Implications of Mass Education on Chemistry Higher Education

Christine O'Connor
Technological University Dublin, christine.oconnor@tudublin.ie

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Abstract

The following paper discusses the implications of government policy for widening access and participation in third level institutes. The increase in 'non-traditional' students has been widely recognised on an international scale; however, some issues of inequality still exist. The 'struggles' associated with widening participation and the creation of a 'new' student type are discussed, with particular reference to chemistry education. A change is needed with regard to the pedagogical approach taken by staff in order to cater for a diverse student body comprising a broad range of learner types, and this must be supported both at departmental and institutional levels. Also included is a review of the literature as to what best practice is in supporting the 'new' third level student. To conclude I look at what the future may hold for third level institutes catering for this 'new' student type.

Introduction

In recent years there has been a distinct change in the student type entering general science courses at third level. This change in student type can be attributed to a variety of factors, in particular the 1996 government policy of widening participation in third level education, and which allows for more places on higher education courses and a free fees initiative for third level students. This reflects a move towards Ireland becoming a 'knowledge based economy'.

> OECD economies are placing an increasing emphasis on the production, distribution and use of knowledge. The knowledge economy is dependent on people's ability to adapt to situations, update their knowledge and know where to find knowledge. These so called knowledge-workers are being paid for knowledge skills rather than manual work.
>
> (Maier and Warren 2000)

Employers are now looking for lifelong learners with a set of transferable skills that include flexibility, initiative, creativity, problem solving and openness to change.

Another factor for change in student type is the marked decrease in entry requirements required for those entering third level general science degrees in Ireland. This is due to the lack of interest of students entering chemistry at second level (Childs 2002). Despite this, there are more students entering third level education than ever before (O'Brien 2005). The result of this increase in participation is a change in student type, creating what is currently referred to as the 'non-traditional' or 'new' student. Stella Cottrell summarised the issues that arise from such widening participation when she stated that higher education institutions 'are slowly realising that it is not simply enough to open the doors: what goes on behind the doors has to change to accommodate new types of student intake' (Cottrell 2001).

Below I shall discuss the difficulties arising in general science courses as a result of this 'new' student type and how these problems may be resolved, before considering what the future may hold for such students.

Why is third level education a struggle for the 'new' student?
Research has shown that for many 'non-traditional' students, studying in higher education is characterised by 'struggle' (Reay *et al.* 2002; Leathwood and O'Connell 2003). The 'struggles' associated with widening participation and the 'new' student type are: student finance, institutional finance, attitudinal barriers, pre-entry guidance, qualifications, flexibility, and language and learning difficulties (Watt and Paterson 2000).

In relation to students entering third level institutes in Ireland it has become more and more evident that students are not researching the context of the programme they are pursuing and that a lot of the time they are unaware of the programme structure. In relation to the 'new' student, this is due to a lack of pre-entry guidance, which may stem from the fact that their friends and family have not experienced third level education. As a consequence of their socio-economic background such students lack academically successful role models in their communities creating attitudinal barriers in the student (Agar 1990; Birrell *et al.* 2000).

Many of the students entering general science courses in Ireland do not have prior learning in chemistry. As mentioned above, as a result of the decrease in the number of students studying chemistry at second level and the lack of interest shown in general science courses, standards of entry requirements have dropped. Kevern *et al.* (1999) demonstrate that, in general, well qualified entrants show a greater tendency to complete their course. Thus, the 'new' student faces 'struggles' with poor study skills, lack of prior academic success, poor writing skills and, now coming to the forefront in the sciences, poor mathematical skills.

Ireland is slowly becoming a multi-cultural society, and the 'new' student encompasses Ireland's first generation of Irish students for whom English language is not necessarily a first language. Language barriers and poor writing skills are thus further difficulties for students trying to study conceptually difficult science topics.

Financial status is another barrier for students attending and fully engaging with their third level programmes. Even though student fees are no longer applied for most higher level institutes in Ireland, the cost of living requires many students to take up term-time jobs. This has major implications for equity: a study by Metcalf (2003) shows that 'term-time employment affected the quality of education. Both cultural and financial factors affected who worked during term-time'. This study also suggests that 'the financial system might lead to an increasingly polarised university system: those that facilitate term time working and those who do not, with the more prestigious universities tending to be in the latter category'. The need for increased flexibility within course structures and course delivery would facilitate students who are required to engage in term-time employment. The introduction of modularisation, semesterisation (academic year delivered in two semesters with end of module summative exams) and the use of ECTS (European Credit Transfer System) credits should enhance the flexibility of programmes in Irish higher education institutes and facilitate lifelong learning.

