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Engineering in communities: learning by doing

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Abstract

Purpose – The purpose of this paper is to focus on a number of initiatives in civil engineering undergraduate programmes at the National University of Ireland, Galway (NUIG) that allow students to complete engineering projects in the community, enabling them to learn by doing.

Design/methodology/approach – A formal commitment to civic engagement was undertaken by the NUIG in 2001 with the establishment of the Community Knowledge Initiative (CKI) to work on mainstreaming civic engagement (service learning) within the curriculum across the institution. Today, the majority of undergraduate and postgraduate degree programmes in the College of Engineering and Informatics at NUIG have embedded service learning into their curriculum. These initiatives allow students to work with and in local communities, international communities and multi-disciplinary groups as part of their academic courses. The paper investigates and shows that community-based projects can enhance student learning and engagement in a number of ways. At NUIG, these projects are framed by a research orientation, commitments to civic engagement and building university-community partnerships, city-university partnerships and partnerships with other official agencies, so that community users can provide real learning problems and contexts for students and researchers and benefit from the results.

Findings – It was found that the students got a sense of pride and satisfaction out of the knowledge that their work may be helping communities and that learning is not just to get marks to pass the exam! The projects can increase the students' sense of ownership of their own learning. Learners are more motivated when they can see the usefulness of what they are learning and when they can use that information to do something that has an impact on others.

Research limitations/implications – The work represents work done in one institution affecting a region in a country. This can be extended to include more institutions and other regions. This paper presents evidence from the aforementioned projects that by creating service-based learning the students' energy in learning can have a positive impact on the community.

Practical implications – The energy and enthusiasm of learners can be better utilised (and increased) by setting assignments as real community-based projects.

Originality/value – This lies in the design of projects and assessment involving education providers and public for the benefit of learners and the society at large.

Keywords Ireland, Universities, Civil engineering, Undergraduates, Assignments, Civic engagement, Community-based learning, Engineering education, Research-based teaching, Service learning

Paper type Research paper

1. Introduction

Service learning as a pedagogical tool provides a means of connecting students' academic study with community and society with the explicit intention of promoting

active and responsible citizenship (Bringle and Hatcher, 1996; Furco and Holland, 2004; Zlotkowski, 2007). Service learning is currently seen as having priority within higher education in Ireland (Byrne and McIlrath, 2012). According to Byrne and McIlrath (2012), this priority has been prompted by the "Celtic Tiger" when the 1990s brought a profound change and the country benefited from a period of economic boom. Coupled with this wealth was a growing concern over perceived declines in levels of "social capital" and to counteract this there was recognition of the potential role that service learning, as well as other civic engagement strategies within higher education could play in redressing the balance (Boland and McIlrath, 2007). The first formal commitment to increasing social capital through civic engagement came in National University of Ireland, Galway (NUIG) in 2001. With the support of a number of benefactors (including Atlantic Philanthropies) the Community Knowledge Initiative (CKI) was established within the university. This initiated "the creation of a radical new approach to the betterment of society through emphasis on three core elements of community-based research, service learning and knowledge-sharing" (CKI, 2001, p. 2) and was subsequently afforded prominence within the institution's Academic and Strategic Plans (2003-2008 and 2009-2012) (National University of Ireland, Galway, 2002, 2008). This funding allowed the university to employ personnel to work on mainstreaming civic engagement within the curriculum across the institution (service learning) and also in encouraging and supporting extracurricular (student volunteering)-based activities. Annually the CKI undertakes a community needs analysis whereby community document their needs related to the disciplines that contain a service learning experience. These needs are subsequently mapped to members of faculty and this process ensures that the university is responding to a direct need and not saturating the community sector with an over-abundance of service learning students. Since the inception of the CKI, over 30 academic degree programmes have incorporated service learning experiences.

