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An intrinsic case study into the appropriateness of a bespoke training model as an approach to supporting the postgraduate demonstrator in developing pedagogical skills suitable for undergraduate scientific laboratories.

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Declaration

I hereby declare that the material, which is submitted in this thesis towards the award of **Masters (M.A.) in Higher Education,** is entirely my own work and has not been submitted for any academic assessment other than part-fulfillment of the above named award.

The material contained in this thesis may be used in future research on condition that the source is acknowledged in full.

Signed...

Date...

Abstract

Postgraduate demonstrators (PGDs) are crucial to the smooth running of undergraduate teaching laboratories; however, they are oftentimes exiled to superficial duties such as enforcing health and safety and procedural instruction. The aim of this intrinsic case study was to characterise the support required by postgraduate demonstrators (PGDs) to develop the key pedagogical skills that would assist them in effectively demonstrating undergraduate science teaching labs. Through supporting PGD development, it is hoped to centralise the PGD in the undergraduate teaching lab and set in place the foundations for a move towards undergraduate teaching labs that encompass aspects of tailored research in the School at the centre of the intrinsic case study. Initial key pedagogical skills identification involved stakeholder surveys, discussion fora, prior knowledge based on literature review and personal experience. Once completed, it was clear that appropriate support to develop the key pedagogical skills was not available to the participants of this case study. Thematic analysis indicated an overall shortcoming in PGD support in developing appropriate pedagogical skills, characterised by a lack of PGD confidence in their ability to effectively demonstrate. The under-supported pedagogical skills areas were mapped onto sub-themes of engagement, communication, grading and providing feedback. This provided a rationale to develop a bespoke training course to assist and underpin the PGDs development as novice academics; to address pedagogical skills gaps and this was delivered following a socially constructed, 'just-in-time' pedagogy. Upon completion, the effectiveness of this model of PGD pedagogical training to suitably support PGDs in their pedagogical development was evaluated by stakeholder survey and discussion fora. Overall, it was noted that the training course had a very positive influence on the PGDs; they developed a noticeable increase in confidence in their ability to demonstrate, they took on additional responsibilities in the lab and developed their own community of practice. Based on the perceived improvement observed in this intrinsic case study, it is recommended that with continual training and appropriate support PGDs can take a more central role in the undergraduate teaching lab and this may allow undergraduate labs to evolve towards a more research centred model that the PGD could enhance and add value to. An in-depth set of recommendations devised from this study is included.

Publications

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List of Abbreviations

ATT: Attitudes Towards Teaching

CLE: Cognitive Learning Evaluation

CoSH: College of Science and Health

DIT: Dublin Institute of Technology

DCU: Dublin City University

GTA: Graduate Teaching Assistant

HEA: Higher Education Academy

HEI: Higher Education Institute

IBL: Inquiry Based Learning

NUIG: National University of Ireland Galway

NUIM: National University of Ireland Maynooth

OECD: Organisation for Economic Co-operation and Development

PBL: Problem Based Learning

PGD: Postgraduate Demonstrator

PhD: Doctor of Philosophy

SEEQ: Student Evaluation of Educational Quality

SoFSEH: School of Food Science and Environmental Health

SPGD: Senior Postgraduate Demonstrator

STEM: Science, Technology, Engineering and Maths

TCD: Trinity College Dublin

TSE: Teaching Assistant Self-Efficiency Scale

UCD: University College Dublin

UCC: University College Cork

1.1   Research context and rationale

The role of the practical lab session has been, and continues to be, central to science education (Hofstein & Lunetta, 1982 and 2004). Every student undertaking a science-based degree will, at some stage, enter into the undergraduate teaching lab (the more common terms of 'lab' and 'labs' plural will be used from here on) to develop their practical lab skills. In comparison to lecture-based teaching, there has been limited research into the roles and duties of those tasked with 'teaching' practical scientific skills. This is despite the number of students that participate in and regularity of this scene. Frequently these duties; such as technical skills demonstration, instrumentation usage, scientific calculations and experimental data interpretation and analysis, are assigned to postgraduate demonstrators (PGDs), also referred to as Graduate Teaching Assistants; GTAs), who themselves are oftentimes students, albeit postgraduate. The term PGDs will be used throughout this thesis as it is most common and relevant term in this research.

PGDs maintain a pivotal position within the fabric of the higher education institution. They typically have more face-to-face contact with the undergraduate student population than the lecturing academic; for example, up to 91% of all early year lab teaching is delivered by PGDs (DeChenne *et al*., 2012). This close contact can be used by the undergraduate student to not only develop their technical and theoretical connections, but also clarify misconceptions and cement their understanding in a more relaxed teaching environment (Jackson & Simpson, 1983). However, the PGDs carrying out this role of novice academics are not always provided with pedagogical training to prepare them for their role as teacher and demonstrator. When it is provided, PGD training can vary from formal, structured and aligned to a further qualification (e.g. St. Andrews University, Scotland) to *ad hoc* provision such as just-in-time workshops. In this research, the effect of bespoke pedagogical training provision on postgraduate demonstrating within the School of Food Science and Environmental Health (SoFSEH), Dublin Institute of Technology (DIT), will be investigated. The SoFESH typically utilises 20-30 PGDs each academic year, distributed over a broad multi-disciplinary base ranging from molecular biology, through organic chemistry to food product development. Currently, no training nor support is

provided for the PGDs within the School, and the development of a training 'module' is appropriate given the imminent roll-out of the structured PhD within the School which requires modules in introductory pedagogy for enrolled postgraduate students.

