TEACHING FELLOWSHIPS

2012 – 2013
Project Reports & Outcomes

NUI MAYNOOTH
CENTRE FOR TEACHING AND LEARNING

NUI MAYNOOTH
Ollscoil na hÉireann Má Nuad

FOREWORD
Professor Philip Nolan, President

I am very pleased to introduce this publication, which presents the reports of completed Teaching Fellowship projects for 2012 – 2013.

The reports document and underline the exceptional commitment of each of the Fellows to reflective practice and innovation in teaching and learning. We are rightly proud of their achievements and contributions to the enhancement of student learning.

While each project is situated within its context and its discipline, the outcomes are relevant to colleagues across the Faculties, and the initiatives undertaken are clearly transferable to other subject areas and beyond NUI Maynooth. We also see significant collaborative activity between disciplines.

We will soon enter a new phase in the development of NUI Maynooth, as the Curriculum Commission reports and we implement its recommendations to transform the curriculum and establish a new Maynooth model for undergraduate university education. The work of the Maynooth Teaching Fellows will be extremely valuable as we work to enhance undergraduate pedagogy and learning.

I would like to congratulate each of you on the successful completion of your Fellowships, and thank you for your exceptional commitment and hard work as demonstrated in the reports presented in this volume.

Professor Philip Nolan
President

INTRODUCTION
Dr Úna Crowley

Considerable attention has been directed towards the pivotal role played by teachers and teaching when it comes to student engagement and enhancing the first year experience, with numerous studies demonstrating the link.[1]

The most consistently influential variable on student engagement and students' academic achievement and cognitive development is the behaviour and teaching skills of lecturers. This includes factors such as accessibility, availability and helpfulness; genuine concern and interest in students; and student–lecturer rapport. Classroom experiences such as validation, whether students are intellectually challenged, receiving clear information and frequent, well-timed, constructive feedback, learning new things and given stimulating assignments are the most important teaching associated influences on student growth, satisfaction, learning success and engagement. The establishment of the NUI Maynooth Fellowship Award highlights the University's continuing commitment to excellence in teaching at both undergraduate and postgraduate levels.

The Fellowships are designed to address the strategically important themes of student engagement and/or the first year experience, to recognise emerging scholars and leaders in Teaching and Learning, to promote cross disciplinary dialogue and to further support and stimulate innovative activity in Teaching and Learning across the university.

Fellowships offer the opportunity for colleagues to put into practice ideas they had been considering over time, but which needed seed funding and time to take forward (for example, new equipment or technology not previously available to them to determine its effectiveness for teaching).

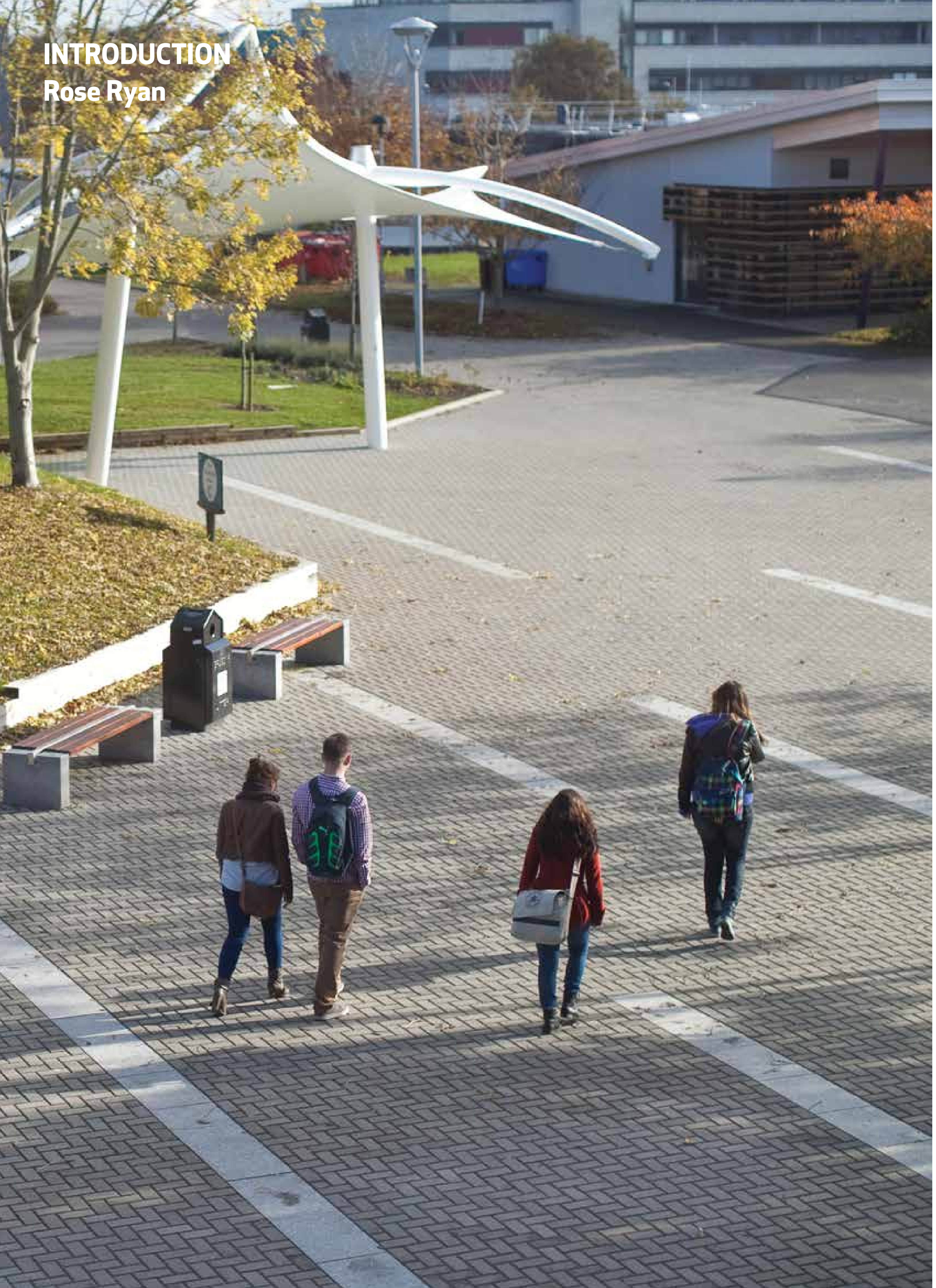
The Fellowships additionally open possibilities to work with colleagues in other departments and draw on the strengths of each other's disciplines. The fruits of those endeavours are now presented here. This publication represents the culmination of more than a year's work by teaching Fellows from the presentation of their proposals at the application stage, through the implementation of their projects, and their completion. It is very encouraging to see the range of projects presented here, the discussion of how they were implemented (including the challenges encountered along the way), and the positive outcomes for students.

I would like to take this opportunity to acknowledge the work of the Fellows and to thank them for their close collaboration with the Centre for Teaching and Learning in the course of the year. Our interactions with Fellows have been very valuable to us as a team and we too have learned from their work.

I would like to congratulate the Fellows warmly on the successful completion of their projects, and wish them well in the continuation of their work.

Dr Úna Crowley
Director of the Centre for
Teaching and Learning

[1] *Pascarella & Terenzini, 2005, Baron & Corbin, 2012; Blaich & Wise, 2011; Kuh, 2010; Thomas, 2012.*



INTRODUCTION
Rose Ryan

NUI Maynooth is one of the leading Irish universities in terms of the diversity of its student body. A large part of our success in supporting students from diverse backgrounds to succeed in higher education is attributable to the development of integrated and innovative approaches to teaching and learning that support inclusion.

The Access Office is excited to support the NUI Maynooth Teaching Fellowships. These projects are stimulating exciting innovation and debate in the area of teaching and learning. The Teaching Fellowships are contributing to the student learning experience as well as supporting student retention, academic achievement and progression. Crucially the Fellowships also aim to embed such developments in the mainstream fabric of the University thereby contributing to the development of NUI Maynooth as an inclusive campus which will enrich the learning experience for all students.

The Access Office congratulates each of the Teaching Fellows on their achievements in this crucial area and would like to take this opportunity to wish you much success in the future.

Ms Rose Ryan
Acting Director of Access
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Designing Large Class Teaching for Inclusiveness: Introducing Universal Instructional Design to Teaching Strategies, Learning Resources and Student Resources

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DR. JOHN G. CULLEN

The project aimed to address the development of strategies supportive of teaching and learning and the development of curricula and resources that encourage student engagement by addressing diversity and inclusiveness. It emerged from a longstanding personal concern that large class sizes unintentionally discriminate against students on the basis of hidden learning problems (such as dyslexia and dyspraxia), physical disabilities, social challenges (such as feeling isolated in third level environments on the basis of one's class etc.) and cultural challenges (such as receiving instruction in a language other than one's first language, or in environments with unfamiliar instructional norms).

One of the key findings of a previous research project I undertook was that large classes did not present a problem in themselves; rather, it was the diversity which is found in such large groups that creates difficulties for students.

This project proposed to address this exploring a practice known as Universal Instructional Design (or Universal Design for Learning). This practice works from the premise that "barriers to learning are not inherent in the capacities of learners, but instead arise in learners' interactions with inflexible educational materials and methods" (Rose & Meyer, 2002, p. vi). Rather than applying UID to one large class scenario, an action research project was conducted with a view to developing knowledge and resources to enable UID across university departments.

Context

Since 2008 I have taught increasingly large classes. In recent years, numbers taking these modules have approached 500. Due to the early stage of growth of my department and recruitment moritoria, it is unlikely that class sizes will reduce in the near future. One of the key findings of the action research project undertaken for my PGDHE in 2010 was that large classes did not present a problem in themselves; rather, it was the diversity which is found in such large groups that creates difficulties for students.

Business students, like students in every discipline, have many rationales for pursuing study in a particular field, but most modules continue be designed, resourced, taught and assessed without reference to the diversity which is found in the student body. Often, we unintentionally assume that the majority of our students are not at a disadvantage, or that they all aspire to similar career goals to those of their lecturers. We then design, deliver and assess our courses with these assumptions in mind, which results in students being unfairly assessed or unintentionally penalized.

Literature Review

One of the key findings of the preparatory stage of the research was that Universal Design is a concept which appears to be much used in practice, but is significantly under-researched, particularly in the context of Higher Education. For example, the Social Sciences Citation Index returned only 14 peer-reviewed 'hits' for the title search 'Universal Design' and 'Learning'; most of which referred to special education. A search of the same database under the search terms 'Universal Design' and 'Higher Education' returned a single peer-reviewed article. A broader search was conducted in a range of databases and a more comprehensive set of results was obtained, but it is important to state that UID/UDL is a hugely under-researched practice and suffers from something of a lack of longitudinal empirical research. This is particularly noticeable in the field of business and management studies where there are virtually no empirical outputs in this professional research field on the subject.

Universal Design first emerged from the field of architectural studies in the 1960s by Ron Mace at North Carolina State University with the introduction of 'barrier free design' as a way of considering methods of eliminating obstacles for people with disabilities. As the benefits to people with a range of needs and abilities were realized the term Universal Design was born. Mace defined universal design as, "the design of products and environments to be usable by all people to the greatest extent possible without the need for adaptation or specialized design" (Hackman and Rausche, 2004). Universal Design, which emerged from a concern for incorporating the greatest level of accessibility in designs for people with disabilities proved to be beneficial to all users of products, services etc. Since the 1990s, the Universal Design approach has increased in usage in many different fields including instructional strategies in the Higher Education sector (Silver et al., 1998) and has become known as UID. Although UID is often researched and theorized in relation to students with specific disabilities (Walters, 2010; Michael and Trezek, 2006), like UD, educational programmes and modules which have been designed with universality in mind have also proven highly beneficial to more general student populations (Reed et al., 2011; Holbrook et al., 2010) and in a range of educational contexts such as, the teaching of music (Darrow, 2010) and occupational therapy (Simmons et al., 2010). It has also been discussed as core to the ethics of socially responsible elements of education (Vavik and Keitsch, 2010; Pliner and Johnson, 2004).

UID aims 'to maximise the learning of students with a wide range of characteristics by applying UD principles to all aspects of instruction (e.g., delivery methods, physical spaces, information resources, technology, personal interactions, and assessments)' (Burghstahler, 2012). UID is related to the more specific concept of Universal Design for Learning which aims to provide 'a framework for designing curricula that enable all individuals to gain knowledge, skills, and enthusiasm for learning' (Ibid., 2). The key component in reaching attaining of these goals is the idea of utilising multimodal approaches to: (1) representing (or delivering) course information to students; (2) engaging students with this material; and (3) assessing student learning through expressing their knowledge:

> **'Methods of representation might include lecture, films, use of the blackboard or PowerPoint presentations, study guides, simulations, computer models, and written summaries of key concepts and terminology. Engagement might be facilitated through classroom participation, group projects, individual research, readings, field interviews and observations, web searches, model building and internships. Expression of knowledge can be assessed through a variety of methods such written or oral times and un-timed tests, individual and group projects and presentations, papers and essays, artistic representations of information, and hands-on demonstrations of particular skills'**
> (Hackman and Rausche, 2004).

As 'universality in instructional design suggests broad and flexible methods of meeting a variety of needs that minimizes the need for special accommodation' (Ibid.), one of the key elements that is required amongst faculty who wish to engage in this inclusive teaching paradigm is flexibility from the outset. This need for flexibility often presents significant difficulties for lecturers, who can become 'burned out' with the diversity that large classes presents (Watts and Robertson, 2011), but who also 'have established teaching patterns and existing curriculum' (Hackman and Rausche, 2004). Challenges are also seen where there is low awareness of UID, lack of teacher training for academics at third level and the often inherently conservative nature of universities (Silver et al., 1998).

Key Outcomes

The key outcome envisioned at the start of the project was the development of a knowledge-base about UID/UDL within the university which could then be exploited by other faculties and departments. NUI Maynooth has an excellent reputation in terms of providing access to learners from all backgrounds and all abilities. It was hoped that this initiative would demonstrate the deep commitment of teaching faculty to this agenda. As is stated below, this project marks the beginnings of a field of professional teaching practice.