Since 2003, service learning has been used as a pedagogical tool in the College of Engineering & Informatics (CoEI) at the NUIG. For example, in 2003, a service learning module was established in a postgraduate IT degree programme – Masters in Information Technology (MIT) (Byrne and McIlrath, 2012). In the same year, service learning was introduced into the BE in mechanical engineering and BE in biomedical engineering as a required component called CAIRDE of the mandatory third-year module Engineer and Society, which is now also a module taken by electronic engineering students. Wallen and Pandit (2009) outline the benefits of introducing civic engagement into biomedical and mechanical undergraduate programmes at NUIG. Over the last three years, the CoEI at NUIG have built on this and implemented a number of initiatives in their civil engineering undergraduate and postgraduate degree programmes to allow students to complete engineering projects in the community, enabling them to learn by doing (see Table I).

This paper will present details of service learning as a pedagogy tool for civil engineering at NUIG and highlight how approaches outlined fit well with the ideas of engaged scholarship (Boyer, 1996) and civic professionalism (Sullivan, 2005). The projects are framed by a research orientation, commitments to civic engagement and building university-community partnerships, city-university partnerships and partnerships with other official agencies, so that community users can provide real learning problems and contexts for students and researchers and benefit from the results. This paper will present evidence from the aforementioned projects that by creating service-based learning the students' energy in learning can have a positive

Module	Programme	Year	Number of students each year	Number of community partners
CE202 Principles of building	BE civil engineering; BE environmental engineering; BSc in project and construction management; BE in energy systems engineering	2nd	139	> 25
Managing development	BE civil engineering; BE environmental engineering; BSc in project. and construction management; MA in environmental, society and development	3rd (undergraduates); 1st (postgraduates)	170	38
Professional experience programme	BE civil engineering; BE environmental engineering; BSc in project and construction management	3rd	8	2
Final year project	BE civil engineering; BE environmental engineering; BSc in project and construction management	4th	10	2
Engaging with the community: research practice and reflection	Structured PhD in College of Arts, Social Sciences and Celtic Studies and College of Engineering & Informatics	MA/MEngSc/ MSc/PhD	10	2

impact on the community. This evidence has been collected through surveys and feedback questionnaires over the last three years. The students' energy and enthusiasm can be better utilised (and increased) by setting assignments as real community-based projects. The students got a sense of pride and satisfaction out of the knowledge that their work may be helping communities and that learning is not just to get marks to pass the exam! Learners are more motivated when they can see the usefulness of what they are learning and when they can use that information to do something that has an impact on others (Bransford *et al.*, 2000). Furthermore, there is evidence to show that such engagement can lead to a widening of participation in engineering education and the professional profile of engineers to include greater numbers of women and minorities (Oakes, 2008).

2. Service learning in civil engineering
In this section, details of modules in civil engineering with civic engagement dimensions are presented, including evidence to highlight the positive benefits to the students, university and community partners. Due to limitation of space, this paper will mainly focus on one module that has embedded service learning for all students – CE202 Principles of Building. However, brief details of other modules will also be presented. These modules have all been individually tailor for the group of students, taking account of their previous learning experiences, size of group, programme, diversity of the group and so on. They all differ in their set-up and focus and are different to both the IT

community-based project in the MIT degree programme (Byrne and McIlrath, 2012) and CAIRDE (Wallen and Pandit, 2009). IT Project provides students with a real-life "client" in the form of a not-for-profit community group who needed support in exploiting IT resources to further advance their work. The client was chosen from the list of those who had signalled a need for IT services through the CKI. The MIT class is not large – it typically has 12 students who all have an upper-class undergraduate degree. They are interviewed as to their suitability before being offered a place on the programme. CAIRDE is a service learning component of the BE in mechanical engineering, BE in biomedical engineering and BE in electronic engineering at NUIG.