1.2 Research Aims and Objectives

The research aim of this intrinsic case study is addressed in the research question and aligned sub-questions:

"How can the Postgraduate Demonstrator be supported in developing pedagogical skills appropriate for undergraduate scientific laboratories?"

Sub Questions:

What are the appropriate pedagogical skills required by Postgraduate Demonstrators teaching in undergraduate science laboratories*?*

How might appropriate skills required by Postgraduate Demonstrators teaching in undergraduate science laboratories be enhanced through suitable training?

The research will focus on how to support the postgraduate demonstrators to develop the key pedagogical skills that will assist them in demonstrating undergraduate teaching labs. Aligned to this primary research question, this research also aims to investigate what pedagogical skills are considered key to assisting PGDs in the teaching lab and how can these skills be developed and enhanced through suitable training. These aims shall be achieved by developing, executing and evaluating a short, bespoke pedagogical training course for all postgraduate demonstrators in the SoFSEH, within the College of Sciences and Health (CoSH) in DIT. Given the multidisciplinary nature of the undergraduate programmes offered within the School (Nutraceuticals, Food Innovation, Food Science and Management, Pharmaceutical Healthcare and Pharmacy Technician), demonstrators assist in the teaching and demonstrating of key lab skills over a range of scientific disciplines and this was considered during the development and delivery of the bespoke training course.

The initial part of this research comprised an information gathering exercise to compile the current roles and responsibilities of the PGD according to all the major stakeholders (the undergraduate students, the postgraduate demonstrators, academic staff, technical staff and School management). The surveys and discussion fora conducted here formed the first part of the data collection for this research project. The collated information was examined and analysed to identify the current gaps in PGD pedagogical training. This gap analysis, combined with specific skill requirements derived from the stakeholders, was used to design a short, bespoke training course adapted to the requirements of those involved in this intrinsic case study (see Figure One). Following delivery of the course the effect of this bespoke training course was evaluated through survey, interviews and focus groups targeting all the key stakeholders. Qualitative data analysis was carried out and data were coded using several key themes and sub-themes based on researcher interpretation influenced by Strauss and Corbin's (1990) Method of Constant Comparison and Braun and Clarke's (2006) six step approach to data analysis. Interpretation and discussion of the findings of this intrinsic case study are extrapolated and examined in terms of the contemporary literature. Finally, conclusions are drawn and recommendations for practice for management, academics and PGDs locally within the SoFSEH, and more generally the CoSH and other Departments of Science are offered.
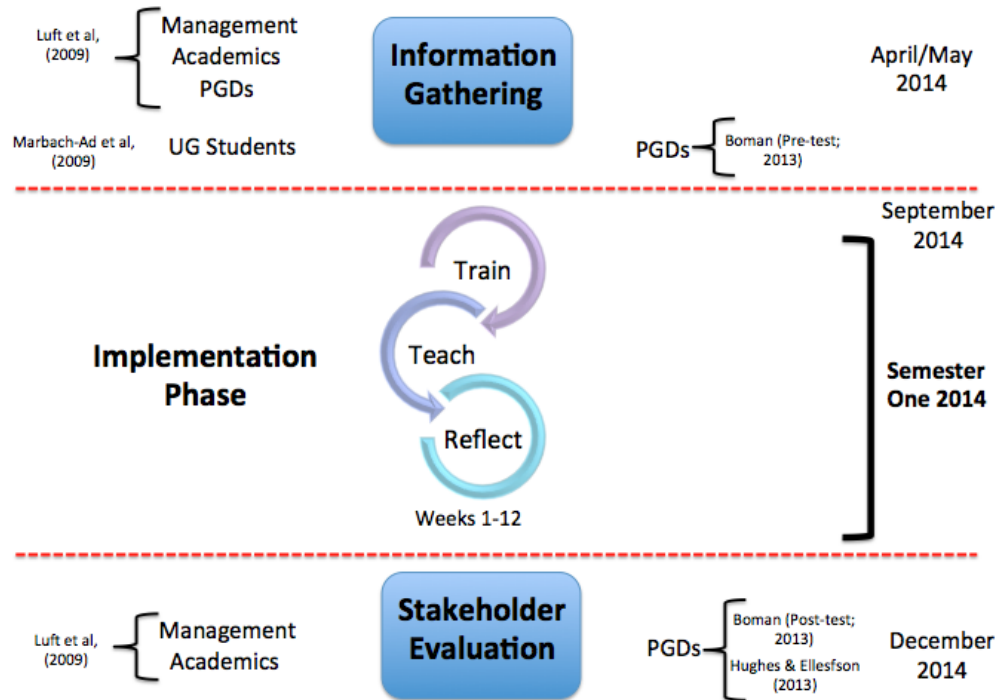
Figure 1.1: Schematic outline, including an indicative time scale, of the research project. Data were collected in all cases by methods based on previously published work, indicated by cited references. The *Information Gathering* phase resulted in stakeholder data that was used to inform the development of the training course. The *Implementation* phase involved the PGDs as the active participants in the training course. The final *Evaluation* phase incorporated stakeholder evaluation of the training course.