The key deliverables from the project stated at the outset were as follows:

1. **This report on the action research project which was submitted to the CTL/Access Office;**
2. **A draft manual on introducing UID/UDL to modules for lecturers. This has been completed and will shortly be uploaded to the project's Moodle page (see item 4);**
3. **A short course / seminar on the topic to be delivered on behalf or in conjunction with CTL/Access Office though the Staff Training and Development Office. This seminar has been designed and will be offered to the NUI Maynooth's Centre for Teaching & Learning for delivery at a time and format of their choosing.**
4. **A Moodle page containing resources on UID/UDL for lecturers has been developed and material from the project will be added to it, and new material and research will be uploaded as it becomes available.**
5. **A peer-reviewed paper has been drafted and is being prepared for submission to Teaching in Higher Education, a practitioner and policy development focused peer-reviewed journal that also carries a '2' ranking on the ABS journal quality list**
6. **A conference presentation will be prepared and submitted as a result work undertaken for this project later this calendar year.**

Part of this project involved undertaking action research on an attempt to introduce UID/UDL in a large class scenario. I elected to do this in a module I taught to first year business students which had 483 students. Data collection took place more regularly than was initially intended (at mid and end-points throughout the project) and the class were surveyed at 3 weekly intervals. Quantitative and qualitative data were collected throughout the process. A number of resources were developed to make the teaching as 'multi-modal' as possible, including:

Methods of representation:

- Lectures
- Professional film clips (every second to third lecture)
- Lecturer film clips and photographs (twice in lectures)
- Weekly-media items (online)
- Lecturer blog
- Graded, assessment focused, PowerPoint presentations
- Weekly pre-lecture podcasts
- Written summaries of key concepts

Engagement

- Classroom participation (through roving microphone sessions)
- Group projects
- Readings
- Observations
- Web searches
- Model building and
- Vocationally-oriented assessments of part-time positions students held.

Expression of knowledge

- Examinations
- 'In-class' ungraded 'mock examinations'
- Electronic examination resource packs
- Oral questioning
- Group projects
- 'Hands-on' skills demonstrations

Project impact

In large, mixed, first year classes it is often the case that attendance rates decrease with time. I found that the adoption of a UID/UDL 'mindset' at the outset of the lectures resulted in attendance remaining very strong throughout the entirety of the semester. Results for the module were very strong compared to past years with a fail rate of only 2% and 6% of the class receiving first class honours.

Students also reported feeling very positive the muti-modal method of delivery and commented positively on what they saw as being a 'variety' of communication devices used. It was seen as welcome break from the usual lecture format, but I remain unsure if they saw this as part of a general lecturing style rather than a concerted attempt to introduce a multi-modal approach to teaching.

Students commented most favourably on the pre-weekly lecture podcast (which was made available on each Monday morning at 7am during the semester as an Mpeg, MP3 and Apple format audio file) and on the electronic pre-examination assessment packs. When I asked for qualitative feedback towards the end of the semester as to why these were welcomed, the response was strongly that such formats allowed students to learn and revise at their own pace.

Action Learning may not have been the most appropriate methodology for this type of study. Only after having begun the project, did I realise that the exploratory nature of the project meant that more time would be needed to develop a deeper resource base and a more expansive understanding of what students need from such an approach. This, however, is not necessarily a 'bad thing' and I have made it the focus of my personal professional development for next year.

There were a number of structural issues that impacted the design of the project. This year was an extremely busy year for my school with a number of unforeseen projects greatly reducing the amount of time that was available to communicate with colleagues across different departments. The largest issue encountered was that of flexibility in delivery. Due to my school's steep growth rate over the last 5 years, a number of expectations have emerged with regard to compulsory completion of assignments, peer-evaluation, usage of peer-evaluation software and student response systems. Although these themselves are examples of other modes, UID/UDL recognises that each class effectively develops it's own culture which has specific requirements. Effectively recognising the diversity within these 'cultures' has greatly impacted how I have contributed to module design as a result.

My fellowship this year has been a preparatory stage for the next stage of development that I will undertake next year.

I believe that sharing my experiences with the following members of the university community could help in the following ways:

Anyone teaching large classes – Watts and Robertson (2011) point out that the sheer scale of large classes can often cause lecturers to retreat into ways of teaching that are 'banking-oriented'. A UID/UDL mindset can greatly alleviate the temptation to do this, and the loss of control that lecturers often experience from doing this.

Novice lecturers – New teachers are often intimidated when beginning to teach. Students greatly appreciate any attempt to make their learning more engaging, and this can be a key confidence building measure amongst new lecturers.

Policy-makers - As the university strategically develops an important departure into the field of liberal education, it will encounter greater levels of diversity, as students face more common routes of entry. This presents a possible difficulty for students who may not share the same social, racial, ability-related characteristics as other learners. UID/UDL can help alleviate this at the outset.

Potential Future Developments

As stated above, it is hoped that the project will continue to be developed next year across all my teaching. The project identified a key structural curtailment - assessment. The restrictive parameters of the module structure has been altered to allow for greater flexibility of delivery and assessment which will be tested across mid-, and large-sized modules next academic year. I hope to report on advances in this practice in the form of an empirical study which will be submitted to a peer-reviewed journal next year and further conference appearances and growth of the Universal Design for Learning Moodle page.

Additional Information

The project ended up being much more 'multi-modal' than I expected at the outset, which meant that I thought about my teaching practice in relation to teaching outcomes in a more focused way. In a large class scenario Watts (2011) noted that lecturers need to build solid boundaries around them – UID involves doing this in a way that doesn't result in the lecturer becoming 'engulfed'.

I was a little disappointed that the students reacted to the multi-modal offerings as consumers, rather than contributors. Despite encouraging students to do so, very few commented on my blog entries, but I hope to develop more work in this regard going forward. Of course, there is huge potential for using social media in this way and further consideration will be give to this field over the next twelve months. In short, I aspire to encouraging a more dialogical form of multi-modal design in my future developments of this fellowship.

I greatly appreciate the support of the CTL and the Access Office for my work. Having completed the project I feel that I am still very much embraking on this learning journey, yet I am looking forward to continuing to improve my own personal practice in this important approach to teaching, and also to contributing to the development of another field of educational expertise in NUI Maynooth.

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Achieving fairness in assessing student group work

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A key challenge for lecturers using group work with students is to find ways to maximize student learning from group projects while ensuring fair and accurate assessment methods. Teamwork and group projects are ubiquitous in education because they enhance the development of skills and knowledge particularly relevant to the real world, provide an excellent forum for experiential learning, promote collaborative learning, and help to more efficiently instruct large student numbers.

Beyond the pragmatic advantages to lecturers of large classes, the literature reports that the learning benefits are numerous and include:

- **the provision of opportunities to apply conceptual skills and theoretical knowledge;**
- **to experience and learn about group dynamics;**
- **to include tasks and activities more directly relevant to professional practice;**
- **to broaden exposure to different views and ideas;**
- **to increase familiarization with different perspectives and problem-solving approaches;**
- **to develop and extend interpersonal and social skills such as collaboration and networking;**
- **to work on larger, more comprehensive assignments individuals would not be able to cope with;**
- **to increase student motivation and engagement; and generally to promote students' learning from each other. (Michaelsen et al., 2004)**

Context

Although the promise of group work as an instructional tool is rarely disputed (Johnson and Miles, 2004), its use often brings about problems that limit and even negate potential benefits (Wiley and Freeman, 2006a). Specifically, the difficulties associated with accurately and fairly assessing individual performance, conflict within work groups, and free riding of individual members are frequently cited problems associated with group work (Fellenz, 2006). Like many lecturers, I have deliberated on ways to maximize student learning from group projects while providing fair and accurate assessment methods and countering the potential negative impact of free riding and internal conflict.

In my view the promise of group work as a teaching and learning method can only be fully realized if perennial problems such as accurate and fair assessment of individual group member performance, intra-group conflict, and free riding are successfully tackled. I have long been intrigued by the promise of using peer evaluation to maximize the learning value that graded group work can bring for students. I have observed that in countries such as Australia, where large classes and group work are the norm they use an information technology solution to this problem. In Australia some universities have adopted SparkPLUS (a software application) to promote equitable participation in group tasks.

I wanted to explore SparkPLUS in more detail. The software enables students to rate themselves and their group peers anonymously against a number of criteria relating to the process of group work, producing two factors that can be used to differentially weight a group mark. Furthermore I felt that by helping students recognise their choices about how they participate in groups SparkPLUS could be effective in promoting more equitable and thoughtful participation in group tasks. It was my intention to examine the development of individual student understanding of the group work process and determine if SparkPLUS could improve the experience of group work for all students and contribute directly to the development of teamwork skills.

Literature Review

It can be difficult for an academic to fairly assess the contribution of individual students to a team project since most of the work may have occurred outside of scheduled lecture or tutorial times (Falchikov and Goldfinch, 2000). Self and peer assessment is often used as a means of handing over assessment of an individual's contribution to a team task to the team members themselves (Johnston & Miles, 2004). In addition to providing fairer assessment, self and peer assessment is reported as assisting students to develop important professional skills including reflection and critical thinking (Mello, 1993; Somervell, 1993). A number of schemes for assessing individual input to student group work can be found in the literature (Fellenz, 2006). Published schemes generally aim at providing differential individual grades for group members (Abelson & Babcock, 1985; Mathews, 1994); increasing the fairness and accuracy of such individual grades (Abelson & Babcock, 1985; Earl,1986; Goldfinch & Raeside, 1990); supporting group development and creating positive learning environments by avoiding negative aspects of group work such as free riding (DeVita, 2001; Goldfinch & Raeside, 1990; Mello, 1993), saving staff time and effort (Rafiq & Fullerton, 1996; Strachan & Wilcox, 1996); and enhancing the experiential learning of students about group dynamics and peer evaluation as well as other professionally relevant skills (e.g., Brown, 1988; Falchikov, 1988; Rafiq & Fullerton, 1996).

More recently authors (Willey & Gardner, 2008a) have reported the effectiveness of using self and peer assessment to improve learning outcomes by providing opportunities to practise, assess and provide feedback on students' attribute development. Falchikov and Goldfinch (2000) reported a link between high quality design of assessment tasks and more valid peer assessments, a view supported by Freeman and McKenzie (2002). Michaelsen discusses the use of self and peer assessment to promote peer learning (Michaelsen et al., 2004), while Willey and Freeman (2006a, 2006b) report using it to produce formative learning-oriented feedback to complete the learning cycle and encourage the ongoing development of skills. Furthermore Boud and Falchikov (2007) discuss its use for developing students' skills for lifelong learning.

Professionals, in addition to being technically competent, require skills of collaboration, communication and the ability to work in teams (Lang et al, 1999). There is a reported competency gap between the level of these skills required by employers and the level developed by students during their undergraduate courses (Meier et al, 2000; Martin et al, 2005). As a way of focusing curriculum development and addressing this gap there has been an increase in assessing students' learning outcomes in terms of specific graduate attributes which they should develop and demonstrate during the course of their degree (Barrie, 2004). Some of these attributes are discipline specific, others are generic to all professions. Generic attributes include teamwork skills, being able to think critically, reflectively and independently and being able to critically appraise your own work and the work of others.

SparkPLUS

SparkPLUS is a tool for facilitating the use of self and peer assessment. It has the capacity to not only assess a student's contributions to a team project, but also allows students to self and peer assess individual work and improve their judgment through benchmarking exercises (Willey & Gardner, 2008a; Willey & Gardner, 2008c). SparkPLUS assists students to make their self and peer assessments by requiring them to rate each other over multiple criteria. The program has the capacity to produce three assessment factors:

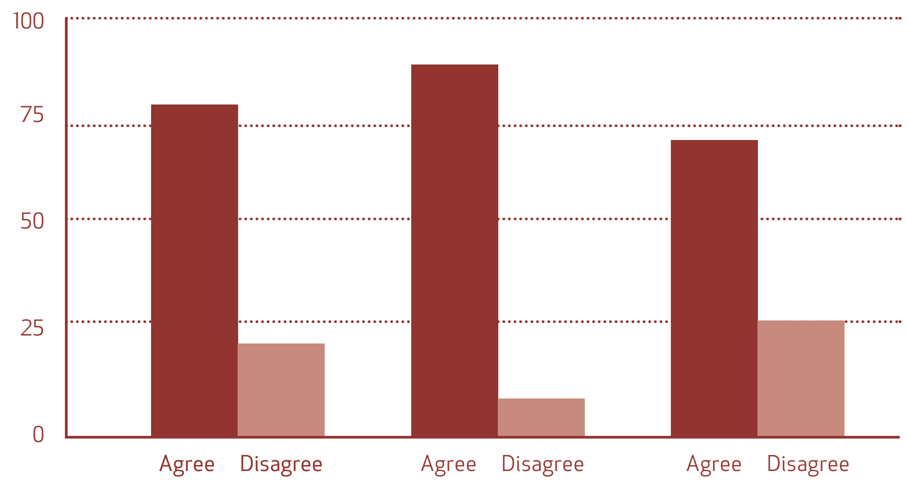
- **The Self and Peer Assessment (SPA) factor is a weighting factor determined by both the self and peer rating of a student's contribution. It is typically used to change a team mark for an assessment task into an individual mark as shown below:**

  INDIVIDUAL MARK = TEAM MARK * INDIVIDUAL'S SPA

- **The Self Assessment to Peer Assessment (SAPA) factor. This is the ratio of a student's own rating of themselves compared to the average rating of their contribution by their peers. The SAPA factor has strong feedback value for development of critical reflection and evaluation skills e.g., a SAPA factor greater than 1 means that a student has rated their own performance higher than the average rating they receive from their peers and vice versa.**
- **The third factor is a percentage mark, the calculation of which depends on the type of task that has been selected (e.g. benchmarking exercise or marking individual work).**

SparkPLUS also allows students to provide anonymous written feedback to their peers and provides a number of options for graphically reporting results. Being a criteria-based tool SparkPLUS allows academics the flexibility to create criteria specifically targeted to allow any task, including development of attributes, to be assessed. In addition, using common categories throughout a degree program, to which academics link their chosen criteria, allows the results to be recorded, for example in an e-portfolio, providing a means for both academics and students to monitor and track a student's attribute development as they progress through their degree.