2.1 Principles of building

All students in second year of the BE in civil engineering, BE in environmental engineering, BE in energy systems engineering and BSc in Project and Construction management (approximately 140 students in total) must carry out a community-based project as part of the module CE202 Principles of Building, where at the start of the project the students create learning outcomes of an individual nature for their project and sign a learning agreement with their community partner. This increases the students' sense of ownership of their own learning, which is in the ethos of the project, as the students are free to pick any topic of interest to them within the broader realm of the module area. Many students appreciated the freedom that they were given to develop the objectives of their project. However, an outcome of the project must be that they fulfil a "real" need of their community partner. When asked in a grouped student evaluation survey in 2011 what they liked about the project and the way it was set up, many students mentioned the community partners and how they liked getting involved/interacting/meeting/working with groups and/or individuals in the community. Further, when asked what do they feel they gained from completing the project 24 of the 40 groups who responded felt that they obtained an increased knowledge and understanding of the project topic, while three groups thought they gained a better understanding overall of the content of the whole course from completing the project, and 16 groups felt that they gained by completing a project on real-world applications. It should be noted that the students were asked to complete the survey in the groups which they were in for their community-based project (two or three person groups). A total of 40 groups took part in the survey. The students were asked to document the group's opinion and consensus into five key questions. The survey was designed to capture relevant information that will be useful for identifying positives and areas for improvements in the set-up or delivery of the module. The community-based project is worth up to 4.2 ECTS, which equates to between 84 and 105 hours of input on average per individual student (D-G for Education and Culture, 2005).

Service learning is a very worthwhile pedagogy. This has been proven from the student feedback from structured surveys conducted in 2009 and 2011 and from the very positive feedback received from community partners. A total of 139 students partook in the community-based project in 2011, which are similar to numbers of 2010. It has taken three years to develop the structure of the community-based project set-up, as well as establishing its value within the university and community.

Salient features of the set-up of the community-based learning project are:

- a detailed and structured guidance document for students and community partners;
- a structured learning agreement that must be completed by the students and their community partner at the start of the project;

- a self-assessment sheet and marking sheet for graders that is available to the students and is in line with the learning objectives of the project, so that it is clear to the students what is expected of them;

- marks are returned to the students with feedback within two weeks of submission of the project and before the end of semester; and

- the reports are sent to the community partner and they are asked to return feedback to the college.

Race (2007) gives some good advice in relation to designing student projects. One suggestion is to work out specific learning outcomes for the projects. Race (2007) suggests that "these will be of an individual nature for each project, as well as including general ones relating to the course area in which the project is located". Each year there are approximately 50-60 individual community-based civil engineering projects completed by the second year students with one or two academics facilitating this. Therefore, it would not be feasible to write learning outcomes of an individual nature for each project. However, some general learning outcomes are set for all projects and the student must write two to three learning outcomes of an individual nature for their project at the start of the semester which the tutor will approve. This gives the students' scope to adjust the learning outcomes to suit their desired learning. This increases the students' sense of ownership of their own learning, which is in the ethos of the project, as the students are free to pick any topic of interest to them within the broader realm of the module area. Sample projects from previous years are made available to students. By seeing the standard of projects previously completed encourages students to at least meet, if not surpass this standard.

Having staged deadlines for the project work is very useful. For example, the author developed a template for a "learning agreement" that the students had to complete with their community partner and submit within two weeks of the start of term. This made the submission more structured, but more than that it gave the student ownership of their project and a sense of having to "deliver" to their community partner. Ensuring the students meet strict deadlines is good practice for them for their future careers.

The students present their mini-projects both orally and in a written technical report. As well as receiving feedback on their written report, they also receive strong feedback on oral presentation skills from an external PR consultant. The Q&A session at the end of the presentations is used as both an assessment and feedback tool on technical capability. The questions are used to further assess the students on the depth of their knowledge in their chosen research topic. Further, instant feedback is given to the students on misconceptions or gaps in the knowledge that were evident. "The significant feedback of learning and the potential of formative assessment to enhance pedagogy provide a strong argument that all assessment activity in universities should aim to provide effective feedback for students. Indeed, feedback is arguably the most important aspect of the assessment process in raising achievement [...]" (Bloxham and Boyd, 2007, p. 103).

