Retention Initiatives For ICT Based Courses

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Abstract - **Ireland has one of the highest concentrations of information and communications technology activity and employment in the OECD. However, there are above average rates of non-completion in such areas of Computer Science (26.9%). The fact that these higher rates are recorded in an area of key national interest in terms of job creation and job retention is a worry.**

The emerging knowledge-based society is transforming pedagogical practices in the post-compulsory, third level, education sector. This is characterised by decreasing use of the traditional face-to-face teaching and a corresponding increase in use of information and communication technologies (ICT). Research has shown that ICT use by student's leads to positive motivational outcomes, supporting a focus upon learning, which, depending on the students personal circumstance, may lead to student attainment and retention.

This paper reports on the pedagogical practices and retention initiatives established for ICT based courses at Irish Universities and Institutes of Technology. The relationships between students' experiences of computing and their success/failure to progress in their course in third level are investigated. The various initiatives, such as creating a sense of belonging, employing pedagogic practices that promote engagement, the development of programming/mathematics learning centers are detailed in this paper and the effects on retention rates presented.

Index Terms – ICT, pedagogies, retention initiatives.

INTRODUCTION

Unlike our European neighbours, Ireland failed to develop its educational system in the immediate postwar years and it was only in 1967 that second-level education was provided free to all citizens. Since 1970, the educational system has been greatly expanded at second and third level to bring it into line with the EU norm. Two thirds of the generation who are retiring from the labour force today left school at 14 or less, and less than 10% of them had the benefit of third-level education. By contrast, 80% of the school leaving cohort last year completed second-level education and over 50% continued on to third-level education. However, how many of these students will complete their studies at their third level institute? An examination of completion rates among students on IT based courses in Dundalk Institute of Technology shows that a large proportion of students who enrol do not finish within the normal duration for their program, and a significant number do not complete their course at all. This is typical of universities and colleges throughout Ireland and globally. Retention rates in 1st year computing courses at Dundalk IT are typically 50-60% for Software Development streams and 60-80% for Application and Support programs [1].

The importance of student success in higher education is incontestable and improving student retention and achievement has, a particularly high priority for the majority of third level institutes of higher education. The issue of retention of students on computing courses in Ireland is particularly manifest in third level educational institutes, where a combination of falling numbers of applicants and reduction in entry points standards, have combined to significantly change the profile of incoming students. High retention rates in computing courses are worrying, especially for Ireland, who was declared once as leader in software development. The probable decline in students studying computing and graduating successfully is alarming for IT companies who have invested substantially in the Irish economy.

FACTORS AFFECTING STUDENT RETENTION

The majority of new students entering higher or third level education leave their initial college of choice without completing a degree [2]. The national US attrition rates have been increasing since the early 1980's at two-year and four-year level institutions, both public and private [3]. The most critical period or stage of vulnerability for student attrition continues to be in the first year of college – at all types of higher education institutions, including highly selective colleges and universities [4]. More than half of all students who withdraw from college do so during their first year [5], resulting in a first-year attrition rate of more then 25% at four-year institutions and approximately 50% at two-year institutions.

Students fail to do well in college for a variety of reasons and we must be aware that there are a variety of reasons for students' non-completion of programs. A study carried out by the Dundalk Institute of Technology Learning Support Unit in 2001 cited the student's reasons for leaving. The principal reason was a lack of interest in their course of study or selection of the "wrong" course (56% of surveyed students). 40% of the students stated that they were unsure about their career objectives and 36% admitted that they were falling behind in some subjects. Other principal reasons given

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included financial and health problems. 20% of students stated that their course of study was not as they expected and 20% had difficulty in managing time (this was particularly the case for students who were commuting long distances, had part-time jobs or children.) References [6] [7] find that students with poor academic skills are less likely to engage in relationships with faculty and other students, and uninvolved students are also less likely than involved students to persist in college, to improve their skills and to implement their career plans.

Relationship between students' experiences of computing and their progression at third level

A recent Organisation for Economic Co-operation and Development (OCED) report [8] placed Ireland in the bottom four countries based on professional development and the use of computers in the school classroom. It also revealed that while the average ratio of computers to students in the OECD countries is 1:9, the ratio is over 1:13 in Ireland. This statistic, according to the Teachers Union of Ireland [9], goes a long way to explaining the dwindling numbers of students pursuing IT courses at third level. Another, and maybe a more influencing factor, is that in Irish second level schools computing is not included as a formal subject on the Leaving Certificate course, (unlike the United Kingdom, where IT is a compulsory National Curriculum subject). It is therefore incumbent on second-level schools and teachers to allocate time for computers and decide themselves the content to be taught. The level or material taught varies considerably depending on the computing expertise of the particular teacher and the resources available to them in the school.