FIGURE 1: Student survey results for Self and Peer Assessment Marking
Reading my groups input/concept and having to assess them against a list of criteria



Key Outcomes

The results (Figure 1) show that the majority of students (ranging from 73% to 92%) felt that all aspects of the group marking of individual submissions and the benchmarking exercises improved their ability to meet the prescribed learning outcomes. While there were some complaints from students that it took too long to complete all the parts of these exercises, generally speaking most students were positive, "… SparkPLUS allows you to see what people think of your work and how you can improve" (student response).

The results also indicate that the use of self and peer assessment made a significant contribution to students' learning outcomes for the exercises used to determine a team member's contribution.

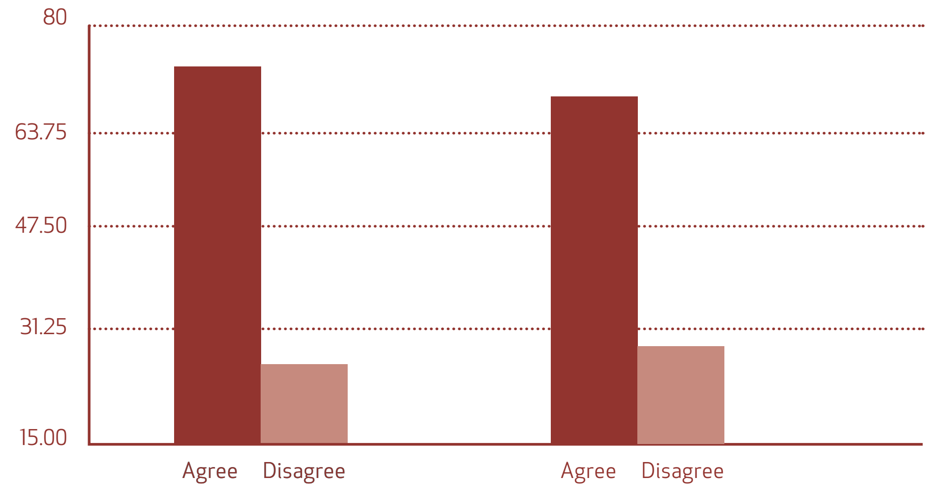
Figure 2 shows that 74 % of respondents agreed that SparkPLUS improved their ability to correctly complete assessments with 70% agreeing that it helped them improve their team contribution. In addition to these results there were many positive responses. A sample of the student comments are reported below:

"Peer assessment facilitated by SparkPLUS improved my group work experience by facilitating and giving me peer feedback with regards to the contributions by the team. It gave all team members an opportunity to give fair and constructive feedback (mostly) to each other, thus improving the performance in projects throughout the semester, and most likely in later subjects also."

"Improved my group work experience as SparkPLUS enables a fairer assessment, I was driven to participate and function with my team as a group. It gave me the opportunity to see my effort (by my SPA rating) and also to know what other team members thought about my performance from feedback received.

FIGURE 2: Results from Post Subject Survey

Multiple uses of self and peer assessment & feedback sessions improved my ability to assess my work and the work of others.



Multiple uses of self and peer assessment & feedback sessions improved my ability to assess my work and the work of others.

Multiple uses of self and peer assessment & feedback sessions enabled me to respond to feedback to improve my team contribution.

I really enjoyed working in a group for this subject and I think SparkPLUS had a big influence in that".

"I strongly believe SparkPLUS should be used for every group work assessment in university and has the potential to be utilised in the workforce."

After reflecting on the use of self and peer assessment with the student cohort, the results are not surprising. I inform students that while fairness and catching free riders is an outcome of using self and peer assessment, it is almost a by-product and happens as a matter of course. I articulate that the real aim and indeed most of the related instruction and tutorial time is spent on facilitating feedback to improve learning. However, it is these two tasks where students assess each other's contribution to team tasks that have the greatest potential to affect their final grade. Ramsden concluded that "from our student's point of view, assessment always defines the actual curriculum" (Ramsden, 2003, p. 182). Some comments from the students reinforce this view:

"Feedback couldn't be used to improve mistakes and consequently improve the assessment marks. I feel it's a big waste when this is the case as the feedback isn't taken as serious as it should be as you can't use it to improve your marks. Even though it helps you to learn, as it doesn't show through in the assessment marks which is ultimately the students number 1 aim, …"

In general for innovations to be successful students must see them as being both useful and adding value to their education. Michaelsen et al., (2004) reported that successful students rated the ability to contribute positively to team-based projects as the most important of 49 possible reasons for their success. Employers are also aware that a student's generic attribute skill level is a good indicator of how successful and valuable they will be as an employee.

Despite this, the development of these attributes is not typically recorded in academic transcripts and in some cases can only be fairly assessed by student peers. The inclusion of self and peer assessment to track student's development within different attribute categories is one method of providing evidence of this development.

A by product of this research was that after initially trying to allocate the module assessment criteria to the different attribute categories I discovered that many criteria needed to be rewritten to more accurately reflect the desired learning outcomes. This realisation led to the innovative redesign of tasks to assess and hence better achieve these learning outcomes. In particular, I was challenged to design assessment tasks that had components that contributed to the relevant attribute categories for the subject. Assessment tasks have now been designed to more thoroughly test a student's application or ability to combine and apply requisite knowledge rather than just testing this knowledge itself. While these results from a single trial need to be interpreted with some caution, they do support the argument that self and peer assessment should be included in any comprehensive method to assess, monitor, track and provide feedback on students' graduate attribute development.

Project Impact

The main aim of using SparkPLUS was to assist students in identifying their individual strengths and weaknesses and through reflection address any competency gaps in their development. The assessment metrics produced by SparkPLUS were shared between all group members in structured feedback sessions several times during the semester. Students were guided on how to both reflect on their own performance and learning, and to give constructive feedback to their team peers. The process focused on improving students' judgement and moving them to be more expert in their ability to engage with subject learning outcomes.

The research results show that the use of self and peer assessment was successful in assisting students to achieve the desired module learning outcomes. The majority of students, greater than 70%, reported that its use improved their ability to meet the module learning outcomes. Using SparkPLUS to assess individual contributions to group work provided an important and substantial step toward dealing with fair assessment of an individual's performance in a group exercise and enabled me to more fully utilize the many benefits of group work for student learning.

SparkPLUS has proven to be an effective approach to empowering students and increasing their engagement in learning. It helped to deliver the full promise of group work as a learning and teaching method and added to the opportunities for experiential learning through active student engagement in peer evaluation. Like other contemporary teaching and learning approaches (Bilimoria & Wheeler, 1995) SparkPLUS moved learning and assessment toward a more student-centered model. SparkPLUS can improve the quality of the students' experience and increase their engagement in the learning task which after all is the best basis for improved student learning from group work.

However SparkPLUS is not without its faults. A number of additional issues should be considered:

1. **Extensive explanation, opportunities for discussion and student input, and strict lecturer adherence to communicated and agreed-on procedures are important for student acceptance, particularly in contexts where peer evaluation is new or has little initial acceptance.**
2. **Students often need time to understand and come to terms with SparkPLUS, and to recognize its benefits. Although most students quickly accept and approve of the approach, some need more time and support.**
3. **As the time required for introducing and implementing SparkPLUS are considerable, commitment to the method by the lecturer is essential. Occasionally technical issues in its application arose and required communicating with the software company. It would be more prudent for a University wide dedicated technical individual to be responsible for the administering of SparkPLUS similar to that of moodle.**
4. **Using SparkPLUS has raised student expectations regarding the quality of all assessment procedures across different parts of a programme.**
5. **Given the time and effort required from instructors and students, SparkPLUS should be employed only if a substantial amount of credit is given for the group work.**

Potential Future Developments

This research supports the inclusion of self and peer assessment processes into any method to assess, monitor, track and provide feedback on student development. Furthermore I found that student engagement with these processes was enhanced by linking student's development to the attribute categories required for professional accreditation. I also found that this type of implementation had strong potential to influence curriculum development by challenging academics to design assessment tasks that had components contributing to the required attribute categories for their subject.

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Department of Chemistry

Peer-Teaching to Enhance the Learning Experience in the Chemistry Laboratory.

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Chemistry is an experimental science and the laboratory sessions should be at the centre of the student learning experience. We envisaged the practical classes to be not only an opportunity to teach technical skills, but also to develop other important aspects of undergraduate training. 3rd year Chemistry students were asked to work in teams and prepare short pre-lab talks, which were delivered to their peers ahead of the lab session.

The students were allocated in groups of 4 and they were asked to cover health and safety, experimental procedure, instrumentation and mechanisms relevant to the experiment to be carried out.

The students were able to avail of an LED interactive system to prepare and display their presentation, to their peers. This type of system lends itself very well to the visualization of molecular structures and mechanisms. It allowed the students to construct a presentation framework (which could include display of material safety data sheets, chemical structures or equipment diagrams, for example), prior to the delivery, as the time allocated for the pre-lab talk during the practical sessions was limited (approx. 20 min).

Each team was advised during dedicated "help-desk" session by a designated demonstrator and the academic in charge. The students were assisted on the use of software and equipment, material to include and review on the pre-lab talk and layout of the presentation.

As this was the first time that pre-lab peer teaching was been piloted in the Chemistry department, the content and delivery of the pre-lab talks was not assessed.

At the end of the project, after all students had presented, a detailed questionnaire was circulated to be filled anonymously, to survey the overall learning experience, which was found to be mostly very positive. Examples of the questions and analysis are provided in the appendix.

Context

During 2012, I took part in the trial of context-based learning resources developed by the Royal Society of Chemistry. This involved working closely with a small group of students and assisting them in the preparation of a project around anti-malarial drugs using wikis. This experience was an eye-opener, as I could observe the response of the students to more constructive teaching approaches, in which they are put a the centre of the learning experience and are asked to take ownership of their own work. The effects that this had on the achievement of the expected learning outcomes and engagement made me realize how important it is to facilitate active learning experiences to the students.

As an experimental scientist, I have always enjoyed the practical component of Chemistry. The laboratory is the perfect context to bring together the theoretical concepts discussed in the lectures and their practical significance. The laboratory provides an ideal environment, where students "learn as they do". The practical settings prompt the communication between students, who very often engage spontaneously in "peer teaching". It was hoped in this project that structured guidance and peer teaching in the form of the pre-lab talks could provide an excellent opportunity to enhance the learning experience of the students in this environment.

Literature Review

The benefits and suitability of using the peer teaching approach in a laboratory (not necessarily a chemistry one) have been well described and documented in literature. The laboratory settings are particularly approximate for this, as it facilitates in its own nature a collaborative and interactive learning environment, where students can demonstrate to each other how to carry out an experiment, a technique, a procedure, etc. A very relevant example of peer teaching in the Chemistry laboratory was recently described by Munoz-Garcia and co-workers[Munoz-Garcia et al., 2012]. This team used peer teaching as a method for active learning, and they set the context of this experience in an electrochemistry laboratory. In this work, the authors also surveyed the students and collected their feedback using questionnaires. The analysis of their results indicates similar trends to those observed in our project. For example, 80% of the students surveyed were in agreement with the statement "I understood the lab better when it was presented to me by a class mate". This is very comparable to what we observed in our experience, when considering the responses offered by the General Science, Pharmaceutical and Biomedical Chemistry and Biotechnology cohort of student (see Appendix, graph 1). Although the type of techniques and instrumentations that would be carried out in a synthetic lab (as in our project) and in an electrochemical/physical lab (as described in this publication) differ substantially, one can clearly see how the peer teaching approach lends itself well to

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the science laboratory environment, and how it can be adapted into the practical component of many different disciplines.

The work reported by Chambers and colleagues describes how peer teaching can also be applied to the context of pharmaceutical care [Chambers et al., 2000]. In this work, it is described how students from the more senior years train first year students in basic pharmaceutical care skills. This also represents an interesting idea for implementing peer teaching throughout the different years of a degree. Numerous examples of peer teaching as an effective tool can be found related to the training of medical professionals, for example, the publication reported by Krych and colleagues on the peer teaching in the anatomy laboratory [Krychet al., 2010]. This approach seems to be particularly popular in the nursing community and a number of reports and reviews are available on this topic. As representative examples, see the review discussed by Secombe on the advantages and disadvantages of this methodology in the training of healthcare professionals. [Secombe J., 2008] For specific examples, the work reported by Kurtz involves peer teaching implementation on the simulation laboratory for nurses. [Kurtz CP, 2010].

Key Outcomes

- **Logistic requirements and feasibility:** The implementation of the project demonstrated, in the first place, the feasibility of adopting peer teaching in a laboratory environment, for relatively large class size (92 students participated). To this end, with the help of Ms. Ria Walsh and Ms. Barbara Woods (technical staff), a preliminary working system was developed, concerning several organizational issues. These included appropriate allocation of students into teams, allocation of the different experiments to each team, examination of convenient timelines and design of a suitable schedule for the pre-lab talks and preparation of a timetable for the help-desk sessions for each of the teams .In addition, information sessions were arranged to introduce to the students the implementation of the peer teaching project. Documents outlining the proposed implementation plan (including project aims, group and experiment allocation, pre-lab talk schedules and help-desk sessions timetable) were drafted and circulated to the students. They were also made available in Moodle in dedicated sections in the corresponding Module space. Support material including guidelines on preparation of presentations and working as part of a group were also prepared and distributed amongst the students.

  This pilot project provided us with an initial framework for the logistics and requirements involved in implementing peer teaching in medium size groups, and has demonstrated its feasibility.