As discussed above, all students completing the community-based project must submit a self-assessment sheet, that is link to the learning outcomes of the project. However, their self-assessment evaluation is not taken into account in the final marks. On the other hand, there are many advantages to using both self-assessment

and peer-assessment, which include making students aware of the characteristics of "good work", encouraging them to take responsibility for their own learning, and encouraging them to reflect on themselves as learners and so learn how to learn (Race, 2007).

The curricular "domains" of knowing, acting and being (Barnett and Coate, 2005) relate to the content, skills acquired by the student, and human development, respectively. Introducing community-based projects improved the curriculum with respect to each of these domains. First, the projects permit the students to obtain a deeper understanding of some aspects of the course. Second, students have the opportunity to develop their skills in areas such as research, teamwork and communication. Third, working on community-based "real" projects can help students to develop through civic engagement, which may also improve their employability and mastery of a discipline. A review on engineering education in the UK in 2007 noted a concern by industry that current graduates do not have the ability to apply technical knowledge to real-world problems (The Royal Academy of Engineering, 2007). Community-based projects help to link the information taught in the lectures to what is needed in the commercial environment and local communities. It is heartening to note that all of the aforementioned benefits of the project were independently identified by the students who undertook community-based projects in 2011. Furthermore, knowledge transfer takes place between the academic, students and local community. One of the advantages of this, noted by Trowler and Wareham (2008), is "claims about a teaching/research nexus having instrumental value in terms of marketing of programmes and courses and institutional reputations".

A further improvement to the set-up of the community-based learning project that will be implemented next year is to have postgraduate students host regular drop-in "clinics" for the students to review their project progress and draft report or to offer direction or ideas on their research. The efforts from the postgraduate students could go towards credits for their structured PhD and help with their practical learning. It would also help the learning experience of the undergraduate students and may improve the quality of the final report sent to the community partner.

Examples of feedback from some of the community partners in 2010 included:

All feedback is positive, working with the students was great. One of them even got involved in a street collection for the centre! The drawings and plans are much more detailed than that of the year before class so will be very useful for grant applications (Galway Rape Crisis Centre).

I finally got the reports last Wednesday, they were in the sanctuary all along, and I work out of Galway. They are fantastic and we are delighted with them, we will be definitely using some of the solutions that the students put forward this year. We will be putting a piece on our Facebook and web site thanking you, your dept. and the students involved (GSPCA).

[…] was very impressed with some of the items they had looked at. I thought that the compost unit was brilliant, the idea about planting willow trees on the land that was not being used, plus providing us with cheap heating costs. I thought this was better idea than the Pet Cemetery as you would have to find people to bury the animals and make the markers for the graves. The raised dog beds were very good and also the drainage. In all a very good commonsense approach to the problems we are experiencing in the shelter (GSPCA).

[…] the report arrived and it appears to be a good assessment of the state of the building energywise. We have already changed from diesel to kerosene. Also the two windows downstairs have been change to double glazed in the two offices. The rest of the recommendations will depend on funding being made available. It was great working with the two students and good to get the report back (Clann Resource Centre).

Students were very keen and interested in topic (Ballybane Enterprise Centre).

2.2 Multi-disciplinary project – "managing development"
Together with colleagues in civil engineering, geography and CKI, the author introduced an interdisciplinary project in 2010 into a number of programmes in NUIG. This multi-disciplinary module, entitled "Managing development" links the MA in environment, society and development (geography) with the BE in civil and environmental engineering, and the BSc in project and construction management. It involved 19 students from the School of Geography and Archaeology and 150 students from the CoEI. The idea for the module was initially developed by the author and Dr Brenda Gallagher (geography). They were keen to develop approaches to teaching that would engage students with communities in a practical and meaningful way. Engineering and geography clearly presented a number of dimensions for successful collaboration. This module complements the engineering projects that the engineering students carry out with community partners in the second year of their programme, which was introduced in 2009 (see Section 2.1). Third year civil engineering students are also given the opportunity to work in Zambia and Nepal with two NGOs, Alan Kerins Projects and Foundation Nepal, as part of their professional experience programme (see Section 2.3).