2.1 The central role of higher education in society

The higher education model is currently undergoing a huge rethinking, both nationally and internationally. Central to this is the worldwide economic downturn witnessed over recent years; however, other key influencing factors include the desire for increased higher education from a wider demographic and greater population base, and the increasing emphasis on knowledge based economies (Vincent-Lancrin, 2004). Depending on the ontological perspective, these drivers can be viewed as positive or negative. The current economic crisis, originating in 2008, was notable for its depth and the speed at which it crossed the world (Rose & Spiegel, 2012). These factors forced governments to quickly address smouldering national issues; issues that were often mirrored in other countries. Higher education was one of these universal issues. Within this sector several key points were raised, including: public concern over higher education subsidy through public funds, massification (mass education) and the need for governments to decide on methods to stabilise economic downturn through the knowledge production (Hazelkorn, 2014).

2.1.1 The knowledge-based economy and investing in the fourth level

The role of the university, and higher education institutions in general, is changing. No longer can they exist as ivory towers untouched by the world around them (Bok, 1982 and Watson & Watson, 2013). The rapid and widespread economic changes in recent years have forced HEIs to adapt and evolve. In many cases this transformation has moved HEIs front of stage as key actors in national, and international, recovery (Trani & Holsworth, 2010). For example, science graduates and postgraduate researchers hold a central position in knowledge creation and development, which will aid higher education in general to translate knowledge into economic profit.

The knowledge economy is built on the simple premise that knowledge enhancement can positively influence, and progress, the economy. Linked to this is specialisation, based on improved knowledge, which greatly improves efficiency and thus has a positive effect on the economy. Finally, cross-pollination of knowledge from different disciplines allows for new knowledge creation and alternative approaches to be implemented, again enhancing economic return. The knowledge economy is iteratively built, each innovation

and each process progression is as a result of adding to, or amending, an existing process based on ever deepening knowledge (Metcalfe, 2010). The value of scientific knowledge creation and application can be clearly seen in Finland's recent economic recovery. In recent years, Finland embraced scientific innovation through integrated scientific policies and developed centres of scientific excellence resulting in the application of science being the foundation of economic recovery (Halme, 2014).

Knowledge enhancement can take place in anywhere, anytime; however, investment in higher education can lead to directed and targeted progress in a shorter timeframe. This investment is generally focussed at the postgraduate level through research and development funding, resulting in an increased number of PhD students and postdoctoral researchers. In this area, Ireland, as with other areas of educational reform, initially lagged behind Europe and the rest of the world. Ireland experienced economical growth after the introduction of universal second level education, which in turn increased the demand for higher education. This was subsequently provided for by the abolition of higher-level tuition fees in the nineties. A talented and educated workforce then emerged in the early part of this century, and financed by a buoyant economy, the government invested €3 billion into fourth level research and development focussing on the science and technology sectors (Hazelkorn & Moynihan, 2010). The government prioritised this move towards knowledge production and the knowledge-driven economy through strategic funding. The National Development Plan (2006) placed higher-level education and higher-level research as central drivers to '*improve economic performance*' (p. 17). This prioritisation was further developed through the in-depth Forfas study examining the role of PhDs in the Smart economy (Forfas, 2010)

However, as observed in other aspects of higher education, once the economic downtown commenced, so did the reduction of funding for the higher-level research. In the early years of the downturn (2009-2010), there was a 30% reduction in research funding (Hazelkorn, 2012). In order to maintain an acceptable level of research in Irish HEIs, governmental policy and initiatives have rationalised the type, scope and breath of research in Ireland. Hazelkorn (2014) outlines how various governmental policies have suggested a focus on

clever copycat development more so than basic research (based on the Innovation Taskforce Report, 2010) and more recently the identification of fourteen research priority areas emphasising industrial relevance (based on the Research Prioritisation Exercise, 2011).

2.1.2 The emergence of the postgraduate researcher as a central figure in higher education

Despite the rapid higher education evolution, research and knowledge creation remains a cornerstone of most HEIs. The role of the doctoral research student is key within the HEIs' research sphere. During the height of government investment into research there was a large emphasis on increasing the number of PhD graduates year-on-year. However, as noted, the downturn in the economy resulted in an alternative approach to doctoral scholarships and research funding in general. The latest available figures show that doctoral level research registrations are stabilising, and even growing modestly; a 2.3% increase in full-time PhD registrations, at a national level, was noted in 2011/2012. However, this contrasts with a dramatic reduction in full-time Masters by research of 18.3%. This suggests that those postgraduates interested in research are committing to a longer course of study, and thus, generating a deeper body of knowledge during their research (HEA, 2012).