- **Student engagement:** For this pilot project, the content and delivery of the pre-lab talks was not formally assessed. Significantly, and even if no contribution to the final module mark was to be obtained for their participations, most of the students engaged very actively with the project. While poor attendance of the students to lectures is a recurrent issue, the majority of the students attended their scheduled help-desk sessions and send their presentations for review to the academic in charge in advance of their presentation well within the deadlines. They were also keen to take part in discussions during the small group help-desk session, which certainly encouraged their participation.

- **Student feedback:** Very detailed feedback was obtained from the students after the completion of the project. They were asked to fill in a questionnaire from which we have gained very valuable information for the development and future implementation of peer teaching in laboratory settings. Examples of the questions and analysis are provided in the appendix. The most significant finding from this survey indicate that the majority of the students:

  - *found the overall experience worthwhile and useful*
  - *had a better understanding of the lab sessions as a result of the peer pre-lab talks*
  - *would like some type of assessment*
  - *would like structured guidelines and assistance.*

- **Student support and resources:** After completion of the project, we gathered a collection of pre-lab talks that were generated by the students. The availability of the interactive LED display system facilitated their preparation. During this process we familiarised ourselves with the capabilities of this system, and have identified a number of topics and experiments that can be developed into problem based exercises and can be useful resources and review material for students.

Project impact

The students benefited from the implementation of the project at different levels. They showed a better understanding of the experiment to be carried out, since they had previous exposure to it as a result of the pre-lab talk, delivered by themselves or by their peers. Although students are provided with a lab manual, many do not read it before the practical; the pre-lab talk assisted the students to familiarise themselves with the procedure and techniques they were going to carry out during the experiment. This was also corroborated by the demonstrators. In order to prepare for their pre-lab talk, the students had to carry out independent reading and research the aspects of the lab they had to cover. At the same time, they were given advice by the academic and help-desk demonstrator, and constructive feedback was offered to them during preparation. As indicated earlier, often students engaged in discussions during sessions. Also, some students used this opportunity to ask questions about lecture material (or additional reading material) related to the pre-lab talk they had to prepare. This provided a forum where students, working in a smaller group, felt more relaxed and willing to engage and did not feel afraid to ask questions and offer answers.

The students gained experience on how to prepare and deliver a clear and well structured presentation; they learnt how to use PowerPoint and the LED interactive system and the software associated with it.

Working as part of a team provided a very useful experience to the students, in many regards, especially when it came to the need to organise the work amongst themselves. They had to designate a "team leader" responsible of coordinating the work and liaise with the academic for review prior to the pre-lab talk. They learned to take responsibility for their work, as their contribution affected everybody else in the team. Students also learned to work and respect their team members, and to be able to communicate with others, to manage their time and to be aware of deadlines.

Most of the students appreciated the opportunity to take part in an active learning exercise. For this to be a successful experience and achieve the intended learning outcomes, it is very important that the students are given clear guidelines and structured assistance. It is also necessary to review their pre-lab talk, prior to the presentation to their peers, in order to ensure the quality and accuracy of the material presented. This is an ideal opportunity to provide constructive feedback and foster discussions.

Peer teaching and resources like the LED system are most suitable for small group learning exercises, such as workshops and tutorials. However, as shown in this project, it can also be adopted in medium size groups.

The student response and engagement with the project has been very positive during the implementation of the project, and has facilitated channels of communication between the students and between students and staff (academics, technicians, demonstrators). Therefore, I think peer teaching opportunities should be sought not only in laboratory environments, but also in other settings and disciplines across the university.

Potential Future Developments

As discussed above, the feedback received from the students after the implementation of the project has highlighted the positive response of the overall experience. Moreover, the students themselves recommend that the peer teaching pre-lab talks be continued for future 3rd year Chemistry students. This has prompted us to adopting peer teaching pre-lab talks as part of the Organic laboratory sessions.

Taking into account the feedback of the students, this new component of the lab will be assessed, and the mark received will contribute to the continuous assessment mark of the module. MCQ questionnaires will facilitate this. This is the subject of an application submitted for the CTL Fellowships 2013-2014 by Dr Frances Heaney, Ms Ria Walsh and myself. We envisage that the experience and knowledge gained during this current project will be extremely valuable as we refine our approach and implementation of peer teaching in the lab. We would also like to revise the settings for the help-desk sessions, in order to make them better structured and more time-efficient. We also expect to make use of the resources obtained during the current project in order to develop them into problem based review material.

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Appendix:
After implementation of the project, students were asked to fill in a questionnaire for feedback on different aspects of their peer- teaching pre-lab experience.Examples of the questions and analysis are provided in the graphs below.

In some cases, the answers have been categorized depending on the student's degree:

- SCI (General Science)
- PBM/Biotech (Pharmaceutical and Biomedical Chemistry/Biotechnology)
- SciEd (Science and Education)

1. It was a good experience to do the pre-lab talk
2. I was able to understand and follow the experiment in the lab more easily after the pre-lab talk
3. Did you think it was useful to prepare your pre-lab talk as part of a team?
4. Do you think the pre-lab talk should be assessed and marked?
5. Did you find the "helpdesk" session useful for the preparation of the pre-lab talk?

Department of Computer Science

A virtual bridge between Maynooth and Kilkenny for Software Development students

DR JAMES POWER

In the 2012-13 academic year the Computer Science department received funding under the Springboard programme to run a one-year part-time Certificate in Software Development in our Kilkenny Campus. The course was fully-funded for eligible job-seekers, and consisted of 6 modules (30 ECTS credits) covering programming, databases, software testing and project work. The funding was based on a full face-to-face teaching commitment by the department.

This teaching fellowship project sought to augment the usual series of lectures and labs by using virtual learning technology to provide additional support, based in Maynooth, for the students in Kilkenny. We had originally intended to use Second Life as the environment for delivering the tuition, but due to technical difficulties, instead used the Blackboard Collaborate system. The system was used in both semesters, in two ways: first, to provide virtual office hours, giving the students access to course lecturers; and second, to provide on-line tutorials, given by graduate students in the department.

Context

NUI Maynooth has been teaching courses in its Kilkenny campus for 15 years and, in the 2013-14 academic year, will be welcoming its first intake into First Arts. These students will be based full-time in Kilkenny for their first year, and will transfer to the Maynooth campus for years 2 and 3. Computer Science has been taught as a first arts subject for several years, and this programme also provides one route of access to our CSSE degree. Separately, the government launched the Springboard programme which provided funding for courses designed to re-skill job-seekers. In this context, the department of Computer Science committed to running a 6-module certificate in 2012-13 under the Springboard programme, designed to be compatible with the 4-module Computer Science stream in first arts. It was hoped that the combination of Springboard funding and first arts students would provide a medium-term future for teaching Computer Science at our Kilkenny Campus.

Since Computer Science is a lab subject, with particular emphasis on programming in the early years, running this type of course posed considerable challenges. Typically, labs and tutorials in our Maynooth campus are supervised by graduate students and, in some cases, senior undergraduate students. Programming, in particular, has received special attention in recent years, and an elaborate system of support, including demonstrators, labs, peer learning and a help-desk, have been put in place. The problem with delivering similar material in Kilkenny was the unavailability of graduate students, or any form of lab support other than the lecturers on-site. As well as the problem of fewer personnel on site, there was also a reduction in the 'social' elements of the support infrastructure, including peer-learning and informal (non-scheduled) access to staff.

Literature Review

There has been much research recently on distance and blended learning as educational organisations seek to capture new audiences and reduce costs. Supporting solutions can range in both technical sophistication and the level of interaction offered or required (Dodero et al., 2003). For example, providing Moodle-based access to resources such as slides, exercises and audio/video material, allows for a relatively simple approach, with low technical commitment and scope for modulating the balance between on-line and face-to-face contact (Rößling et al., 2010). At the other end of the scale, the emergence of massive open on-line courses (MOOCs) offers a model that is completely on-line, though again relatively straightforward from a technical perspective (Martin, 2012). Finally, immersive education environments offer a technically challenging environment, but can be used in either a blended or fully on-line learning context (Sutcliffe et al., 2011).

Much of the original background research for this project concerned the use of immersive educational systems such as those based on Second Life, as this was the original goal of the project. There are a number of challenges associated with such systems. These include the creation of virtual environments, which can involve significant technical effort, as well as the possibility that students will be distracted or otherwise discouraged from engaging in learning activities while in the system. A general-purpose environment such as Second Life has the advantage of providing other means of social interaction, with the disadvantage that this is, of course, outside the control of the course lecturer. Full control can be gained from using a bespoke solutions, such as that provided by an open-source environment like OpenSim, but the disadvantage here is the relative 'emptiness' of such worlds. Finally, a proprietary system like Second Life always carries the risk that the owners of the system will seek to control or interfere with the learning environment (Ramaswami, 2011).

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Since, ultimately, it was not technically possible to use Second Life in this project, further background material on the system will not be discussed here, but the interested reader can consult the references given below, particularly Kloos et al. (2011) and Gardner et al. (2012).

Key Outcomes

As noted previously, the original intention of this project was use the Second Life system to provide an interactive learning environment, where students based on the Kilkenny campus could interact with mentors based in Maynooth and, possibly, other students in Maynooth. However, it quickly became evident that using the Second Life system over the Maynooth/Kilkenny network posed technical problems relating to network connectivity that could not be resolved in the short term. Alternative solutions, involving the OpenSim environment were investigated, but similar problems arose. Thus, as a fall-back position, the Backboard Collaborate system was used instead.

The system was used in two main ways. First, two of the lecturers involved in the course ran 'virtual office hours' on a weekly basis during the first semester. This consisted of a designated time during which the lecturer (based in Maynooth) would be available to answer questions on the course via the Blackboard system. These proved popular with about one third of the class, and mainly focussed on practical aspects such as programming. This seemed particularly suited to the Blackboard environment since programs could be easily typed in the collaborative space and then discussed with the students, and edited in-place. It also allow the students to copy and paste the code to their own computers and try it out there – something the students regarded as particularly important.

During the second semester the Blackboard system was used for tutorials on the programming module. These tutorials were provided in two streams.

The first stream was a set of general tutorials, available to all the class, run by a postgraduate in traditional problem-solving mode. The second tutorials were one-to-one targeted tutorials, aimed at students who appeared to be struggling with the material. Both of these were well attended, with the problem-based tutorials tending to centre on revising material that had been covered in the labs.

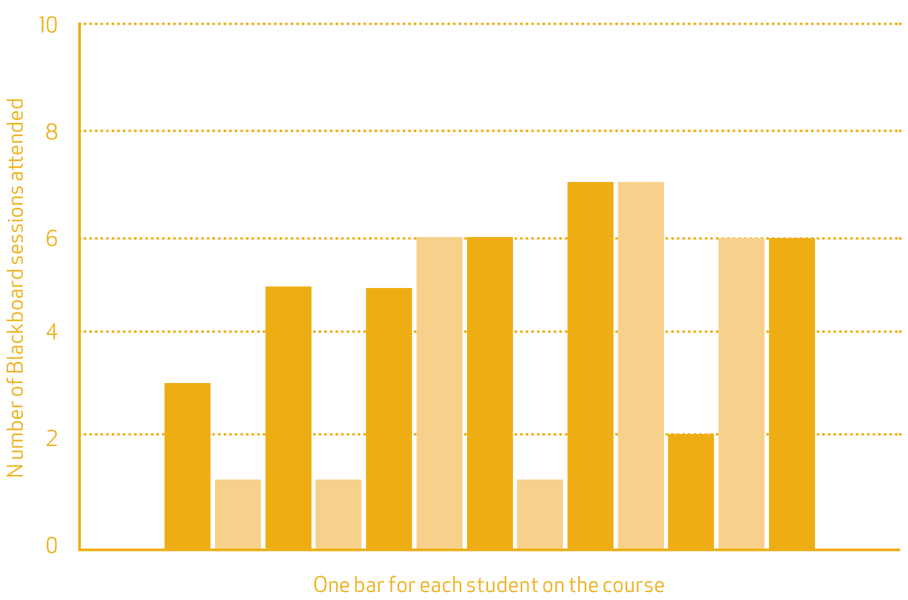
There were some initial problems with the set up of the system as the students sorted out issues with their network connectivity and headphones, but this quickly settled down as they became used to the system. Generally, the students reported a positive experience with the system, although three of the 12 students did not make significant use of it. One interesting finding was that the students all chose to use the system from home. A fully-equipped lab was set up in Kilkenny, with the students on the course having exclusive access (and good connectivity), so it was something of a surprise that they chose not to use it. However, it should be noted that these were part-time students, and so access to the campus itself may have been an issue here.

Project impact

Since there were only 13 students on the course, it is difficult to present convincing data on the relationship between their use of the Blackboard system and their performance in class. In particular, since later tutorial were targeted at weaker students, this would distort any attempt to compare marks with usage.

The following figure shows the usage of the system during both semesters. Here each bar represents a student in the class, and its height is determined by the number of Blackboard sessions the student attended. The second semester data includes the one-to-one tutorials, and so records quite high usage by some students. As can be seen from the chart, the majority of the students made significant use of the system, with some notable exceptions. (Two of the students who made little use of the Blackboard system subsequently withdrew from the course). Note that due to the different number of Blackboard sessions available in each semester, the scale on the horizontal axis on each graph is different.

SEMESTER 1 – Autumn 2012



On reflection, two main points emerge regarding the Blackboard Collaborate system. First, the system proved to be technically robust and quite usable, both from the lecturers' perspective at Maynooth, and from the students' own computers at home. Initially, there was some overhead in getting the various audio and other elements working, but this decreased as the lecturers and students got used to the system. Second, the students did not appear to have significant misgivings about using the system, and quickly adapted to it, and made good use of it.