This multi-disciplinary module involved groups of MA and engineering students jointly developing critiques of a selected range of NGOs, leading to the production of a set of evaluation posters which assist these NGOs in identifying strengths and weaknesses, and thereby contributing towards improving their approaches to particular activities or strategies in which they are engaged. This project-based approach involves students adopting specific roles as part of a team, collaborating with one other to devise the project structure, set realistic goals and timelines and deliver an end product.

The format provided an active learning environment for students, enabling them to apply classroom-based learning to an actual organisation, in order to identify how or whether such concepts and approaches are being interpreted and applied in a real-life setting, to comprehend the potential gap between theory and practice when set against such a real-life situation, and to suggest whether and how examples of actual policy and practice might be redefined and improved.

As mentioned, the exercise is multi-disciplinary in nature, involving students from two separate colleges; it also involved collaboration with NUIG's CKI, thus incorporating a strong community-relevant dimension to each project. A deeper understanding of the NGO sector enhanced students' awareness that altruism and civic responsibility were to be valued and encouraged in both personal and professional spheres. From the NGOs perspective, the students' evaluations of their individual organisations had revealed the potential for continued collaboration into the future: "What the students have revealed is that their particular perspectives, drawn from both geography and engineering, can provide very rich and critical insights that

enhance understanding of a wide spectrum of development issues, and which in turn can help NGOs to better project the invaluable work they already do".

Dr Brenda Gallagher (School of Geography and Archaeology) who brought her own professional experience of development work in Malawi, remarked that the project has presented the students with a broader perspective on development within national and international communities: "There are many fixed ideas about the nature of NGO activities and often little awareness about the difficult practical and ideological environments which they must navigate. This project has helped to bring the students closer to an understanding of these issues, and to identifying ways they can constructively assist NGOs in their activities".

2.3 Community-based professional experience programme (PEP)

In April 2009, the CoEI at NUIG initiated a pilot programme with the Alan Kerins Projects to give their undergraduate students the opportunity to work in developing countries as part of their academic courses through the professional engineering programme. In the first year, the overall main objective of the project, which has a one-year duration, was to design a lower-cost sustainable construction technology, such as stabilised soil blocks, by replacing or reducing the amount of cement with alternative materials that are sourced locally and are a waste or by-product of another industry. This would reduce the cost of constructing new buildings, as well as improving the local economy of the area, directly benefiting the community. The project was divided in three phases, as shown in Figure 1. First, an extensive literature review was carried out by the students in parallel with laboratory tests at NUIG, which aimed to replicate and improve the characteristics of stabilised soil blocks currently used in western Zambia (Creedon *et al.*, 2009a). Second, the students from NUIG, together with a qualified engineer, travelled to western Zambia in August 2009.

This trip was used to gather further information on materials available locally that can be used in the manufacture of low-cost sustainable construction techniques, such as stabilised soil blocks (Creedon *et al.*, 2009b). In addition, the civil engineering students designed (in collaboration with Engineers Ireland) and ran workshops for the orphan and school children in western Zambia to encourage the children to explore the world of science and engineering, which may inspire them to pursue a career in this
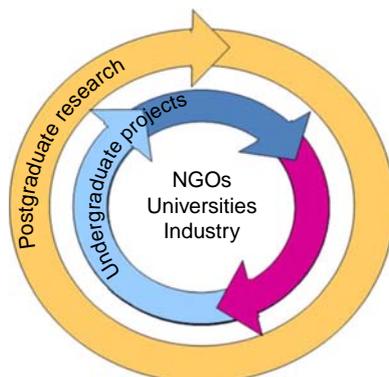
Figure 1.
Model for "Engineering for humanity" projects

area. This could potentially lead to up-skilling of the local workforce and increasing employment in the area. Other initiatives undertaken by the students included surveying of a proposed site and the redesign of a water supply system (Creedon *et al.*, 2009b). The students had a lot of interaction with the locals and were able to gain some practical engineering knowledge. In the third phase of the project, the students completed their final year projects on experimental investigations of stabilised soil blocks (Creedon and Fitzgerald, 2010; Fogarty and Manton, 2010).