There is a wide variation in the levels of competence that students are presenting on entry to ICT courses in third level colleges. Given that the withdrawal rate of students in computing courses is among the highest withdrawal rate in Irish third level institutions, it is difficult to ignore the wide disparities in computer experience these students have when they enter a first year course [10], [11], [12]. While some students are entering courses with previous experience in programming, web design, multimedia in addition to office applications. Others in the same class may never have used a computer [1]. In cognizance of the large disparity of resources and levels of expertise offered to these students in post primary school, one can hardly be surprised that some are left feeling bewildered and discouraged when faced with how little they know, when some of their classmates exhibit high levels of computer literacy in the early weeks of the course. It is in this period of time that many first year students take the decision to dropout. This also poses a great challenge for lecturers teaching these first year students, as they are dealing with a wide range of abilities.

With Computer Science not being a Leaving Certificate [13] subject, students enter the course without standard or common skill set. Recruitment and retention of computing students is therefore an obvious challenge.

Relationship between ICT and Motivation

No matter what the subject area, the act of engaging in higher education for most students is indicative of their commitment. They want to be successful, and some persevere in the face of considerable adversity, perhaps because of factors that are difficult to measure such as motivation, self-efficacy, and whether the student has a sense of "belonging" (both academically and socially) in the institution. On the other hand, those who drift into higher education without a strong sense of purpose are likely to exhibit lower levels of commitment and hence persistence.

Motivation is a force that energizes, sustains and directs behavior towards a goal [14], and researchers have found a high correlation between motivation and achievement [15], [16], [17]. A student's motivation to learn lies at the very core of achieving success in schooling. Given rapid technological advancement, an ever-changing knowledge base, shifting workplace needs, a continuing motivation to learn may well be the hallmark of individual accomplishment. Research has shown consistently that efforts to improve or maintain student motivation can lead to better retention and achievement [18]. The intrinsic and extrinsic factors that influence the student on their initial course selection are important to remember and there is strong evidence to show that the initial motivations of students as expressed by their reasons for enrolling, aspirations, expectations of college, etc. do not vary significantly between students who subsequently stay and students who leave [19].

It is widely recognized that information technology is one of the most critical tools in higher education as it permeates every aspect of a university, from the first contact tool a student has with its website, through the myriad systems that manage and provide access to its information. Research has shown that ICT use by pupils and teachers in primary and second level education lead to positive motivational outcomes, supporting a focus upon learning, rather than the mere completion of tasks [20]. ICT helps to draw pupils into more positive modes of motivation and appears to offer a means for a range of pupils to envisage success. It enables students see possible end-points for their work, and to recognize that they can work towards these in order to complete work. However, the use of ICT has to be coupled with learning tasks, which are appropriate, and where teaching provides a core of focused pointers (such as where to find appropriate sources, and how to select relevant information.) Positive motivational outcomes are most frequently found when ICT is used to support engagement, research, writing and presentation of work.

Where ICT uses supported internal cognitive aspects of learning, such as in computer science, there are indicators that the motivation arising from the use of ICT was linked to the enhancements in attainment for that specific subject. Innovative and challenging uses of ICT can improve pupil's data handling skills, their ability to construct complex models, their understanding of the value of different from of ICT, as well as increasing motivation. There is a strong relationship between the ways in which ICT has been used and pupil's

attainment, and a crucial component in this is the lecturer and his or her pedagogical approach.

INITIATIVES TO INCREASE MOTIVATION AND STUDENT RETENTION RATES IN COMPUTING COURSES

In tackling the reasons for student dropout or non-completion, it has been shown that a combination of approaches is much more effective at increasing retention, than single strategies. Reference [21] states that most colleges and universities have been unable to increase their retention rates because they tend to use single-treatment strategies in their retention programs. In an Irish context, the Higher Education Authority (HEA) makes a number of specific recommendations regarding how the respective Irish Universities should go about addressing the issue of increasing student retention, with particular concern for computing courses. Initiatives such as adopting a welcoming approach to students, introducing innovative teaching, using ICT in course delivery, establishing learning support centers and facilitating small group tutorials are all advantageous in increasing retention rates.