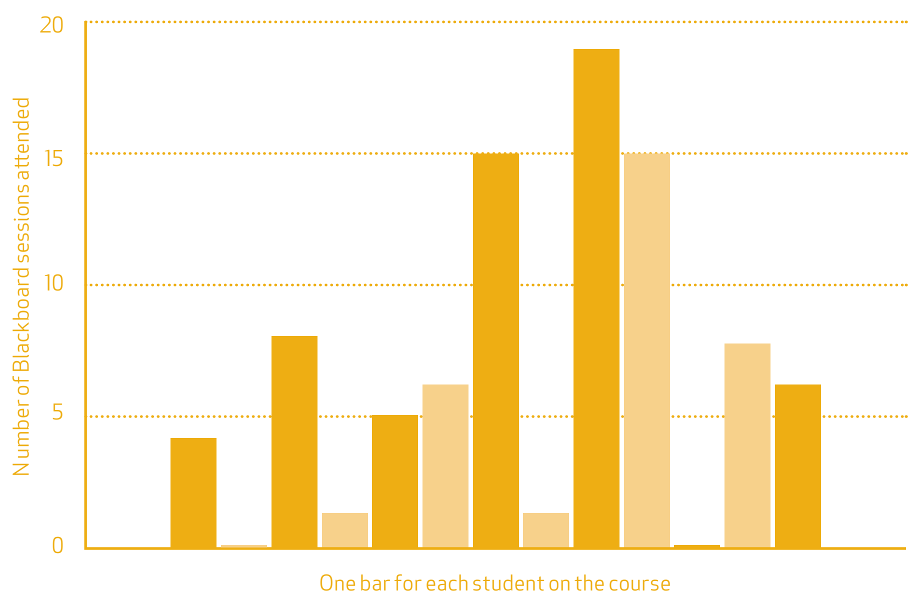
Some caveats would have to be offered also. First, these were students on a CS programme, and thus could hardly claim any kind of technophobia, or reluctance to use computer-based technology. Second, the nature of the material (programming) leant itself naturally to presentation in the system, since it was text-based, and lecturers and students could collaboratively view and edit sample programs. Third, all the Blackboard-related support offered was as an 'extra' in the course, over and above the usual lectures and labs, and this may have made the students more appreciative of its availability.

While the overhead involved in setting up the project and using the system was not any more than might have been expected, it was still significant, and effectively front-loaded. Now that factors outside our control have ended our relationship with Kilkenny, it is difficult to see any immediate benefit to the department from this project. Thus, I would recommend that anyone considering developing such an approach should seek a firm medium-term commitment to the programme at university level, so that the significant up-front overhead can be ameliorated over the lifetime of the project.

Potential Future Developments

Shortly after the start of this project, it was decided at university level to exclude Computer Science from the first arts offering in 2013-14, so our immediate future had to be based on the Springboard funded programme. Regrettably, Springboard funding was not secured for 2013-14, thus effectively terminating our department's involvement with the Kilkenny Campus. Hopefully, our experiences may be useful for other departments that continue to be involved in Kilkenny.

SEMESTER 2 – Spring 2013



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The Immersive Education Initiative, http://immersiveeducation.org/

OpenSimulator, http://opensimulator.org/wiki/Main_Page

Second Life Virtual World, http://secondlife.com/

Departments of Computer Science, Music & Media Studies

INTERCEPT – Interdisciplinary New Technologies for Entrants to Reinforce Creativity, Enthusiasm, and Practical Thinking

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The motivation behind the INTERCEPT teaching fellowship project was to develop a program of extra-curricular activities that would appeal to first-year students but that also could be opened up to include more senior years. The project was a collaborative effort between the Departments of Computer Science, Music and the Centre for Media Studies, and was created for students on the Music Technology and Media Studies degree programs.

The students on these programs enjoy both art and technology. However, prior to entry to the university, they will have had much more opportunity to exercise their artistic skills because developing technological skills can require expensive equipment and mentors with experience, which are not usually available at secondary school level. The project aimed to have an open environment, that was supervised, where students could come each week and learn by making technology that was relevant to their field of study. This technology could be in hardware or software; previous involvement in a 'Maker's club' lab was the inspiration for this approach. The extra curricular sessions were to be run once a week and the funding would be used to pay for demonstration and the purchase of relevant equipment and components depending on the individual projects that the students wanted to work on. The project team leaders had experience with making music technology and multimedia applications in hardware and software so were in a good position to help the students to formulate and execute their ideas. Also, they would help them to learn to implement their ideas step by step, which is the only way to create technology effectively.

Context

The prior experience of being involved in the 'Maker's club' at the Department of Electronic Engineering was the spur for creating this project. The openness of this club where the students by themselves found what they liked to work on, instead of just tackling the prescribed assignments they had with their modules, was seen to be very rewarding for them. Furthermore, the recent prevalence of a DIY culture of hardware and software projects, with instructions distributed as text, images and video over the internet, made it possible for students to pick a project to begin building and learning from. Because experienced academic staff attended the club it meant that any technical problem could be tackled successfully and therefore students had a good chance of completing their projects.

It was felt that this collective learning could be extended and formalised for incoming first years as for many years students had expressed an interest in these types of activities. We believed that by creating our own space students would feel less intimidated and be more successful.

Literature Review

The inspiration for this project came from the Maker movement. This started on the west coast of the US around 2005 and year-on-year its popularity has grown immensely and it is now worldwide. This movement was the result of several trends: the availability of high quality open-source software tools and hardware kits; cheap hardware controllers and components; online collaboration facilities; and a desire for people to connect and build physical technology. These developments led to the appearance of Maker workshops and gatherings, known as a Faire. The whole ethos behind this movement was for participants to enjoy making technology and just appreciate the art of doing. It is only more recently that this movement been noticed by the academic community. A workshop titled 'Innovation, education and the Maker movement' [1] was held in 2010 in New York. It was acknowledged at the workshop that there have been parallel developments in the academic sphere over the last decade in research into education strategies for the STEM (Science, Technology, Engineering and Mathematics) subjects. Both approaches have many shared goals including deep engagement with content, critical thinking, problem solving, collaboration, and learning to learn. One of the aims of the 2010 workshop was to discover how the Maker movement could be used to invigorate teaching and learning in the STEM fields.

The intention being that the act of making would draw the learner into finding out more about the theory that underlies the technology they are working with. A major difference between the outputs of making and those of a formal education environment is that it is not results-driven. There is no evaluation of the output per se, the value is derived from the process of making itself. It is intrinsic. Third-party commentary is merely observation. This, therefore, is a point of divergence between the academic and the maker approach. At the workshop, the subject of soft metrics for assessment was discussed. This could be a 'Hope Index', or some other measure of engagement. Another proposal was to assess the intellectual progress of learning to make by the reordering of a particular set of learning strands designed for students of science. This ranged from an initial exploration and testing, up to identifying themselves as a contributor and being part of a collective. By the close of the workshop it was recommended that more needs to be done to find more effective means for assessing the affective dimension of Making that distinguishes it from other hands-on approaches to teaching in the STEM disciplines.

From the workshop proceedings it can be seen that there are a number of interesting academic challenges that surround the phenomenon of Making. As a result, our particular project could contribute to the discussion and was definitely worth observing. However, because it was the first time to consciously run this type of Maker group we are cautious as to how we interpret its intellectual trajectory and its final outcomes. Nevertheless, this year's project could be a way of foundation for the establishment of future maker groups which might fill the knowledge gaps that currently exist. As it turned out, it was the practicalities of student availability that determined how the project could be run during the year. Furthermore, as the project was there for the students, the primary focus was to ensure that they were deriving the maximum benefits from it.

Key Outcomes

The project had a number of outcomes. First of all, the first year students that did come along very much enjoyed the atmosphere in the lab. Finding a lab time that suited everyone was difficult as all Music Technology students take more than one subject in their BA. We found that the best compromise was to hold two sessions a week on Thursday and Friday afternoons. When the project began there was a very healthy turnout and we established a Moodle site so that we could communicate easily with one another. At the beginning of the first semester, we organised a number of talks over a number of weeks on different topics for the students in order to broaden their horizons. Joe Timoney and John Maloco gave a talk on basic electronics, Victor Lazzarini on programming for mobile devices, Jeneen Naji on actionscript and Adobe flash programming, and Aodhan Coffey on the Arduino hardware kit. As a result of these talks, a software group formed that was led by a Music technology postgrad and a second year student. Victor acted as a supervisor for this group. They met every Friday afternoon to work together. Their common interest was musical applications that worked with external gesture inputs, such as from the Microsoft Kinect. They worked very well together and eventually, by the end of the second semester, had contributed to the Digital Arts Showcase that was held in the Iontas Building, NUI Maynooth, in April, and won this year's Student Entrepreneur competition that was run by the University's Commercialisation Office.

A parallel hardware group was also created, supervised by Joe Timoney, to build guitar effect units or synthesizers. In the first semester, they met on a Friday but for the second semester it was found that Thursday was a more preferable day. Contrasting with the first semester, a more structured approach was taken in the second semester. To give the students experience with soldering we started with cable making, and had everyone assemble some audio cables. Then, guitar effects that could be assembled using veroboard were covered. This was found to be far more flexible for the lab than creating dedicated PCBs. For a number of weeks was worked on building a 'fuzz face' guitar effect and a number were completed successfully. The students were really happy when they got them working and tested them with an electric guitar. From this group one student will be taken on by the Computer Science department to do a summer SPUR research project. Also, the students from this group will be encouraged to participate at the NUIM stand in this year's Dublin Maker Faire which was held on July 27th at TCD in Dublin.

Jeneen Naji supervised a digital poetry group who worked on making an interactive poetry app with Flash. The group consisted of a first year Digital Media student and a second year Media Studies student. The project was presented at the ePoetry 2013 Conference in Kingston University in London.

Project impact

The students definitely found it to be a good learning experience. For the hardware group, it definitely raised their enthusiasm for their subject as they felt that they could achieve something tangible. Working together in the lab also helped to improve my own understanding of what the students were interested in and what their ambitions were. For the software group, they had a strong sense of achievement when they won the student entrepreneur competition. They synthesized what they learned in the classroom and through their research created a product idea that was viewed by external judges to have value.

A lot was learned about how to organise this type of learning experience. In particular, it was found to be very important to put a definite structure on the basic learning that the students need to have in the beginning. Although they have creative ideas they may be too ambitious if they do not have the skills. Furthermore, they can lose interest if they don't feel that they are making reasonable progress. Thus, they must be taught enough at the beginning so that they have a degree of independence when they commence their own project. Another difficult area is trouble-shooting. This is an essential but tedious aspect of building technology, and can be frustrating if an issue is not resolved quickly. This is a tough skill to teach and some solutions can be very elusive. Good humour and patience are essential in fault-finding and we helped students to recognize this.

There are a few aspects to this project that would be useful to others in the university. Firstly, it provides a format for the concept of an interdisciplinary project between the Arts and Science faculties. Secondly, to be willing to look outside to non-academic innovations, such as the DIY technology movement, on occasion, and to consider whether it would be possible to integrate some of its useful qualities into the university learning process. Thirdly, in the interdisciplinary creative fields it can be rewarding to teach essential skills but through a format that lies outside of the curriculum structure. This also helps students to appreciate the difference between learning for exams, as happens in school, and learning for life as is the goal for university. This also includes the skills of independence and critical thinking as they find and assemble their own projects in this type of learning forum.

Potential Future Developments

This project will be run again next year as a Maker's club and we will take on board all that we have learnt from this year. The hardware group will have a more structured initiation for the first semester before being given freedom in the second semester. Providing materials in the form of kits to work on in the first semester would be a good idea. If the group have their own project that they build successfully, documentation of the project using video, images and text would be very useful for future students at the club. Additionally, if the Maker's Faire is to be a regular event in Ireland the research of the club could be extended to have a regular representation at it. A final point is that if the resources were available it could be worth conducting research into solving the problems regarding the correct methods for assessment of Making activities as was mentioned above.

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Education Department
Navigating Other Worlds (NOW)

ANGELA RICKARD

The Navigating Other Worlds (NOW) project piloted the use of a Digital Game Based Learning (DGBL) approach to teaching and learning among Third Year Science Education (BScEd) students. Introducing the students to a 3-D 'virtual world' platform that was developed for schools by MissionV [1], the project aimed to explore the concepts and practice of DGBL through a practical, student-centred learning methodology.

The project set out to promote creative approaches to teaching curricular-based topics and to develop opportunities for interaction, collaboration and reflection among the students. Fundamental to the project was the desire to challenge student teachers to consider new ways to mediate the Science curriculum in second level schools using DGBL. It was hoped that by undertaking this project BScEd students would become better equipped to introduce such an approach in their own teaching and value the development of creative, collaborative and communicative capabilities for themselves as for their own students.

Working in groups, the students' task was to design and construct a learning resource in the virtual world that would convey, in a visual or 'physical' form, some aspect of the Junior Cycle Science and/or Maths Curriculum. The project culminated in the production of a voiced-over screen capture of the team's in-world creation as well as a jointly written reflection on the implications of using this methodology in teaching at second level.

While navigating a virtual world was central to the project, it was also proposed that links to real world contexts of Science teaching and learning would be established. Through this project we had hoped to build in a connection between the BScEd students and second level students in a school in Tanzania. A number of technical and logistical issues made it difficult to establish a direct link with the Tanzanian school in the manner envisaged. However, three Tanzanian students did have the opportunity to participate in the project in Maynooth January 2013 and their work was shared with the BScEd students.

The NUIM student cohort involved in this project were a class of twenty-seven Third Year BScEd students with whom I had worked on another initiative [2], during their second year. The earlier work had also aimed to encourage collaborative and creative learning. In addition it had sought to encourage students to become constructive critics of their own teaching and to engage them in practical and purposeful uses of digital technology for learning, namely video editing and multi-media presentation. In this previous work, the students had demonstrated particularly high levels of creativity, work ethic and tech savviness and that experience of teaching them prompted me to develop a more challenging learning project for them in respect of educational technology for their third year Teaching, Learning, Assessment and ICT module (ED302). About this time, I became aware of the work MissionV had been doing in primary schools (Burke 2012). Following discussions with James Corbett, CEO of MissionV, we formulated the proposal for the NOW project that would explore the potential of DGBL for teaching Junior Cycle Science and Maths.