The success of this pilot programme led to it being continued in April 2010 with another group of third year civil and environmental engineering students being chosen. This project and some of the other initiatives in the CoEI indicate potential areas where ethical, globally aware, civically engaged and socially responsible engineering education can flourish. Benefits to various stakeholders – students, community partner and academic staff – have been highlighted by Goggins (2010). The aforementioned projects are framed by a research orientation, commitments to civic engagement and building university-community partnerships, so that community users can provide real learning problems and contexts for students and researchers and benefit from the results. Furthermore, they have led to a number of postgraduate research projects being undertaken in NUIG (see Figure 1). NUIG are actively seeking funding to allow them to implement further related research projects.

Its success has caused the programme to be expanded in 2011 and is entitled "Engineering for Humanity", which is a joint initiative by NUIG, Alan Kerins Projects and Foundation Nepal. In all, four engineering students undertook placement in Nepal with Foundation Nepal after completing an initial training period in NUIG under the supervision of the author. Similarly, three engineering students and one project and construction management student initially completed Phase 1 of the project in NUIG under the supervision of the author and then travelled to Zambia at the beginning of June 2011 for seven weeks placement in western Zambia. The objective of this year's group working on projects in Zambia links to the work carried out over the last two years, as specified in the scope of works issued to students with the notification of the placement opportunity in October 2010. Students were chosen for this programme based on a competitive interview process. Students receive a conditional offer for a position on a programme provided that they fulfil all the requirements set out. They must complete pre-departure training and preparation and submit the signed pre-departure form containing information such as contact details, travel itinerary, health insurance, pre-departure medical examination, immunisations received, pre-departure training and so on. This form has been adapted from that developed by Dr Dympna Casey in the School of Nursing & Midwifery at NUIG.

There are a number of undergraduate degree programmes in NUIG during which students work in developing countries and obtain credits towards their degree. The author has worked with the colleagues in the School of Medicine, School of Nursing and Midwifery, CKI and the International Office to introduce this year multi-disciplinary pre-departure training in NUIG for these students. Further specific technical training is given to students partaking in the elective programme entitled "Engineering for Humanity" prior to working in the field in developing countries. These students are based on campus in NUIG for up to eight weeks prior to working in the field. The students undertake laboratory-based work and research projects, as well as receiving courses on cultural awareness, security, child protection and issues in global development. Benefits of the pilot programme have been highlighted by the author elsewhere (Goggins, 2009, 2010).

2.4 Engineering education workshops for primary and post-primary schools
Since 2009, the author has been developing engineering education workshops in collaboration with Engineers Ireland and the Alan Kerins Projects to encourage orphan and school children of western Zambia to explore the world of science and engineering. These workshops are being run by engineering undergraduate students from NUIG in primary and secondary level schools in Ireland, Zambia and Nepal. They may inspire young people to pursue a career in this area. This could potentially lead to upskilling of the local workforce in developing countries and increasing employment in the area. Further, linking the schools in Zambia and Nepal with disadvantaged schools in the Galway and Dublin areas could enhance the cultural awareness and further inspire the students involved in the project.

The author is investigating the feasibility of setting up year-long "engineering experience programmes" that are run by the local teachers for the children during the year. The children could be given a specific theme in the area of engineering (e.g. engineering and agriculture) and the children research different topics in this area (e.g. trees for use in buildings, cow-dung as a material for construction, equipment for cultivating crops, the tractor and so on). The local teachers would be given the resources necessary to supervise and direct the projects. There could then by an "award" giving ceremony at the end of each year.

There are also other initiatives being undertaken at local level by academics and students of the CoEI at NUIG. For example, together with Sarah Knight, outreach officer at the Ryan Institute, the author organised a "Family Fun Day" as part of "Engineers Week" on Saturday, 19 February 2011 in Galway City Museum. This was a free family fun event entitled "Engineering for Communities" with activities on the day to suit all ages. Visitors were able to take part in hands-on interactive activities spread throughout the museum. Each activity explored engineering solutions to different community needs such as bridge building, sustainable housing, medical devices, water treatment and electricity. Engineering undergraduate students from NUIG were involved in designing and running these activities.

