning paradigms. The new role of university teachers is to establish the theoretical and contextual boundaries by structuring access to resources, and to facilitate the learning environment. The challenge to students is to accept responsibility for the depth of their learning and to exercise the choices they now have before them. As learners focus more and more on processes and skills in accessing information, ineptitude in the use of technology is no longer feasible.

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# TEACHING AND LEARNING PROTEIN CRYSTALLOGRAPHY OVER THE INTERNET

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## ABSTRACT

The Internet, information technology, and the increased need for lifelong learning, are changing higher education. We describe the structure of a one-year, protein crystallography course delivered completely over the Internet, and the teaching and learning experience of the first two years.

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## INTRODUCTION

No one will deny that the Internet and information technology are already changing the education system at all levels. We believe that, in the next decade, the way many people study for higher degrees will change: influenced not only by technological change, but by an increased need for lifetime learning, and by financial pressure. The 'average' postgraduate science student in the United Kingdom will no longer be a 23-year old full-timer with supportive parents and a large overdraft. The Open University has offered masters degrees by traditional distance-learning methods for many years, while Birkbeck College has a tradition of part-time study for mature working adults. Increasingly now, many institutions are offering study material and even complete courses over the Internet. The British government recently announced a major initiative to create e-universities, bringing together universities and the private sector, which will exploit the new information and communication technologies.

The School of Crystallography at Birkbeck College, University of London, has been in the vanguard of these developments since 1993 with three Advanced Certificate courses: the Principles of Protein Structure, using the Internet (PPS); Protein Crystallography, on the Web (PX); and Powder Diffraction, on the Web (PD). All these part-time courses, exclusively delivered over the Internet, are of 12 months duration and require a B.Sc. or equivalent, although most students are graduates. Students, who complete one of these courses successfully, receive the award of an Advanced Certificate from Birkbeck College. This qualification is approximately equivalent to half a UK M.Sc. degree.

What are the advantages of Internet-based teaching? Students study part-time in their own time, and at their own convenience (there is the future potential for students to study totally

asynchronously, as and when funding becomes available). The computer and Internet connections needed are relatively cheap and readily available, although there are variations by country and sub-population. Students may benefit from part-time tutors who have a worldwide reputation in their fields. Fees are low, and living-expenses non-existent, which opens access to students from emerging economic areas. Finally, students can use public domain software to interact with multimedia teaching material. However, because Internet learning is distance learning, motivation and time management may be a problem. Additionally, the learning experience may be second-rate, because of absent means of communication like body language and intonation. Academic rigor and accreditation are other potential problem areas.

## DEVELOPMENTS IN PROTEIN CRYSTALLOGRAPHY

For proper understanding of biological function, a detailed knowledge of the three-dimensional structure of biological macromolecules and their interactions with ligands and the aqueous environment is required. Protein crystallography is indispensable for this. It is no longer solely the domain of the mathematician and physicist, but that of the biologically orientated scientist, and is now a very multidisciplinary technique that has overlap with biochemistry, molecular biology, bioinformatics, biophysics, and organic chemistry (Blundell, 1996). This revolution is also apparent from the increase in the total number of structures solved: from 2,000 in 1993 to 12,000 in 1999 (<http://www.rcsb.org/pdb/holdings.html>). Protein crystallography has a central role in structural genomics in the understanding of the function of newly discovered genes. The technique has started to provide a job market in the pharmaceutical industry, where it has an important role in drug design, and in biochemistry laboratories. In addition, the latest biochemistry textbook by Voet et al. (1999) has a strong focus on structures,