Context and Literature Review

It is worth teasing out the metaphor contained in 'Navigating Other Worlds' to present more fully the context in which this project was developed. A navigation of the MissionV virtual environment, as well as the proposed link with Tanzania, were the immediate worlds evoked in the title of the project. However, the changing contexts of teaching and learning in second level schools and the inherited cultures of the world of teacher education are the other 'real world' environments this report will attempt to navigate in order to present the rationale for the NOW project.

- **Second level school context**

  Although official policy on technology in education in Ireland promotes the idea of its integration in all subjects as a pedagogic tool to support teaching and learning in a constructivist setting (DES 2008), the barriers preventing this from happening in Irish second level schools have proven particularly robust (McGarr 2009). Traditional approaches to teaching and learning persist (Shiel et al. 2011) and although teachers espouse the values associated with constructivist approaches, their enacted ways of teaching are very often at odds with these espoused ideals (Ertmer et al. 2012). Constraints of time and finance, as well as school culture and accepted modes of teaching and learning, mitigate against active approaches becoming the norm in classrooms. Meanwhile, other barriers such as the teachers' confidence concerning the integration of technology in lessons (Charlier and De Fraine 2012), coupled with fears about classroom control can also be difficult to overcome, particularly for the student or newly qualified teacher. Added to this, in the context of introducing a game-based approach, are the perceptions surrounding digital games themselves, where the label 'video games' very often carries a negative connotation and association with

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[1] MissionV is a not-for-profit organisation developing online game-based learning experiences for students at risk of significantly underachieving. See www.mission.ie

[2] An initiative entitled CRiSTaL: Critical Reflection in Science Teaching and Learning

violence, social withdrawal and addiction (Bosche and Kattner 2011). Even when teachers do use games, frequently it is to reward effort and is seen as a moment of 'time out' rather than being integral to learning (Charlier and De Fraine 2012).

In spite of these obstacles, however, DGBL has developed in popularity in recent years (Prensky 2007; Gee 2003) gaining an ever-increasing number of proponents so that it can now boast an international peer-reviewed journal (IJGBL) and numerous national and international conferences. Although research into the ways in which DGBL is being used in schools is still relatively scarce (Garris et al. 2002; Felicia 2009), some early adopters present convincing accounts of its impact on learning in second level schools (Ke 2009). Frequently cited arguments for using computer games in education include the strength of the approach: to engage learners; to encourage active learning approaches; to enhance the learning of complex concepts and to promote collaboration (Charlier and De Fraine 2012). If such arguments have merit it would seem timely to investigate them further in practice.

Timely too is the recent announcement of the proposed reforms to the Junior Cycle curriculum (NCCA 2012). The discussion around The Framework for the Junior Cycle also provides an insight into the motivation behind this project. The reformed curriculum proposes, among other things, to give greater attention to and accreditation for active, interactive and collaborative learning. The emphasis on key skills in the Framework including such skills as 'being creative', 'working with others' and 'managing information and thinking', all of which are permeated by relevant uses of digital technology (NCCA 2012), provides added impetus to integrate technology in teaching and teacher education. The suggested development of a short course in computer coding, for example, may also open up new possibilities for teachers and students alike.

However, making the imaginative leap into using technology in a creative, student-centred way to teach curricular content is not obvious as we have seen from decades of investment in technology in schools with relatively little return (McGarr 2009). Seizing the opportunity to experiment with and explore innovative uses of technology with pre-service teachers is therefore of paramount importance to ensure that newly qualified teachers are properly informed and critically aware of the potential of DGBL.

– Teacher education context

The NUIM teaching fellowship awarded to this project includes the aim of addressing students' difficulties with learning in the university, as well as promoting their 'engagement with core readings, independent research … and critical analysis'. The award is designed to encourage us to find ways to enable students to 'transit from previous learning contexts into university learning'. For the majority of undergraduates their previous learning context is second level schooling. For the students on a concurrent teacher education programme, such as the BScEd, it is also their future professional context. Student teachers need to be innovative and creative in their approaches to teaching and learning if they are to succeed in bringing about changes to teaching and learning at second level that will in turn impact positively on the lives and educational prospects of their students. The NOW project is underpinned by a belief in the potential for DGBL to contribute to bringing that about.

Outcomes of the NOW project

For the NOW project a range of different applications of technology were explored. Working in groups of three throughout an eight week period of the first semester 2012/13, the main focus of the work for the twenty-seven students in the class was on the creation of an 'in-world' teaching resource that could be used to teach (present, illuminate, explore, test understanding of…) any aspect of the Junior Cycle Science and/or Maths syllabus. For this they had access to a password protected OpenSim environment (OpenSim is an open source version of Second Life™) and were given live and online tutorials on how to access it, manipulate their avatars and construct artefacts on each team's respective 'island'. They were also shown how to integrate the program coding editor Scratch (adapted for Second Life environments) to add animation or interactivity to the artefacts created in OpenSim.

While the creation of the teaching/learning resource was the main focus of their teamwork, the assessment procedure used did not evaluate the resources created. Instead students were asked to evaluate these themselves. The two-fold assessment task consisted of the development and presentation of a voiced-over screencast of the in-world resource (with transcript) in order to have a representation of the resource available outside of the virtual world. This was to be accompanied by a 1,000 word reflection from each team on the process of creating their teaching/learning resource. In this they were to take into consideration the curricular content, the main scientific/mathematical concepts presented as well as the pedagogic thinking underpinning the resource that the team had produced.

To create the screencast students were shown how to download and use SM Recorder software for PC and QuickTime Player for Mac along with audio editing program Audacity. Their outputs were shared on a password protected wiki site using PBworks.com. Once the students' work was completed I created, using GoogleSites, a separate website that was accessible in the public domain and would contain all of the students' work: sites.google.com/site/ed302nowproject. Having secured their permission to so do, I also used this site to convey my feedback to them in the form of a comment posted on each team's reflection. This was intended to enable teams to view and learn from both their own and other teams' feedback. Teams were awarded a team grade that was communicated to them privately.

As mentioned above, another aspiration of the project was to maintain and strengthen the bond between NUIM and the Young Scientist Tanzania (YST) initiative, but establishing direct communication with the Tanzanian school proved too difficult within the time frame of the project. However, as part of their prize, the winners of YST 2012 travelled to Ireland for the BT Young Scientist Exhibition in January 2013. On that occasion a special workshop under the aegis of the NOW project was organised on campus during which the Tanzanian students (three girls from Kibosho Girls' School, Kilimanjaro) created a '3D poster' of their YST project. The girls' voiced over virtual poster (a YouTube video) is included on the Google site with the BScEd students' work.

Impact on learning

For the purposes of this report, I undertook an overall evaluation of the project using an anonymous paper-based questionnaire distributed to students at the end of the semester. The students were encouraged to give a frank account of their experience of the NOW project and the impact they felt it had on their learning in general and their views about DGBL in particular. Twenty-four students responded to the questionnaire.

The obstacle of a relatively steep learning curve combined with a short time frame and additional pressures of 'labs, assignments and lesson plans' made the project particularly challenging for students. That said, a number of students cited these very challenges as justification for their feelings of satisfaction in having accomplished so much.

Students were enthusiastic about the idea of the project and many noted that they had learned a lot about DGBL, considered it 'exciting', 'different' 'beneficial' and the idea behind it 'solid'. Typically, they said that the project 'had great aims/intentions and was extremely innovative and forward thinking', and it had 'opened [their] mind to a more creative way of teaching'. But these positive appraisals were unanimously qualified by concerns about the weight of the workload and the lack of time to develop their ideas. For many of the 'limitations of the [OpenSim] software' hindered their progress, with many of them seeing it as dated and/or difficult to manipulate.

When asked what the single most valuable aspect of the project was for them, the main areas cited were 'group work', 'being creative and innovative', and the 'broadening of minds' concerning 'what is out there and how useful the resources are'.

The students also noted significant gains in terms of their confidence about DGBL. While a quarter of the group said they 'didn't know' if it had impacted on their confidence 58% said they felt more confident. For some, it had shifted their views about teaching using digital games:

> **I know it can be done. I thought it would be impossible when we began.**

> **Yes. As I now have experience of it first hand and know logistically it would work in a classroom.**

> **As a visual learner myself I always try to incorporate gizmos or video games. Like this particular project is quite intricate in detail so doing it myself I would feel more confident showing how to do it to my students.**

One student noted that s/he had been motivated to 'research the topic' and 'really [think] about it and its uses' and had begun introducing a GBL approach in class.

Where students did not feel confident the reasons cited were lack of time and a lack of skills required to do it again:

> **I still feel it is too time consuming. In a 40 minute class period you would get nothing done. Maybe in a TY or an after school activity – I wouldn't be confident to implement it into the classroom.**

The students commented positively on the potential of DGBL in a reformed curriculum, particularly in using a cross-curricular approach whereas, with the possible exception of Transition Year, most considered it not feasible to do within the current structures of second level teaching.

Students were asked if their experience of group work had been positive. Twenty of the twenty-four students gave an unqualified 'yes' to that question while three answered 'don't know'. One said 'no', adding simply that s/he preferred working alone. It is noteworthy, however, that all of the students saw value for their professional lives in learning the interpersonal skills required for successful teamwork. In this they referred both to its value in the classroom and in developing fruitful collegial relationships:

> **I think we have improved in working as a group from last year so it shows that in school it is not going to be an overnight success but with repetition everyone will benefit.**

> **Group work can be pushed aside by teachers who see it as an excuse for students to act up. This has shown me that when a project has begun students will want to collaborate and develop their project rather than mess or procrastinate.**

Take it from me, I am a huge procrastinator but once I started on NOW I couldn't stop.

I feel I've become more sensitive to the requirements for successful collaborative team work, equal contribution, respect for each contribution etc.

I think if a group of teachers were working on a project like this where everyone had equal gain out of it they could work well as a group, otherwise it could be more challenging.

The NOW project was not only demanding on students. Many of them observed that planning and organisation would be key to the successful integration of DGBL in teaching. This was also my experience where advance preparation, technical testing were required. I had possibly an even steeper learning curve than did students as I grappled with the complexities of installation guidelines and set up an alternative to Moodle to communicate with the students, using a wikisite for the first time. Added to this were the complications of the university firewall and unanticipated technical issues that made for time demanding experiences in an already busy schedule.

Adopting a constructivist pedagogic approach also requires a shift in position for a lecturer/teacher. Moving from a scenario where content knowledge is prepared and delivered to students in a lecture to one where students must research, develop, problem solve and discuss ways to represent their learning, demands a different disposition than the traditional transmission style lecture. Even where lectures are conducted in discursive and student-centred ways, the lecturer has a very clear idea in advance what she would like the students to learn. Relinquishing control over what is to be learned is particularly difficult to do and in this project it has heightened my appreciation for the fear factor that can constrain teachers from implementing innovative approaches and new technologies in their lessons.

Trusting that the real learning was to be gained from students working things out through a combination of accessing the supports available to them and using their own ingenuity and creativity, I had to hang back and allow the learning to emerge. Early misgivings expressed by the students about whether the virtual world could be used to teach science at all unnerved me to some extent, but these grumbles subsided as teams began to develop creative ideas and started constructing models for their chosen Science and Maths topics.

Space and word count precludes me from detailing or analysing the students' projects, although I do hope to do so in a future publication. Suffice it to say for now (for NOW) this group of BScEd students were justified in feeling immense sense of pride in the work they produced.

While it is not envisaged that we will continue to use the MissionV platform in its current form, the experience itself, the collaboration with James, as well as the feedback from students, have been very valuable for shaping my thinking, deepening my understanding of DGBL and for informing teaching strategies I hope to implement in the future.

Acknowledgments
I would like to thank James Corbett of MissionV for sharing his expertise with me and with the BScEd students in this project. Thanks too to Gary Feeney and Patrick O'Regan in NUIM Computer Centre for the technical support provided. Finally, a special word of thanks also to the participating BScEd students, who are always a joy to work with!

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Department of Electronic Engineering

A Project Oriented and Problem-Based Learning (POPBL) Pilot Module

DR BOB LAWLOR, DR SEAMUS MCLOONE & MR ANDREW MEEHAN

This project involved the design and implementation of a group Project Oriented and Problem-Based Learning (POPBL) pilot module with a cohort of first year students on the BE in Electronic Engineering Programme in the Department of Electronic Engineering. The pilot module was implemented during semester 2 of the 2012/13 academic year and involved a total of eighteen students working in three project groups.

The initial group sizes were 5, 6 and 7. One student left the programme during the semester so that the final group sizes were 5, 5 and 7.

The theme of the pilot module was electronic circuit design and implementation and it replaced two previously taught modules on the programme, namely, professional skills and introduction to engineering design. These previously taught modules were each allocated 5 ECTS credits so that the pilot project module was allocated 10 ECTS credits.

In semester 1 the students took six conventionally delivered 5 ECTS credit modules, namely:

- Electronic Engineering Fundamentals
- Introduction to Programming
- Computer Architecture & Digital Logic
- Engineering Mathematics 1
- Physics for Engineers 1
- Electronic Material Science

Similarly, in semester 2, in parallel with the pilot project module, the students also took the following four conventionally delivered 5 ECTS credit modules:

- Electric Circuits
- Computing for Engineers 2
- Engineering Mathematics 2
- Physics for Engineers 2

The rationale behind the pilot project was that by engaging in a substantial group project the students would have the opportunity to experientially develop their design and professional skills e.g. written and verbal communication skills as well as their teamwork skills. A further objective was that the students would get to apply and combine elements of the above prior and parallel taught modules in a 'real life' project. The full module descriptor for the pilot is available online at [EE199 2013].

Context

> **'Creativity and innovation are related to collaborative knowledge and to the process of collaborative knowledge construction or learning'**
> [Jensen 2013a].

However, assessment drives learning, and in many conventional higher educational institutions, the need for detailed individual assessment can make it difficult to systematically encourage or facilitate collaborative learning.