Create a Sense of Belonging

The importance of the students' first experience of the higher education institution is widely acknowledged. Tinto's [2] model indicated that social engagement, as well as academic engagement, is an important influence on student retention. By adopting a welcoming attitude to students, creating a sense of belonging in the higher educational institute, students will feel more confident in their new surroundings. This applies, as much to when students are choosing the programs on which they will enrol, as when they arrive at the institution. An offhand approach, disorganized or overly bureaucratic arrangements, and excessive queuing for activities are all inimical to student engagement. A positive approach to students supported by existing students as guides and mentors to the newcomers, can help students to feel at home in the institution. Reference [22] stresses the importance of mentoring and peer support for student from non-traditional groups and the sensitivity with which this has to be handled, especially when those involved come from different racial backgrounds. Make the induction process welcoming and effective, avoid overloading the students with information: concentrate on the essentials in their first few days, with a system through which students can follow up particular needs. Have a "one-stop shop" for student support services, thus maximizing the probability that the student query will be brought to the attention of someone promptly. A range of researchers, including [2], [23] and [24], have in various ways emphasized the importance to a student of feeling that they are a member of a community. For some students a sense of belonging will develop as a matter of course: for others it may not, unless the institute makes an effort.

Employing Pedagogic Practices that Promote Engagement

About the middle of the 20th century, educational psychology experienced a major shift as theorists moved away from viewing learning as the acquisition of specific, observable behaviors and toward seeing it as an internal mental and often thoughtful process [25]. This shift, commonly described as the "cognitive revolution" has resulted in a much greater emphasis on teachers knowledge and thinking in the process of learning to teach.

There is extensive evidence of ICT contributing to pupil's attainment [26]. However, the evidence shows that these benefits depend on the way in which the lecturer selects and organizes ICT resources and how this use is integrated into other activities in the lecture and beyond. There is a "homeostatic" tendency for academics to reproduce the teaching experiences with which they are familiar, which may not lead to the engagement of students in more active forms of learning. The availability of materials in electronic form means that "transmissive" forms of teaching, such as lecturing, need to be adopted judiciously, rather than unquestioningly. Contact between academic and students needs to be characterized as "quality time" in which the expensive resource of the former needs to be used to optimal effect. The more learning experiences are active, the greater in the chance of student engagement. An institutional commitment to student learning implies a sustained commitment to the promotion of teaching approaches likely to enhance students' success, and requires firm leadership.

Reference [27] asserts that transferable skills can be enhanced by broadening the learning environment and by using less passive teaching styles. "An emphasis on more active learning by students would seem vital to facilitate the process of "learning how to learn" a skill which is increasingly important in industry today." In endeavoring to broaden the learning outcomes a shift from a closed to an open paradigm of pedagogy is needed. With the closed pedagogy the focus of interest is on the products of learning not the process. The learners are passive, a didactic teaching methodology is used to get the learners to master specific chunks of knowledge; this produces surface learning. With the open paradigm a more active, participative and dynamic learning environment is created. The students will ultimately be learning by doing, learning by experience, sharing ideas, problem solving, synthesizing, communicating, all of which are in the higher order of cognitive skills. The role of the lecturer changes to that of facilitator for learning to happen. "Expertise is seen to reside in the ability to stimulate learning rather than communicating the body of knowledge" [28]. The open paradigm produces deeper learning and is the conduit to developing "generic learning" [29]. It develops core transferable skills along with subject specialist skills thus broadening the learning and hopefully providing a more holistic education. It is more learner-centered; the teaching methodology changes from a transmission model to a facilitative one where the emphasis is on learning or creating the environment for learning to happen.

The creation of innovative teaching methodologies specifically designed to create a more motivating and engaging learning environment for IT students, are facilitating this change from closed to open paradigm. These innovations incorporate the problem-based learning approach to information technology for students of both software and hardware based programmes. Problem Based Learning is a curriculum development and delivery system that recognizes the need to develop problem solving skills as well as the necessity of helping students to acquire necessary knowledge and skills.