2.5 Engaging with the community: research practice and reflection
The module, "Engaging with the Community: Research Practice and Reflection", was designed to support postgraduate students in learning the practice of community-engaged research. This module is one of the outcomes of the Community-Engaged Research in Action project (CORA), which was led by Dr Padraig MacNeela (School of Psychology, NUIG), Dr Josephine Boland (School of Education, NUIG) and Fintan Maher (Director of Development and Communications, COPE Galway). CORA aims to further enhance sustainable and collaborative research partnerships between the university and community – a process which began with COPE Galway. This module was developed by the aforementioned individuals, together with the author and other colleagues in the College of Medicine and Health Sciences, the Centre for Participatory Studies and CKI.

NUIG is the first university in Ireland to offer postgraduate students the opportunity to apply their discipline-specific knowledge and skills to the design, conduct and reporting of a community-engaged research project. From September 2011, PhD students will have the option of working in small teams to address the research needs of voluntary or community organisations, as a credit-bearing module in a postgraduate research programme.

This research initiative builds further on the international reputation NUIG enjoys for supporting civic engagement. The CKI and ALIVE volunteering programme

support thousands of students each year who work with community and voluntary groups. With the implementation of this module, NUIG aims to build on this success by developing PhD students' research skills in an applied, real-world setting to meet a community need.

3. Conclusions

This paper discussed the introduction of service learning into a number of modules in civil engineering in NUIG. It has been shown that service learning gives students the flexibility to further explore areas that interest them, while gaining experience of working in a small team with community partners on "real" projects. Further, the community-based projects give the students scope for creativity and criticality. The development of service learning activities has enhanced students learning. The approaches outlined in this paper fit well with the ideas of engaged scholarship (Boyer, 1996) and civic professionalism (Sullivan, 2005). Feedback from students supports this. The projects outlined in this paper are framed by a research orientation, commitments to civic engagement and building university-community partnerships, city-university partnerships and partnerships with other official agencies, so that community users can provide real learning problems and contexts for students and researchers and benefit from the results.

Engineers almost exclusively work in multi-disciplinary teams on projects. Thus, it was a key driver for the author to introduce multi-disciplinary community-based projects into the undergraduate and postgraduate degree programmes. Over the next academic year, the author plans to further develop this type of learning and build stronger relationships with community partners. He believes that this will have instrumental value in terms of marketing of programmes and courses and institutional reputations, which could contribute to widening of participation in engineering education and the professional profile of engineers to include greater numbers of women and minorities.

This paper presented evidence that by creating community-based learning the students' energy in learning can have a positive impact on the community. However, one of the main challenges is to maintain and increase the value of the programmes for the community partners. In other words, the outcome of the student's learning should be significantly beneficial to the community partner. The introduction of an interdisciplinary community-based project for students on structured PhD programmes in NUIG should contribute to this. Furthermore, continuously developing the other modules has helped increase the value of the programmes for the community partners, as well as for the students and academics involved. This paper has shown that civic engagement by students at both the local and international level can have positive benefits. Their energy and enthusiasm can be better utilised (and increased) by setting assignments as real community-based projects. The students got a sense of pride and satisfaction out of the knowledge that their work may be helping communities and that learning is not just to get marks to pass the exam! Learners are more motivated when they can see the usefulness of what they are learning and when they can use that information to do something that has an impact on others (Bransford *et al.*, 2000).

The value of civic engagement by students and staff at NUIG is recognised internationally. In 2010, NUIG was awarded funding to work on service learning in Jordan and the Lebanon for next three years as part of an EU Tempus Tempus IV project – Tawasol. One of the key aims of the project is to share experiences with colleagues in Jordanian and Lebanese to help develop modules in service learning.

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