In 2014, the biggest discipline for postgraduate research in Ireland is the Sciences, with almost 3,000 registered doctoral students across the national higher education sector. This is almost double the next nearest discipline, Arts and Humanities at 1,500 registered doctoral students. This contrast is even more clear when viewed in terms of international research students, almost three times as many international doctoral students are Science based researchers (approximately 750) compared to the next nearest discipline, Arts and Humanities (approximately 250). Overall Ireland is maintaining a stable position close to the OECD average for graduating PhDs (close to 1.5% of the population in the reference cohort examined), which suggests that the latest governmental policies are working in order to maintain Irelands research base (HEA, 2012). Ireland is also competing well on the global scale in terms of research output, maintaining a position in the top twenty countries according to the Thomson Reuters Essential Science Indicators (Love, 2011). With limited funding,

governmental co-ordination and rationalisation, postgraduate researchers are still at the forefront of knowledge generation. Furthermore, the doctoral researcher holds a pivotal, yet sometimes unrecognised, role in the higher education system as a whole.

2.2 Postgraduates researchers who teach; a distinctive tribe with a key role

The core role of a postgraduate research student is to carry out specialised research in order to "*systematically acquire and understand of a substantial body of knowledge which is at the forefront of a field of learning*" (DIT, 2011; p. 20). This body of knowledge can lead to directly enhancing the knowledge-based economy through, for example, a spin-out company formation. Most postgraduate researchers also carry out teaching and learning duties during their postgraduate training. Unfortunately, these postgraduates who teach are often thought of as the '*forgotten tribe*', or worse, casual '*slave labour*' within the higher education model (McCready & Vecsey, 2013, p.105).

Within Science, Technology, Engineering and Maths (STEM), the PGD plays a pivotal role in structuring undergraduate learning; particularly in the lab. Indeed, in the lab the PGD often has more contact time with undergraduate students than tenured academic staff. For example, in certain research universities almost all large undergraduate basic sciences lab instruction is provided by the PGD, in some cases as high as 88% (chemistry) and 91% (biology; DeChenne, *et al*., 2012). This trend is likely to be maintained, if not exaggerated further, by the increasing massification of higher-level education predicted both internationally and nationally (O'Connor, 2013). The postgraduate student thus maintains a key dual role in not only the development of the knowledge-based economy, but also in the education of the large cohorts of undergraduate students entering higher education.

In Ireland, this important role of the postgraduate in supporting undergraduate teaching is highlighted in the Department of Education and Skills (2011, p.54) National Strategy for Higher Education to 2030 Report (commonly referred to as the Hunt Report and cited as Hunt, 2011 from this point onwards), which recommends, "*a culture of enquiry and engaged scholarship should permeate the work of all higher education institutions*". The postgraduate researcher is central

to the development and maintenance of this culture of enquiry. As active researchers and novice educators, the postgraduate holds a pivotal place at the interface of research and learning (IUQB, 2005). Hunt (DES, 2011, p.77) recommends that all learning should be "*informed by up-to-date research*" and facilitated by "*open knowledge flows*", and thus the postgraduate becomes a central player. The Hunt Report also outlines the need for a researcher career pathway, in which researchers are provided with opportunities to develop critical and lifelong skills that will enhance the researcher and the hosting higher education institution (IUA, 2014). Hunt (DES, 2011) clearly recommends the provision of appropriate opportunities for postgraduate researchers to develop their pedagogical skills as "*researchers should, where possible, be afforded opportunities to participate in teaching such as lab supervision and tutorials*" (p.16). Enacting the recommendations from the Hunt Report could result in the benefits extending beyond the postgraduate researcher, to the undergraduate student population and ultimately to the hosting higher education institution. The postgraduate student, in the role of the PGD, should be celebrated as being a member of '*distinctive tribe*' with much to offer (McKiggan-Fee, *et al*., 2013, p.171). The unique skill set offered by the PGD should be harnessed in undergraduate teaching, particularly in the lab.

PGDs are not academic staff yet they play important roles in the education of undergraduates. PGDs often do not have to hold a teaching qualification; however, it should be noted that not all academic staff hold a teaching qualification either (Allen & Rueter, 1990). PGDs do require support, through appropriate training, in the fundamentals of pedagogy before they begin to demonstrate (IUQB, 2005). However, providing a PGD pedagogical support structure raises several questions; including, how can the need to train PGDs in the fundamentals of pedagogy align to the research ambitions of most PhD researchers? Most PhD researchers are in HEIs to research on their topic of choice; teaching is a secondary by-product that may result in the postdoctoral researcher choosing an academic career path (McAlpine & Emmioğlu, 2014), 2014). Not all doctoral researchers will choose an academic lecturing role. This may be through personal choice or the current poor employment prospects in this sector (Larson *et al*., 2014). This seemingly contradictory scenario; the need to train in pedagogy to assure quality in their teaching duties during their PhD, but

the non-universal requirement for direct pedagogical skills in their postdoctoral careers, can alienate PhD students and reduce their effectiveness as PGDs in the undergraduate learning lab.