The proposed innovation would develop effective approaches to attracting, engaging and retaining existing and prospective students in the areas of IT and on computing courses. Increasing student confidence by fostering good problem solving practice, improving student motivation through the provision of a stimulating, state of the art learning environment are all outcomes of such methodologies. The innovation in teaching creates an infrastructure for an *essential skills* or *outcomes* approach, to ICT teaching/learning which can be introduced across IT-based courses at all levels. This strand could directly tackle the skills shortage in the IT areas by actively developing among student a toolbox of identifiable techniques that need to be mastered in order to demonstrate competence in a range of IT areas.

Using ICT to deliver learning opportunities to computing students also has implications for the retention of such students. Opinions and experiences are mixed as to whether on-line learning results in lower or higher retention rates compared to traditional methods. In many instances the use of ICT to deliver courses results in lower retention rates than traditional methods, although some institutions have stated that retention improves as it allows students to study at a time, place and pace that is most suitable for them. Some may argue that a challenge faced for computer and/or electronic engineering course delivery via ICT is the terms of lab work, a vital part of the student learning. Studies show substantial evidence however, of the contribution made to students learning by specific application of ICT such as the use of computer simulations and modeling [26].

Many institutions recognize that learning using ICT may not be the best method of learning for all individuals and that some will be more suited to this type of learning then others. In recognition of this, pre-entry advice and guidance including checklists of qualities needed for on-line learning should be offered. There is a clear need to ensure that such students have access to other support mechanisms, both pastoral and academic. Many institutions use videoconferencing, chat rooms and discussion groups as a way of supporting students, and have found that use of such technology can enhance the experience of some under-represented students. Just as student support is necessary for traditional methods of learning so it is important for ICT based learning.

Learning Support Units

Reference [30] provides a number of examples of cultures in science-based departments that were indifferent to, and in some instances inimical to, student learning. Wherever there is pressure on academics to focus on tasks other than student learning, there is a risk that the academic culture will be perceived by students as indifferent to their needs. Where students perceive indifference, there may be an effect on students' engagement, and, as [2] observes, this "supports the argument that the students academic and personal development can be enhanced by heavy involvement."

One way to provide a culture supportive of student learning is the creation of a Learning Support Unit. With the support of the HEA Information Technology Investment Fund, several Irish higher-level educational institutes have established such units (University of Limerick - Mathematics Learning Center, Institute of Technology Tallaght – Engineering Support Center, Dundalk Institute of Technology – IT Learning Center, Trinity College Dublin - Programming Support Center.) The activities of the center are justified on the basis that is well known that many capable students, for a variety of reasons, may find it difficult to achieve the required standards in programming or mathematics to support their degree studies. Some of these students would be described as "at risk" and would be most likely to complete their degree programs and there has been remarkable satisfaction and support for the Learning Centers in the various institutions [31][32].

The provision of an intensive support centre for students studying IT subjects is aimed at improving completion rates among student by providing dedicated, focused and expert learning support in the traditionally problematic area of computer programming. The centre provides: peer support, learning evaluation, at risk diagnosis and learning skills development. Specific interventions for under-performing students would include intensive workshops in problematic areas, summer schools for students needing to repeat exams, and one-to-one support and advice, and the delivery of customised IT study skills workshops and the introduction of collaborative learning software.

CONCLUSION

There are many routes one can take in searching for solutions to increase student retention rates in computing courses. However broadly speaking, research in retention falls into two broad categories: (1.) Research that investigates the perceived problems of dropout or failure to achieve qualification goals. (2.) Research that identifies possible solutions: how providers can improve or raise retention and achievement rates [33]. Solutions to the first point and to problems in the field of human behavior are rarely simple. There is a difficulty in understanding why one student withdraws from higher education whereas another, with apparently similar background and characteristics preserves and succeeds. There is however a defined link between students experience with computers at primary and secondary school and their subsequent progression and accomplishment at third level.

Evolving and utilizing innovative ICT developments will assist in increasing students motivation and tackling the retention problem.

When we stand back from the individual student, we can appreciate that certain circumstances are likely to encourage student success and others to discourage it. A major focus is how third level institutes can increase the probability of computing students success and actions such as creating a sense of belonging, employing pedagogic practices that promote engagement and providing accessible and helpful support services assist. Some of these matters are primarily under institutional control, whereas others are for students to take in hand. Yet others, are matters beyond the powers of institutions or individuals, and are the responsibility of Departments of Education and higher education systems, such as introducing computer science as an examinable subject at second level.

Universities and Colleges cannot guarantee students' success, since a great deal depends on the students' own commitment and determination, but they can, through the ways in which they go about their work, increase the odds in favor of success.

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