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# Implications of Mass Education on Chemistry Higher Education

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**Abstract**

The following paper discusses the implications of government policy on widening of participation at third level institutes. The increase in 'non-traditional' students has been widely recognised on an international scale; however some inequality issues still exist. The 'struggles' associated with widening of participation and creating a 'new' student type is discussed in particular reference to chemistry education. A change in mindset of staff on their pedagogical approach to cater for a diverse student body with a broad range of learner types is required. This must be supported from a departmental and institutional level. A look at the literature to investigate what best practice may be in supporting the 'new' third level student is reviewed. In conclusion a view at what the future may hold for third level institutes catering for the 'new' student type is summarised.

## 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 such as the government policy of widening participation in third level education. More places have been provided in higher education courses and a free fees initiative for third level was introduced in 1996. 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 peoples 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 that there is a marked decrease in entry requirements of students entering third level general science degrees in Ireland. This is due to the lack of interest of students taking chemistry at second level. (Childs, 2002) Nonetheless, 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 which is referred to as the 'non-traditional' or 'new' students. 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) In this paper the problems arising in general science courses will be discussed, how these problems may be resolved and a look to the future for the 'new' 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 of participation and creating a 'new' student type are; *students finance, institutional finance, attitudinal barriers, pre-entry guidance, qualifications, flexibility, language and learning difficulties*. (Watt and Paterson, 2000)

In relation to the 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 a lot of the time are not aware 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. Due to their socio-economic background the 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, due to the decrease in students studying chemistry in second level and the lack of interest in general science courses, there has been a large decrease in the entry requirements. It has been shown in a study by

Kevern et al. (1999) that in general, well qualified entrants show a greater tendency to complete their course. The contributing factors to the struggle of the 'new' student are poor study skills, lack of prior academic success, poor writing skills and coming to the forefront in the sciences, poor mathematical skills.

Ireland is slowly becoming a multi-cultural society and the 'new' student also encompasses Ireland's first generation of Irish students where the English language is not necessarily their first language. Language barriers and poor writing skills are 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 education institutes in Ireland (with exception to non-EU residents) the cost of living requires many students to engage with term-time jobs. This has major implications for equity as it has been shown in a study by Metcalf (2003) that *"term-time employment affected the quality of education. Both cultural and financial factors affected who worked during term-time"*. In this study it was also suggested 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 and in Ireland this has been addressed in third level institutes by employing campus Disability officers. The role of the Disabilities office is to support structures and facilities currently available to students within the institute. However, the structures and facilities are dependent on the institutional finance lending to varying levels of support across institutes. It would be interesting to track the future employment of chemistry graduates with learning difficulties to ascertain

(i) what level of support their employers provide?, and (ii) what roles they are employed in?

Looking at the educational barriers of the 'new' student, third level institutes must look towards catering for student diversity (non-traditional, disabled students and students with learning difficulties) in chemistry education. The feasibility of students succeeding in third level education will be dependant on 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*".

**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 the staff are now required to have a greater understanding of appropriate pedagogic practices required. (Knight and Trowler, 2000) "*Practices that are effective for the non-traditional student are likely to be effective for all learners.*" (Woodrow and Yorke, 2002) This may suggest a move to constructivist approaches which include 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). Curriculum is 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) 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 must be considered when developing assessment strategies. Constructively aligning (Biggs, 1999) the learning outcomes and assessment methods in order to drive the achievement of learning outcomes is a necessity. The transferable skills (flexibility, initiative, creativity, problem solving and openness to change) required for our 'knowledge workers' of the future should be integrated in 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 (VLE's) hosted on WebCT or Blackboard may support their learning process. Gorard and Selwyn, (1999) talk about the use of VLE's to create a 'learning society', 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 VLE's incorporated with modularisation will lend to lifelong learning through flexibility. "*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 students taking modules when suites the individual and builds up a set of credits worthy of a degree award or other. 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 due to widening of 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 opportunity of employment 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 re-writing of the curriculum. Creating modules of learning packages which are both engaging and flexible for the student and the lecturer will support the learning process of the student. Modules and learning material may be hosted on-line in VLE's to cater for distance learners, part-time students and students with different learner needs, giving greater access to courses and creating a 'learning society'. Curriculum should be updated every five years and move strategically to support Irish industry and research. Policy writers should acknowledge the implications of widening of participation in higher education and provide financial support to facilitate this societal change.

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