2.2.1 Postgraduate demonstrators; key influencers of learning in the lab

A central aspect to undergraduate science education is the development of core lab skills appropriate for the future career of the student. Although discipline specific competencies are developed in later undergraduate years, the basic lab skills are often established in the early undergraduate years. Johnstone and Al-Shuaili (2001) describe these key aspects of learning in the undergraduate lab as the ability to plan an experiment, to execute the experiment with appropriate manipulative skill, and finally observe, record, interpret and communicate the data generated during lab work. At the most basic level those tasked with 'teaching' lab skills will influence all aspects of lab learning including include broader skills and competencies such as experimental design, data evaluation, accuracy and safety (White *et al*., 2013).

This is particularly true for first year undergraduate students, as they transition from second level to higher education. Some of these students may not have had access to a lab during their second level education and, as such, require guidance during the development of their fundamental lab-based skills. It can be very beneficial for apprentice scientists to observe and discuss how a skilled scientist, the PGD, carries out their lab work. In this environment, learning can be a mixture of behaviourism, where the undergraduate student replicates the actions of the skilled PGD, and also cognitivism, as the PGD talks through their thought process as they, for example, set up an experiment. Central to this process is a natural working relationship; where the apprentice is willing to learn, the skilled PGD is willing to pass on their knowledge and the "*principles of natural conversation*" exist between novice and 'expert' (Moore, O'Neill & Barrett, 2008, p.54).

The transition from novice to experienced scientist requires the undergraduate student to develop advanced skills in planning, design, performance, analysis, interpretation and analysis. Mastery of these areas requires substantial development of both the psychomotor (manipulation and observation) and the cognitive (problem processing) skills (Hofstein, 2004). In the correct

environment, with the correct instruction and method of facilitation, the undergraduate can quickly reach a level of basic competency allowing a more autonomous learning curve to be taken.

2.3 Teaching and learning effectiveness in the lab

The effectiveness of lab teaching has been anecdotally investigated for many years; however, significant evaluation in the literature is limited. Skeff's (1988) early attempt to document the factors influencing clinical teaching can be aligned to lab teaching (see Table 1.2). The academic has a key part to play in many of these factors and without prior training, or experience, the undergraduates learning will not be complete. For example, one of the key aspects of learning is timely and appropriate feedback (Higgins *et al*., 2002). Without prior training and guidance in the provision of suitable feedback, and the mechanisms involved in providing feedback, the novice academic practitioner may not feel comfortable in giving feedback to undergraduate students. This can result in a poorer learning experience for the undergraduate student, particularly in hands-on, skill-based subject areas (Mahmood & Darzi, 2004).

Herrington and Nakhleh (2003) explored the influence of the PGD in the effectiveness of undergraduate lab learning, focussing on the chemistry lab. The authors built on the previous works of Lazarowitz and Tamir (1994) and Pickering (1998) who noted the most important person in the undergraduate teaching lab was the PGD, and one of the primary reasons why lab teaching styles have remained static was the failure to consider this important role maintained by the PGD.

Herrington and Nakhleh (2003) based their measure of learning effectiveness on the promotion of positive change in the undergraduate student. To evaluate this change, students were initially surveyed on their understanding of the qualities of an effective PGD and how an effective PGD can enhance their learning experience. Interestingly, the results of this study coded onto three key themes, as outlined in Table 2.1. 'Knowledge' was broken into two broad areas, one of which was knowledge of teaching and learning approaches suitable to undergraduate teaching labs. Again, without prior training in these areas, many PGDs would have limited knowledge of learning theories and would most likely revert to the teaching method they are most used to, i.e. the way they were taught

as an undergraduate. This chimes with Pickerings (1998) ideology that PGDs are not generally considered for specific pedagogical training and hence the closed pedagogical circle, resistant to change, is destined to repeat itself. Furthermore, the other themes of communication and affective domain as identified by Herrington and Nakhleh (2003; see Table 1.1) could also be improved through suitable and timely PGD training and support.

Table 2.1: Summary of Herrington and Nakhleh (2003) three themes of effective PGD teaching in the chemistry lab.

Theme	Additional Information
Knowledge	Understanding both technical/scientific and teaching/learning concepts.
Communication	Explaining complex concepts in simple language.
Affective	Interested and engaged in student learning.

2.3.1 Lab pedagogy; different approaches to achieve different goals

The style of lab can also affect not only the learning experienced by the undergraduate, but also affect the teaching delivered by the PGD. Traditional labs are considered those that follow an expository style, otherwise known as 'recipe' or 'cook-book' labs. Undergraduate students in these labs follow a pre-determined method to achieve a pre-determined outcome and typically communicate these findings in a standard lab report (Dunne and Ryan, 2011). The depth of undergraduate learning here is questionable; however, there are advantages to running this style of lab, particularly with large first year cohorts. On an economic level, it is much cheaper to prepare the undergraduate teaching lab with multiple repeats of the same equipment and consumables; technical preparation time can be reduced and the process optimized. Logistically, for the PGD, expository labs can be easier to run as the results are more predictable and the undergraduate assessment and feedback procedures can be streamlined through years of optimisation.