Since its foundation in 1974, the University of Aalborg in Denmark has developed a world-wide reputation as a centre of excellence in 'Project Oriented and Problem-Based Learning' (POPBL), particularly in the disciplines of Engineering and Science [Moesby 2004]. Collaborative learning (or peer-learning) is a central element of the Aalborg model as the projects are always undertaken in small groups.

In November 2011 Prof Lars Peter Jensen from the University of Aalborg visited NUI Maynooth and facilitated two workshops, one aimed at a University-wide audience and one customized specifically to the Department of Electronic Engineering.

Following these workshops the authors followed up with Prof Jensen and arranged a return visit to Aalborg to explore possible collaboration initiatives and to find out more about how the Aalborg POPBL model might be adapted to the NUIM Dept of Electronic Engineering context. This visit took place on June 25/26 2012. Following this visit it was decided by the department of Electronic Engineering to carry out a POPBL pilot with the full cohort of incoming first-year students on its BE in Electronic Engineering programme. The CTL fellowship project is based on this pilot project.

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Literature Review

Traditional engineering education is closely connected with the understanding of scientific and technological development [Kolmos 2006]. Kolmos further argues that while this scientific-technological component is very important, it needs to be complemented with a socio-cultural component. The systematic integration of such a complementary socio-cultural component into engineering education is a central element of the Aalborg POPBL model. Kolmos refers to the learning outcomes of the socio-cultural (or group project oriented) component as process skills or competences and states that 'there is a growing awareness that learning methods can be used as a means to achieve process skills, and that engineering education as a whole has to change from a very teacher-centred to a more student-centred system'. Another significant feature of the Aalborg model is that it systematically engenders peer-learning among project-group members. Research in educational psychology has shown peer learning to be one of the most powerful forms of learning, drawing upon the 'zone of proximal development' (ZPD), a concept developed by the Soviet psychologist and social constructivist Lev Vygotsky (1896 – 1934) whose work has had a major influence on modern pedagogical theory at many levels.

Kolmos also cites the work of Schön (1983) who refers to the importance of reflection in the Aalborg model. Schön states that 'a reflective practitioner is a person who is capable of analyzing situations, choose and use relevant knowledge and reflect on own experiences.' In this context, Kolmos also refers to reflection as 'another forceful element of learning as advocated by the Kolb cycle of learning' [Kolb 1984] and further cites the work of another pioneer of modern pedagogical theory, namely, John Dewey (1859 - 1952) who has stated that 'we do not learn from experience, … we learn from reflecting on experience'.

Another pioneer of modern pedagogical theory whose work has had a strong influence on the development of the Aalborg model is Jean Piaget (1896 – 1980). Piaget's theory states that 'the key to learning lies in the mutual interaction of the process of accommodation of concepts or schemas to experience in the world and the process of assimilation of events and experiences from the world into existing concepts and schemas'. Bruner has offered further insight into the practical application of these pedagogical concepts in his 'theory of instruction' in which he makes the point that the purpose of education is to stimulate inquiry and skill in the process of knowledge getting, not to memorize a body of knowledge: "knowledge is a process, not a product" [Bruner 1974, pp.72].

Light (2001) also offers much practical guidance on the application of these pedagogical concepts within higher education contexts. For example, in the context of small group teaching he states that: 'we are now realizing that changing the size of groups can be one of the best ways to encourage independent expression' [Light 2001, pp. 123]. Woods (2000) also offers a wealth of practical guidelines relating to tried and tested instructional methods aimed at the integration of process skills development into engineering educational programmes. In Moesby (2002), he notes that in year 1 of the Aalborg engineering and science programme, the focus is more on the fundamentals of both engineering and science as well as the fundamental process skills. In this context he states that at Aalborg University, 'during the first year of studies, students learn to adapt to Problem-Based Learning (PBL), along with the acquisition of necessary basic knowledge within fields of mathematics, physics, information technology, and discover the relationships between technology, as well as the context in which the technology appears'.

Moesby (2004) offers detailed guidelines relating to making the transition from a conventional lecture-based delivery of an engineering education programme to one based on the Aalborg model. In this paper, Moesby stresses the importance of adapting the core principles of the Aalborg model to the local context rather than trying to replicate it in detail. For this reason he suggests that the most effective way to make such a transition is to phase it in over the duration of the education programme i.e. for a four-year engineering programme, the transition should be phased over four years, beginning with a new cohort of incoming first-year students. Such a phased approach allows time to reflect on experience and refine accordingly in adapting the model to the local context. He also presents useful guidelines relating to the recommended administrative and institutional supports needed for the most effective transition to an Aalborg-styled model. Kolmos (2008) also presents a comprehensive overview of the Aalborg model including a detailed description and comparison of the various styles of group project facilitation in a PBL environment.

Key Outcomes

The pilot module proved a most worthwhile exercise in the sense that the lessons learned in undertaking it could only have been learned experientially. Despite studying the available literature and detailed guidelines relating to the Aalborg POPBL model, mistakes were nonetheless made at the implementation stage. These mistakes were, however, very valuable learning experiences. The main instruments used to gather data from the pilot module included independently facilitated focus group sessions with staff and students and a detailed anonymous end-of-project survey.

The project documentation e.g. interim and final group project reports, 2-weekly reflective submissions and process reports also gave valuable insight into the pilot project.

The primary lessons learned related to two specific aspects of the POPBL approach, namely, structure and communication.

Structure

Many students indicated that they had too much freedom to direct their own learning and would have preferred a more structured module as this might have helped them through periods when their motivation was low. For example, in response to survey question 2.3 (How, in your opinion, could facilitation be improved by the facilitator?), 11 of the 17 suggested that there should have been mandatory weekly meetings with the facilitator. Similarly, in response to survey question 2.4 (How, in your opinion, could facilitation be improved by the group?), 12 of the 17 suggested mandatory weekly meetings with the facilitator. This point was also evident in both the student and the staff focus group sessions (the student focus group feedback is shown in Appendix 2). One possible interpretation of this point is to recognize that a significant majority of the students learned the value and importance of meetings in a group project. If they learned this 'the hard way' then that might even be for the better. Aalborg are well aware of this 'problem' and allocate the first three weeks of their first semester for new students to undertake a short group project during which they learn the importance of structured meetings 'the hard way' [Jensen 2013b].

Communication

Much of the student survey and focus group feedback suggested that important information should have been communicated in a clearer and more timely manner; for example, the reflective journal template should have been presented on day 1. Other examples of the types of information which was unclear included: PBL overview, project management guidelines, course layout and week-by-week breakdown, interim and final report guidelines and templates. This finding was also consistent with the views of the project facilitators who, with the benefit of hindsight, recommend the preparation of a detailed POPBL student handbook covering all of these and related issues. The preparation of such a handbook is currently underway and will be included in their final Aalborg POPBL project report.

Project impact

In the student focus group session, the feedback indicated several aspects of the pilot which they felt had impacted positively on their learning namely: the workshops; the reflective journals; the online discussion; the practical application of theory; the group work; the self-directed learning; the 'real-life'/experiential learning; and the 'variety of roles' which they had the opportunity to experience. Strong evidence of these positive aspects is also indicated in the student survey responses e.g. 15 of the 17 students agreed (10) or strongly agreed (5) that this was an effective method of learning for them (a representative subset of the student survey quantitative feedback is shown in Appendix 1). Two of the three groups engaged and performed very well with the pilot, scoring approximately 10% higher than the overall class average mark for the full semester. The level of engagement from the third ('left-over') group, however, was very poor and this was reflected in their assessment.

The overall average final mark for this group was 28% as compared to an overall average final mark for the other two groups of 60%. It should be noted that the five members of the 'left-over' group all failed at least five of the conventionally delivered taught modules throughout the academic year.

The primary lessons learned from undertaking the pilot POPBL module related to module structure and communication as discussed above. In hindsight, our year 1 students are really not used to self-directed learning or group-learning. Their prior educational experience is best described as mainly extrinsic and largely structured. This might change in the future with the recent introduction of initiatives such as Project Maths [Project Maths 2013] and the scheduled revision of the state Junior Certificate examination to a more continuous assessment / portfolio-based system [NCCA 2013]. Nonetheless, right now the transition of our incoming year 1 students to a more self-directed learning environment needs to be carefully managed and they need to be given time and support in developing the new learning skills required to gain full benefit from a POPBL programme.

For anyone interested in exploring the POPBL model, in the context of their own discipline, we would highly recommend the design and implementation of a similar pilot as many of the necessary skills are best learned experientially. We would hope that the general findings of this pilot project would inform any such pilot module, particularly, in the engineering and science disciplines. As described in section 2.6 above, the pilot module was based on a subset of the overall programme content. This subset represented 10 of the 30 ECTS credits associated with the semester, the remaining 20 credits being allocated to taught modules.

Research on POPBL has found a 50/50 split of workload between the group project and parallel associated taught modules to be optimal [Moesby 2002, Moesby 2004, Kjersdam 1994]. The pilot feedback was consistent with this finding in the sense that both the students and the facilitators would have preferred a more even division of the project and taught module workloads. With careful coordination of taught modules and associated project themes it would appear that the POPBL model could be readily extended across the entire BE Electronic Engineering programme within which it was piloted. One challenge identified in the pilot is the need to carefully coordinate the project themes and associated taught modules. We believe that this would be a requirement in other disciples also.

Potential Future Developments

The obvious extension of the pilot module is to use the lessons learned to develop a phased integration plan for the POPBL model throughout the entire BE programme. The development of this plan is currently underway. The new engineering science option (MH201) within the general science programme at NUI Maynooth has a significant project-based element in each year and it is envisaged that the findings of the pilot will be used to inform and support POPBL activities within this new programme option. It is anticipated that this new option will provide opportunities for more interdisciplinary projects which span areas of science and engineering.

Although the Aalborg POPBL model can be implemented effectively at the Faculty and Programme level, it is nonetheless believed that 'an institution-wide adoption of the model provides the greatest educational benefits' [Barge 2010, pp. 10].

The academic staff members who participated in the pilot module are also happy to help interested staff from other departments and/or faculties who may be interested in adapting the Aalborg POPBL model for their specific context e.g. on a similar pilot basis.

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Section 3: Additional Information

Appendix 1 –
Sample Student Survey Quantitative Feedback

Instruction – place an 'X' in the appropriate box for each of the statements listed below.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
PBL is an effective method of learning for me.	5	10	2		
PBL prepares me for my exams.	1	6	8	2	
PBL prepares me for my future professional life.	8	8	1		
PBL improves my teamwork skills.	9	6		2	
PBL improves my written communication skills.	4	9	4		
PBL improves my presentation skills.	7	10			
PBL has motivated me to learn.	5	8	3	1	

Appendix 2 –
Student Focus Group Feedback

What worked?

- *Workshops worked well but could be more spread out: more phased/spread out – more frequent and shorter. Need to change the pacing on the workshops.*
- *Reflective journals worked well – kept students 'on track'.*
- *Moodle discussion was good.*
- *Learned more about the theory: learned to apply the theory – the practical application of the theory made the theory more understandable.*
- *Group meetings worked.*
- *Experimenting and self-directing the projects.*
- *The 'real life' aspect of the experience and the skills learned doing the project.*
- *Experienced a wide variety of roles – this was good.*

What didn't work?

- *The way the groups were formed was a problem. There was a group of leftovers'. Groups decided by 'who came in the door first'. There were people who rarely showed up who were in the last group. The way the groups was picked was technically 'fair' but it would have been better if they were random. The best students should be distributed, as should the weakest, and the rest divided across the groups. (Not all students agreed with this.)*
- *Groups too big – better to have smaller groups – 3 or 4 better. The work division with 7 is complicated. There is greater capacity for 'passengers' in big groups.*
- *There were gaps along the way, by the facilitators, that made the learning process difficult.*
- *Lack of feedback from the tutors. Wanted more feedback on the report and more detail about what needed to be in it.*
- *Communication didn't work very well – all channels of communication were poor.*
- *Felt there was lack of class structure. It would have been good if the class met as a group once a week.*
- *The brief for the project was very vague – could have done with more guidelines.*
- *Workshops were very long – should have been phased.*
- *There was a clash with deadlines between this module and other modules. There could be improved coordination between this module and others/the programme*
- *Time management was a problem as were the deadlines.*
- *Process too unstructured.*
- *Need for an introductory class – a group working and PBL overview.*

Changes?

- *Need for reflective journal template earlier.*
- *More guidelines generally would have been useful – it all felt a bit vague. Confusion over the process of project based learning – an overview would have been useful.*
- *There should be mandatory group meetings with the group and a tutor each week.*
- *Should be more structured.*
- *Should be a class group gathering every week to keep everyone focused.*
- *A course layout that plotted what should happen week 1, 2, 3, etc.*

More guidelines on the project.

- *More help from the tutors. Students felt they could have done with more help.*
- *If they went down the wrong road, they could have been helped to identify the dead end – that would have helped students.*
- *Reflective journal from the start of the classes.*
- *Template for the report.*
- *More input from the tutors.*

Any surprises?

- *Time – how long it took. There wasn't enough time to do the work.*
- *How much learning we had to do ourselves – how much research it took*
- *Students felt they learned a lot – a lot more than just sitting in the lecture*
- *That they had to do the learning for themselves*
- *More enjoyable. More work but it is better to be doing the stuff – better than the lecture. When you research on your own you learn better – that is much better. Deeper understanding than in the lecture.*
- *There should be more project based learning but it is hard to get into it in first year. Maybe gradually more of it over the years.*
- *Knowing that there is no repeat means that you have to put more work in to the module.*
- *Work load is much greater than expected.*
- *Surprised that there wasn't more conflict – fewer fights than expected and any conflict was easily resolved.*
- *Surprised not to see any tutors in the labs at any of the classes' lab times. It would have been good if there was a tutor 'floating' in the room – roaming tutors would have been useful.*
- *Students felt that they were 'guinea pigs' – felt a little neglected, felt cast adrift to some extent. Fear of failure.*

Final comments

Project Based learning better than conventional approach – only 2 disagreed with this: didn't like the group; lecture is clearer – there is a feeling that you are missing out on stuff. A good balance between the lecture and the PBL would be good.