Students with learning difficulties (mainly dyslexia) are increasingly being recognised in third level education. In Ireland this has been addressed by third level institutes

employing campus Disability Officers. The role of the Disabilities Office is to support structures and facilities currently available to students within the institute. However, as the structures and facilities are dependent upon institutional finance, levels of support vary across institutes. It would be interesting to track the future employment of chemistry graduates with learning difficulties to ascertain: (1) what level of support employers provide and (2) the roles in which such students are employed.

When considering the educational barriers the 'new' student must face, third level institutes must therefore look towards catering for student diversity (non-traditional, disabled students and students with learning difficulties) for the feasibility of students succeeding in third level education is dependent upon the levels of learning support implemented institute-wide (Naidoo 2000). Bamber and Tett (2000) have recognised the need for this support:

the university must accept that the implications of offering access to non-traditional students does not end, but rather begins, at the point of entry. This means providing sustained support to students throughout the course in relation to the internal and external factors that affect the learning process.

(Bamber and Tett 2000)

What is best practice in supporting the 'new' third level student?
In this society of equal opportunities and education for all, how can we implement sustainable support mechanisms for the 'new' student?

Planning for learning means that designing the forms of instruction which support learning becomes as important as preparing the content of programmes.

(Dearing 1997)

Institutes must look at catering for a diverse range of learners and staff are now required to have a greater understanding of the appropriate pedagogic practices necessary for this (Knight and Trowler 2000). However, as Woodrow and Yorke (2002) put it: 'Practices that are effective for the non-traditional student are likely to be effective for all learners'. This may suggest a move towards constructivist approaches, including theories on the social nature of learning (Vygotsky 1978) and research into effective learning models (Hein and Budny 1999; Johnstone 1997; Gabel 1999; Spencer 1999; Herron and Nurrenbern 1999). Curricula are currently being developed to cater for a more heterogeneous student body, and it has been argued that 'separate provision of the academic support type has a limited impact, and that a mix of semi-integrated and integrated models of curriculum provision offers better prospects for helping a wide spectrum of students to succeed at university' (Warren 2002). The curriculum should be contextualised as much as possible to link the theory to practice. One such learning model is Science Technology Society (STS), as demonstrated by Solbes and Vilches (1998).

By engaging all levels of learner types we are acknowledging the 'multiple intelligences' (Gardner 1993) of our diverse student body. This will enable students to 'learn how to learn' in a method appropriate to their individual needs. By introducing study skills and professional skills early into the curriculum this enables students to identify how they learn as an individual. Equity on how the student will be assessed also must be considered when developing assessment strategies. Constructively

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aligning the learning outcomes and assessment methods in order to drive the achievement of learning outcomes is a necessity (Biggs 1999). The transferable skills (flexibility, initiative, creativity, problem solving and openness to change) required for our 'knowledge workers' of the future should be integrated within the learning outcomes.

'Once engaged with learning, changes in self perception can occur, including self confidence and increasingly positive attitudes toward learning' (Gallacher *et al*. 2000) In order to facilitate students who must engage in term-time employment the creation of Virtual Learning Environments (VLEs) hosted on WebCT or Blackboard may support their learning process. Gorard and Selwyn (1999) talk about the use of VLEs to create a 'learning society', although they also state that 'the application of ''technological fixes'' to underlying socio-economic determinants of participation will solve some problems, create others, and leave many unaffected'. However, the use of VLEs, incorporated with modularisation, will lend to lifelong learning through flexibility. For the institutes themselves, 'Part-time students are not only in the (silent) majority but represent a model of lifelong learning, generate significant income for the universities and represent a resource of great potential for higher education' (Davies 1999). This creates an image of modules designed to allow students to take them as and when it suits them and to build up a set of credits worthy of a degree award or other qualification. This educational structure has been in place in higher education institutes in European countries for decades and does lend to social inclusion.

What does the future hold?
Much research has been carried out on the problems arising as a result of widening participation in higher education internationally, and we should learn from what has already been discovered and the possible solutions suggested. Institutional change is required to support and successfully cater for the learning needs of the 'new' student type. In order to create a feasible employment opportunity for the 'new' students, as 'knowledge workers', they must first 'learn how to learn'. Research into learning activities and implementation by staff must be supported throughout the institute. Integration of key transferable skills in the curriculum is necessary and may require restructuring or rewriting of existing curricula. Creating modules of learning packages that are engaging and flexible for both student and lecturer will help facilitate this. Modules and learning material may be hosted online in VLEs to cater for distance learners, part-time students and students with different learner needs, allowing greater access to courses and creating a 'learning society'. Curricula should be updated every five years, with the main focus on supporting Irish industry and research. Policy writers need to acknowledge the implications of widening participation in higher education and provide financial support to facilitate the changes outlined above.

Bibliography

Agar, D. (1990) 'Non-traditional Students: Perceptions of Problems which Influence Academic Success, *Higher Education (Historical Archive)*, 19 (4): 435–454.