These advantages could be considered insignificant in comparison to the major pedagogical disadvantages to implementing expository lab work. Students gain limited exposure to key elements of scientific lab work such as experimental design, problem solving, critical thinking and creativity (McDonnell *et al*., 2007). These are the very skills the PGDs have developed during their own postgraduate research; however, expository style undergraduate labs can reduce the PGDs ability to pass on the skills they have acquired. An alternative style of lab, that promotes and celebrates the core skills of the research scientist, would promote deeper undergraduate learning. The adoption teaching labs that encompass research; such as those focussing on problem (PBL) and inquiry based learning (IBL), has been shown to enhance the experience of both the undergraduate and the PGD (Dolan & Johnson, 2009; French & Russell, 2002;). This alternative approach would also simultaneously illustrate that the greatest teaching resource in the undergraduate lab then becomes the lab-based researcher, the PGD.

Table 2.2: Skeffs' (1998) seven-component framework to enhance teaching effectiveness in the clinical setting and a comparative alignment to lab teaching.

Component	Explanation	Alignment to lab teaching
Learning Climate	Atmosphere of the teaching environment.	The lab is a learning environment where students fell free to ask questions and learn from peer and academic engagement.
Controlling the Teaching Environment	The focus and the pace of the content are appropriate.	The experimental goals are achievable, suitable and the skills are demonstrated at the appropriate time.
Communication of Goals	The learning outcomes are clearly communicated.	The experimental lab skills are clearly defined and mastery is assessable.
Understanding and Retention	Students display a deep understanding of the content.	The required experimental skill set and theoretical knowledge is achieved and demonstrable.
Evaluation	The learners can demonstrate they have achieved the learning outcomes.	Student learning is aligned to the evaluation protocols.
Feedback	Information is provided to the learner in order to improve the learners understanding.	Students should receive formative and summative feedback on both their technique and scientific record keeping and reporting.
Self-Directed Learning.	The learner identifies gaps in their learning and acts, under their own initiative, to close these gaps.	Students reflect on their theoretical, lab and communication skills and identify areas that require further study.

2.4   Incorporation of research-like activities into undergraduate labs

The integration of research and research-like activities should be central to undergraduate learning. Neary and Winn (2009), through the 'students as producer' philosophy, have suggested the positive effect on student learning through the inclusion of real-life, complex and unstructured research-like activities at the core of the undergraduate curriculum. In this approach to learning, undergraduate students are encouraged to develop their understanding by carrying out research, or research-like, activities early and throughout their undergraduate studies. This philosophy aligns to the PGD and how they develop understanding of their research topic; through research, and chimes with seminal works of Healey and Jenkins (2000) and Brew (2010).

Aligning how PGDs research and how undergraduate students learn by carrying out research-like activities would be beneficial to both cohorts. Integrating research-like activities into the undergraduate lab can develop skills that prepare students, and PGDs, for life-long learning and enhance their future employability. An obvious example here would be the teaching experience gained by the PGD; particularly important if the PGD intends to enter into an academic career. Exposure to contemporary pedagogy, for example such areas as student-centred inquiry based learning, will enhance future academic perspectives and potentially introduce novel teaching methods into other institutions (Partridge, *et al*., 2013). Furthermore, life-long skills such as communication, time management and enhanced self-confidence are attributes that the PGD can use in their own research and their future career (McCready & Vecsey, 2013; Anon., IUA, 2014).

Although a potential symbiotic relationship could be forged, it is crucial that the undergraduate research activities are aligned to the curriculum and are authentic as possible in order to enhance the student learning experience (Schuck and Kearney, 2008). The type of research carried out by the undergraduate, and facilitated by the PGD, should be tailored. This research tailoring can vary from research led, wherein the student assists in current research and is thus PGD centred; to research based, where the student is central to the process and undertakes research and enquiry, and is PGD facilitated (Healey and Jenkins, 2009; see Table 1.3 for relevant examples). A subtle blend of this research spectrum would provide appropriate structure and support for undergraduate

students; simultaneously allowing undergraduate students to develop as autonomous learners and maximising the positive influence of the PGD.

This blend can be achieved by introducing structured and facilitated research-like and research-based lab learning. Inquiry-, discovery- and problem-based labs are some of the more popular alternatives to the traditional, expository lab that encourage undergraduates to develop their core skills as apprentice research scientists and are suitable to all undergraduate years (Buck, *et al*.; 2008, Domin, 2007). The PGD can add value to these lab-teaching environments; drawing on their own research and learning experience to support and guide the undergraduate students.

Table 2.3: Summary of methods of lab teaching and learning encompassing research aligned to Healey's (2005) concept of inquiry-based learning focussing on discipline specific research. Summaries of example applications of the four types of research and associated reference are also noted.