Department of Experimental Physics
Pilot scheme for Learning Support for 1st Year Experimental Physics (Experimental Physics Drop-In Centre)

DR NEIL TRAPPE

This fellowship involved the establishment of a Physics Drop-In Centre as a source of additional academic support for students in first year Experimental Physics. The 'Drop-In Centre', offered (at specified times each week) extra tuition/help with lecture material, tutorial problems, general problem solving sessions and advice in the experimental techniques required for the physics laboratory. Both science and electronic engineering students take Experimental Physics and this resource was available to all students.

Context

The Maths Support Centre at NUI Maynooth has supported many students by allowing them visit a facility to seek advice or help with related material. Many science students use this facility and often enquired as to why such a facility did not exist for all science subjects. Anecdotal evidence from the students about the benefits of such a resource encouraged me to apply for the Teaching Fellowship to trail the use of such a learning model in the Experimental Physics Department, especially for students entering potentially with limited experience of Experimental Physics. Typically, only half of the entering students have taken Leaving Cert Physics and at the start of the course feel that the material is difficult. The first topic covered is classical mechanics and demands students to interpret equations and apply solutions to physical situations; many students initially find this challenging. The Drop In Centre was targeted towards assisting students in this regard and supporting them throughout the year as they gained more experience in engaging with Experimental Physics.

The social and academic background of students entering 1st Science at NUIM is diverse.

Typically many students (circa 40% of first year) have not had the opportunity of taking Physics to Leaving Cert level and therefore feel overwhelmed at the start of the course. Consistently students often requested extra assistance, often struggling both with the academic level and the volume of material covered in the course. In addition, in our experience, some mature and access students at Maynooth often did not have much previous experience carrying out experiments in a laboratory or with mathematically based problems. The basis of setting such a centre up, to complement the formal lectures, tutorials and laboratories which students experience, was to help students who had limited previous experience in laboratory subjects like Experimental Physics. This extra facility sought to give them the information and tools they require to do well in Experimental Physics (laboratory techniques, problem solving, mathematical tools required specifically for Physics, computer skills etc..).

For the academic year 2012 – 2013 the Drop In Centre was opened for six hours per week mainly run by Experimental Physics postgraduate students who assisted the students with queries and clarifications.

These postgraduate students volunteered to act as facilitators/tutors and were given guidelines initially as how to accommodate the first year students and assist in addressing their questions. All the postgraduate students also demonstrated in the undergraduate laboratories and had some experience in interacting and explaining physics problems. As the centre was physically located in the first year laboratory, students had access to the experimental equipment related to their mandatory laboratory reports and so had access to this apparatus to practise or clarify experimental assignments.

The feedback from students who attended was very positive and most students who attended regularly indicated they were finding it useful. Overall only about 25% of the first year body used the centre. This is viewed as a lower percentage of engagement than was perceived initially for this resource. When students were surveyed about non-participation they mainly indicated that time restrictions in their busy schedules and having no need for additional assistance were the main reasons given for not using the facility. However, of the students who did attend, all returned regularly to the facility and reported a positive learning experience.

Related Literature Review

In applying for the Teaching Fellowship Award in 2012 I was very aware of the success of the Maths Support Centre at NUIM and the benefits that this initiative has brought to students at Maynooth. The concept of adopting this model to Experimental Physics was a motivation to apply for the Teaching Fellowship. The pedagogical advantage of giving extra support to students is obvious and Dr Ciaran Mac an Bhaird and Dr Ann O'Shea have illustrated the benefits of the Drop In centre in a number of publications. [1] [2] and the enquiries from students

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over the years of having an equivalent in Experimental Physics motivated me to apply for the Fellowship and investigate the benefits of this extra teaching resource.

I became aware that many other international Universities had a similar model of a Learning Centre of a voluntary 'Drop In Centre' also and examples include

- http://lsc.cornell.edu/ (Learning Support Centre Cornell University)
- http://www.drexel.edu/physics/resources/undergraduate/helpcenter/ (Drexel University Help Centre)
- http://www.physics.uottawa.ca/sites/default/files/physics/Physics%20Help%20Centre2012Fall.pdf (Ottawa University Support Centre)

The teaching of introductory physics courses is difficult as the diverse spectrum of background experience and related mathematical knowledge makes getting the right academic level and the delivery of the material very difficult [3] [4]. This is especially true at Maynooth as typically about half the first year students have not taken Physics to Leaving Certificate level. I am the first lecturer delivering a mechanics course to first year and I observe the divergent opinions about the material as students new to the discipline really struggle with the new concepts and the widespread use of interpreting equations to understand a physical situation [5].

The goal of the Drop In or Support Centre was to have extra learning and support resources available to the students to help them understand the material in a casual friendly environment which would be both an academic and social benefit for the students.

Key Outcomes

Overall, and drawing from the feedback from student questionnaires, the outcomes of the project could be summarised as follows:

- **Timing – at the start of the academic year a Doodle poll was carried out to find the optimal times in the science/engineering timetable to open the Drop In Centre. Based on this poll the opening times were fixed with six one hour periods during each week (5 days a week) in the first year Experimental Physics laboratory.**
- **25% of the first year science and engineering students taking Experimental Physics visited the Drop In Centre at least once with 80% of this cohort attending multiple times.**
- **Over 600 visits were logged officially (more students actually attended) with an average rate of 4 visits per session with many students staying on average for 10-15 minutes of direct help but many others using the space in the lab when open to work as individuals or groups.**
- **Based on student feedback the two main reasons that the rest of the student population did not attend were that their timetable did not allow them visit or that they felt that they did not need to attend as they were getting on fine in the course.**
- **To address the timetable issues raised above, students could seek to have the Drop In Centre Open if they wanted to attend outside of office hours but this facility was not subsequently utilised.**
- **All students who attended the Drop In Centre reported a positive useful experience.**

The range of queries in the Drop In Centre spanned lecture material, sample numerical questions, laboratory experimental techniques and laboratory report writing which were the areas initially targeted.

Specific assistance with mandatory assignment material was sought by some students but a policy of giving assistance only in a general way was adopted so students could not use the help to complete mandatory assignments. It was important to have a policy on this so that students knew the boundaries of the use of the facility.

In feedback forms returned, no criticism or improvements to the arrangements were made apart from having the option of an open study area available for students to work together in. Unfortunately, due to policy reasons the first year laboratory could not be open unsupervised.

All students surveyed requested that the lecturer delivering the material was not present in the Drop In Centre as they preferred to speak with postgraduate students.

In conclusion, I was very happy with how the Drop In Centre operated and the positive feedback received from the students who attended. The contribution of the Experimental Physics postgraduate students, who acted as tutors, was enormous and they really excelled in engaging with the first year students in a friendly and welcoming manner. One of my main concerns is that 75% of students did not attend and did not participate in this voluntary project. I anticipated a larger cohort of students attending the Drop In Centre but this was not taken up mainly because of not believing they required extra assistance or that their timetable was too full to visit the Centre. The Centre was promoted in lectures as a learning resource for all levels of students rather than being a remedial help centre.

Perhaps better marketing and initiatives to encourage students to attend to advance their position and engage them at different levels is required to be in place in order to obtain better engagement more widely across the full first year cohort.

Project impact

Through anonymous feedback forms all students who attended the Exp Physics Drop In Centre reported a positive experience where the postgraduate students offered useful advice and help with lecture material, problem solving or experimental techniques and report writing. Overall the project was a success with this service helping many students although the overall attendance was only 25%.

At the start of this project I anticipated that many more students would avail of the opportunity to get enhanced tuition/assistance with the course material and experimental techniques. As noted, 25% of the first year class attended the Drop In Centre and I was surprised at how low this percentage turned out to be after surveying the students and asking them to engage on a regular basis. In discussions with the Teaching and Learning Centre various initiatives to promote the Centre were undertaken (special topic revision sessions, help with exam questions etc) as well as extensive promotion in all first year lectures and yet the regular attendance did not significantly improve. The students who did attend, and many attended very regularly, really did have a positive experience with the Centre but I really anticipated wider engagement. More initiatives to attract more students seem to be required such as maybe a novel physics question competition so that each week we could give a small prize to promote participation.

I understand that a science student taking three experimental subjects in first year would be busy with laboratories (one of the main reasons for non-attendance was students claimed to be too busy) but even a short visit to the centre (10 minutes) would be of benefit to these students. Also, in the future either as a Faculty-wide Drop In Centre or as a departmental Drop In Centre I hope to continue with the initiative and hopefully adopt various novel schemes to attract more students.

I believe that the model of a Drop In Centre for the various subjects/departments could be of great benefit to students and may help engagement and participation while potentially reducing the dropout rate of first year students who engage with the idea of extra tuition and assistance. I believe to achieve widespread engagement of the student body the concept of a Drop In Centre needs to become established and recognised as being for all students to better their understanding and not just being a remedial resource. Perhaps initiatives and promotion need to be coordinated centrally to establish such a scheme. I am aware that the Computer Science Department also piloted a Drop In Centre in their department for first year students and there a full time coordinator was paid to oversee and execute various initiatives in the Centre. Also, the participation of undergraduate volunteer students helping lower years is also a good way to expand the time slots that the Drop In Centre facility is open with the undergraduate tutors gaining teaching experience and something to include on a curriculum vitae. This would be a great bonus to have a person with set time to devote to the project as it is difficult to dedicate a lot of time each week with other teaching/research responsibly of the full time academics.

Potential Future Developments

This project in setting up an Experimental Physics Drop In Centre is planned to be run within the department next year. Also, a number of first year coordinators in the Science and Engineering Faculty are currently discussing the concept of a Faculty wide support centre pilot potentially using senior undergraduate volunteer facilitators/tutors. A shared resource like this would rationalise the inputs from each department but also give the centre recognition for all students and facilitate them to engage more fully with the support being offered. All science and engineering departments are potentially interested in participating which is very promising. With faculty-wide involvement, students will hopefully be very aware of this proposed facility and this should help increase participation and attendance.

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This project aimed to build on a 2011-12 Teaching Fellowship, which Fraser and Mooney were awarded, and which enabled them to pilot an innovative use of a software package they designed to run in a 3rd Year Geography module in Spring 2012. The software, which was put together in summer 2011 by Computer Science graduates under Mooney's supervision, allowed students to create a virtual portfolio of photographs and 'tweets' based on fieldwork they conduct.

This project aimed to extend and cement the gains made in the 2011-12 pilot by running the software package in a 2nd Year Research Methods module in the Dept of Geography. The module, which has 270 students, is a central part of the Geography department's curriculum. Waddington, who leads the 2nd Year module, joined Fraser and Mooney with a view to using the software to enable students to conduct fieldwork in their home place. The software was designed precisely for this purpose; however, to make it work for such a large class size and be accessible for an instructor with limited time, such as Waddington, the rollout required additional attention from Computer Science experts. Bergin therefore joined the team to provide additional and extensive expertise in the area of web design and app design.

The portfolio element of the project was peer-assessed in a fun and interactive way that students enjoyed – 100% of respondents in a survey (n = 83; response rate 60%) about the portfolio said they enjoyed doing the work. The project was group-based but with a strong and clearly-defined individual component, which students liked.

Context

The funding we received in 2011 gave us the opportunity to explore the type of learning outlined in this project and provided initial evidence of student achievement and engagement with the chosen topic. As a final desired outcome was to make the approach both more widely applicable and more user friendly, we wished to develop the software further and to explore its use in a different context working with a larger group.

Key Outcomes

- **Interdepartmental collaboration**
  Working in a team which included both technology and subject specialists enabled the development of a project which both met the desired learning outcomes of the Geography module and was achievable practically. This involved the people from both departments broadening their understanding of the issues involved in using software in different subject contexts.
- **Development of Student ICT skills**
  One of the desired outcomes of GY 201: Methods of Geographical Analysis is the development of ICT skills for use both within the subject and more widely. Use of this software made a contribution to the achievement of this outcome. The work was completed by the vast majority of the class of 270 students.
- **Software development**
  In addition to refining and improving the performance of the first version of the software an Android mobile phone 'app' was also developed. This could be downloaded and then used to interact with the project by up-loading images and comments to the site.
- **Student learning**
  Students developed an appreciation of landscape evaluation both from their own experiences and by examining the work of others. They also had to develop the ability t o summarise/ identify the main point of the work, as the 'tweet' allowed only 140 characters.

Project impact

Many students found the experience positive and enjoyed that they had been encouraged to explore their own home area from a new viewpoint or had broadened their understanding of different concepts, by looking at varying interpretations provided by colleagues. They also learned a variety of technical skills, such as re-sizing images to facilitate up-load to the site. The abilities to judge the work of others (as well as their own) and to provide helpful feedback were also developed.

A major learning point was that collaboration of this sort requires patience and very clear communication between partners, particularly when they are bringing very different understandings and knowledge. Essential requirements are for clarity of guidance to student participants and for user-friendly technology. We also learned that enthusiasm and a wish to develop new approaches to learning are stimulating and provide encouragement for further 'experimentation'.

The resource has potential for use in many other areas of the university as the software may be used with any size of class and in any subject where visual images are used in some form of learning. Writing skills are also developed in terms of summarising and identifying key points, by using a low character count for the 'tweets'. Within Geography, it has already been used in its earlier format in another aspect of the subject and could be used, for example, in the introductory modules in first year to encourage students to begin to examine their environment in a critical way.

Potential Future Developments

As noted above, the resource has potential both for further development within the university but it would also have much wider potential. However, in its present state, it would be difficult for the non-specialist to do this. Further investment of time and finance are required to take the software to the next stage, where a generic interface for set up and operation would be required so that the desired project can be set up without technical assistance.

Members of the Centre for Teaching and Learning team provided the administration for the Fellowship project and acted as contacts during 2012 – 2013.

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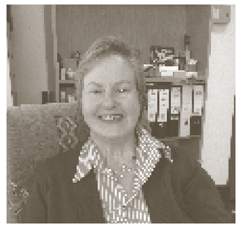

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