Bamber, J. and Tett, L. (2000) 'Transforming the Learning Experiences of Non-traditional Students: A Perspective from Higher Education', *Studies in Continuing Education*, 22 (1): 57.

Biggs, J. (1999) *Teaching for Quality Learning at University*, Buckingham: Open University Press.

Birrell, B., Calderon, A., Dobson, I.R. and Smith, T.F. (2000) 'Equity in Access to Higher Education Revisited', *People and Place*, 8 (1): 50.

Childs, P.E. (2002) *Chemistry in Action*, 68 (33): Winter edn.

Cottrell, S. (2001) *Teaching Study Skills and Supporting Learning*, Basingstoke: Palgrave.

Davies, P. (1999) 'Half Full, Not Half Empty: A Positive Look at Part-time Higher Education', *Higher Education Quarterly*, 53 (2): 141.

Dearing, R. (1997) 'Higher Education in the Learning Society', London: HMSO. Available at www.leeds.ac.uk/educol/niche/natrep.htm

Gabel, D. (1999) 'Improving Teaching and Learning through Chemistry Education Research: A Look to the Future', *Journal of Chemical Education*, 76 (4): 548.

Gallacher, J., Crossan, B. and Leahy, J. (2000) 'Education for All?: Further Education, Social Inclusion and Widening Access', *Research Briefing No. 4*. Available at www.ioe.stir.ac.uk/Research/Briefings/CRLLBriefingNoteNo4.pdf (accessed 5 January 2006).

Gardner, H. (1993) *Multiple Intelligences; The Theory in Practice*, New York: Basic Books.

Gorard, S. and Selwyn, N. (1999) 'Switching on the Learning Society? Questioning the Role of Technology in Widening Participation in Lifelong Learning', *Journal of Education Policy*, 14 (5): 523–534.

Hein, T.L. and Budny, D.D. (1999) 'Teaching to Students' Learning Styles: Approaches That Work', *29th ASEE/ IEEE Frontiers in Education Conference*, San Juan, Puerto Rico.

Herron, J.D. and Nurrenbern, S.C. (1999) 'Improving Chemistry Learning', *Journal of Chemistry Education*, 76 (10): 1354–1361.

Johnstone, A.H. (1997) 'Chemistry Teaching – Science or Alchemy?', 1996 Brasted Lecture, *Journal of Chemical Education*, 74 (3): 262.

Kevern, J., Ricketts, C. and Webb, C. (1999) 'Pre-registration Diploma Students: A Quantitative Study of Entry Characteristics and Course Outcomes', *Journal of Advanced Nursing*, 30 (4): 785.

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Knight, P.T and Trowler, P.R. (2000) 'Department-level Cultures and the Improvement of Learning and Teaching', *Studies in Higher Education*, 25 (1): 69–83.

Leathwood, C. and O'Connell, P. (2003) '''It's a Struggle'': The Construction of the ''New Student'' in Higher Education', *Journal of Education Policy*, 18 (6): 597.

Maier, P. and Warren, A. (2000) *Integrating Technology in Learning and Teaching; A Practical Guide for Educators*, London: Kogan Page.

Metcalf, H. (2003) 'Increasing Inequality in Higher Education: The Role of Term-time Working', *Oxford Review of Education*, 29 (3): 315.

Naidoo, R. (2000) 'The ''Third Way'' to Widening Participation and Maintaining Quality in Higher Education: Lessons from the United Kingdom', *Journal of Educational Enquiry*, 1 (2): 24.

O'Brien, C. (2005) 'Changing Ireland; CSO Statistical Yearbook of Ireland', *Irish Times*, 21 October 2005.

Reay, D. (2002) 'Class, Authenticity and the Transition to Higher Education for Mature Students', *Sociological Review*, 50 (3): 398.

Solbes, J. and Vilches, A. (1996) 'A Science-Technology-Society (STS) Interactions and the Teaching of Physics and Chemistry', *Journal of Science Education*, 81 (4): 377.

Spencer, J.N. (1999) 'New Directions in Teaching Chemistry: A Philosophical and Pedagogical Basis', *Journal of Chemical Education*, 76 (4): 566.

Vygotsky, L. (1978) *Mind in Society*, Cambridge, MA: Cambridge University Press.

Warren, D. (2002) 'Curriculum Design in a Context of Widening Participation in Higher Education', *Art and Humanities in Higher Education*, 1 (1): 85.

Watt, S. and Paterson, L.C. (2000) 'Pathways and Partnerships: Widening Access to Higher Education', *Journal of Further and Higher Education*, 24 (1): 107.

Woodrow, M. (2002) Social Class and Participation, Good Practice in Widening Access to Higher Education; The Follow Up Report To 'From Elitism To Inclusion'. Available at European Access Network, 2002.