Research Type	Explanation	Example	Reference
1. Research led	Students exist as audience and the emphasis is on research content.	Students developed their understanding of protein based diseases based on the evaluation of real medical cases and associated lab work.	Brauner *et al*., (2007)
2. Research orientated	Students exist as audience and the emphasis is on research processes and problems.	Students learn about the process of scientific writing and publication. This leads to discussions about scientific enquiry.	Wilmott *et al*. (2003)
3. Research tutored	Students exist as participants and the emphasis is on research content.	Students work in groups to develop hypothesis driven labs and attempt to solve problems in and hands on environment.	Foote *et al*., (2014)
4. Research based	Students exist as participants and the emphasis is on research processes and problems.	Students participate in five PBL based modules cumulating in a capstone project that focuses on an industry specific new product development.	Ferguson & Sanger, (2011)

2.4.1 Research like labs can enhance postgraduate personal development

Sandi-Urena and co-workers (2011) examined the effect of PGD work in an intellectually stimulating teaching environment, as is often found in research-like teaching labs. In their study, Sandi-Urena and colleagues observed how, in the correct teaching environment, PGDs developed their metacognitive skills, their epistemological perspective and their affective engagement, echoing Herrington and Nakhleh's (2003) previous work. Development in each of these areas was seen to be beneficial to the PGD in their own research. For example, development of their epistemological perspective allows the PGD to become more reflective in their own learning and research. Oftentimes this development stems from an internal conflict surrounding the PGDs own understanding of 'knowledge'. Through reflection, the PGD forms their own epistemological outlook and this directly influences their own research and life-long learning. This epistemological transformation can take place through other life experiences; however, it is accelerated through reflection of their dipolar research/teaching experience (i.e. their personal research and assisting apprentice scientists in their research; Sandi-Urena *et al.*, 2011).

2.5   Overuse of underprepared postgraduate demonstrators in labs

Ideally, PGDs would teach in a stimulating environment and receive adequate support and guidance as they develop their teaching skill set. However, in the Sciences in particular, lab teaching tends to be carried out by under-supported PGDs. The increasing rise in the use of PGDs can be aligned to the reduced budget in the higher education sector, and the mantra of 'do more with less'. In simple terms, a PGD is much cheaper than a full-time lecturer. For example, it makes economical sense to have several PGDs running undergradute teaching labs; thus reducing the institutions salary spend and relieving the over-stretched academic allowing him/her to concentrate on more scholarly activities (Park, 2002).

The PGD is, therefore, often faced with large classes of early undergraduate students (typically greater than one hundred students), whom themselves are dealing with a considerable educational and life transition (Scott & Maw,

2009). Although it may make economic sense to allow PGDs to teach undergraduate labs, it does not make ethical or pedagogical sense. The PGD can be placed in an uncomfortable position; coming from a pedagogical 'no-mans-land'. They must span the chasm of student and academic, often times with little or no training, resulting in ineffective teaching (McKiggan-Fee *et al*., 2013). The PGD sense of identify also influences their ability to teach and demonstrate. PGDs have been noted to feel under-valued and under-supported by their institutions (Park &Ramos, 2002), which can result in tension and conflict as the PGD struggles to strike the balance between researcher and novice academic (Muzaka, 2009).

2.5.1 Postgraduate demonstrators' requirement for training

Without suitable PGD training, undergraduate student lab learning can suffer, through no fault of the PGD. The PGD is simply neither prepared, nor supported, to take on the demanding role of the novice academic practitioner and hence the usefulness of the learning experience is questionable (Knottenbelt *et al*., 2009). To fully harness the potential of the PGD as an important part of the higher education fabric, the hosting institution must provide suitable support and training. This training would allow the PGD to become familiar with appropriate pedagogical approaches to teaching, learning and assessment. These are the common areas that most PGDs feel they require additional support before they commence teaching (Cho, *et al*., 2011). The European Association for Quality Assurance in Higher Education (ENQA, 2005; p.14) simultaneously recommends the fostering of "*vibrant intellectual and educational achievement*" facilitated by "*qualified and competent staff*". The role of quality assurance in higher education has increased in importance in recent years as HEIs seek to transparently demonstrate, for example, the standards of teaching (Lichtenberger, 2013). In order to maintain an acceptable level of teaching in all member HEIs, the EQNA recommend that staff involved in teaching should hold a minimum level of competence and, furthermore, staff should be afforded opportunities to develop and extend their teaching capacities (ENQA, 2005; Anon., 2015b).

2.5.2 Current training and support for the teaching postgraduate demonstrator

Despite the prevalence of PGDs in the undergraduate teaching lab there is evidence to suggest that many PGDs are still under prepared to teach; DeChenne and co-workers (2012) noted that 37% of Chemistry PGDs and only 15% of Biology PGDs receive some professional development before beginning their teaching in the US. More generally, in the UK, 20% (n=1500) of all PGDs receive no training prior to commencing their teaching duties (Wenstone, & Burrett, 2013). Aligned to this figure, Scott and Maw (2009) noted that UK bioscience PGD training was compulsory in 74% (n= 35) of the higher education institutions surveyed. However, the standard and relevance of the training provided was mixed; for example >60% of PGDs received training in lab safety whereas <50% received training in student assessment and grading. There is less published data from an Irish context; however, most universities have specific postgraduate training courses in pedagogy (e.g. UCD, TCD, UCC, NUIM and NUIG). Additionally, some also offer specific awards to recognise the important contribution made by the PGD (e.g. *TCD Best Demonstrator Prize*).

It is common for PGD teaching training to take place at the end of a PGDs personal postgraduate research journey where the PGD attempts to gain as many supplementary qualifications as possible to enhance employment prospects (Beaton *et al*., 2013). A more sustainable, efficient and effective use of PGD teaching training would be the integration of pedagogical training as a cornerstone of the postgraduate training course. One potential method to achieve this is to incorporate pedagogical training into a structured PhD model for doctoral studies.

2.5.3 Pedagogical training integrated within a structured PhD

A structured PhD may offer a suitable compromise between the need for structured training in specific areas and the requirement for novel research as part of doctoral education. There appears to be a move towards this approach to doctoral studies in recent years. For example, at a European level the structured PhD has gained in popularity over the traditional approach of apprenticeship-style PhD research; in 2007 around 25% of HEIs offered

structured PhD courses, by 2010 this had risen to almost 66%. Additionally, less structured, short courses as part of a more traditional PhD are become more prevalent, rising from 50% of HEIs offering day long courses in 2007 to 72% in 2010 (Dance, 2013). Some European countries do, however, lag behind. For example, in Ireland the structured PhD is quite a new development with the Irish Universities Association (IUA) outlining the context of an Irish structured PhD course as recently as 2009 (DIT, 2011 and IUQB, 2009).

Development of life long and employability skills is central to the Irish structured PhD, with the guideline that the students' research, generic and transferable skill set should be developed through a formalised and integrated course of activities (DIT, 2011). Providing postgraduate students with structured training in the pedagogical fundamentals will not only enhance the PGDs ability to carry out their role as teachers but it will also improve the undergraduate learning experience. PGDs provided with pedagogical training have demonstrated the use their new skills in many aspects of their postdoctoral career, including those PGDs that do not progress into an academic life. Skills and characteristics developed during their structured PGD pedagogical training and PGD teaching duties that are used in their postdoctoral career include improved communication skills, enhanced ability to manage conflict, use of reflective practices and the development of self-confidence (Park, 2004). These are the very generic and transferable skills outlined as key learning outcomes in doctoral education and are also valuable attributes to supporting undergraduate student learning.

There are many examples of institutions, particularly research-orientated universities, providing structured PGD development courses, which incorporate teaching training. St. Andrews University is one of several UK universities that offer PGD specific teaching and learning modules. Topics covered in these modules include learning theories, reflective practice, equality and diversity, internationalisation, effective teaching and curriculum design. These modules are accredited with the HEA (Higher Education Authority, UK) and align to the UK Professional Standards Framework Descriptor 1. This allows PGDs that complete the course to apply for recognition as an Associate Fellow of the Higher Education Academy

(McKiggan-Fee, 2013). From an Irish context introductory pedagogy modules are offered as part of structured PhD courses in many universities (e.g. UCD, TCD, UCC, NUIM and NUIG).

Aligned to a structured approach, supplemental support can also be provided to the PGD thorough academic supervision and peer mentoring (Park, 2004). Many institutions provide additional 'guidelines of best practice' regarding support for PGDs in their teaching role; such as dedicated meeting times with academic staff, common rooms and the provision of feedback and feed-forward on their role and the curriculum on which they teach. Formal recognition and departmental integration hold obvious benefits to the PGD, however, the benefit for the institution and the undergraduate students is also clear; skilled, trained and reflective PGDs will enhance the learning experience for all students as they learn in the lab.

2.6   Adopting a new, holistic, approach to learning in the lab

Teaching undergraduates in a research-like environment is beneficial to the development of essential PGD research skills (Feldon, *et al*., 2011). Simultaneously, the undergraduate apprentice research scientist benefits from the inclusion of research-like activities in the undergraduate curriculum and engagement with the PGD. If the benefits of research like activities are clear for both undergraduate students and PGDs, then should this method of teaching lab skills (and theoretical content) be expanded to cover the entire curriculum? Healey and Jenkins (2009) put forward a convincing argument, using case studies to provide evidence, for the inclusion of research and inquiry in all aspects of every undergraduate curriculum, not just STEM. The scope and the depth of the research carried out can be tailored to suit the level of undergraduate student; however, the exposure to this approach to learning should be absolute, from first year through to graduation and beyond. This approach would require a radical curriculum overhaul to centralise research into the undergraduate curriculum (Russell *et al*., 2015).

If the undergraduate students and the PGDs adopt this philosophy, only the faculty members remain to embrace this pedagogical paradigm. In many research centred higher-level institutions, undergraduate teaching is the

responsibility of PGDs; however, often times the course, overall curriculum and method of delivery are pre-determined by full-time staff. Integrating pedagogical-based research into the faculty portfolio is one way to square the circle of 'publish or perish' and the requirements of the undergraduate student and PGD. Furthering this concept of research-based and research-informed teaching Ramsden and Moses (1992, p. 273) describe how research and teaching can be harmonious and compatible partners: "*Scholars who are energetically occupied in creating or reinterpreting the knowledge of their subjects will be competent lecturers: teaching based solely on the research of others is dull and fails to inspire students*". By embracing a research-based teaching lab undergraduate students can become a valuable addition to the research world, the PGD can teach and inspire in a stimulating and rewarding environment and the lecturer can align their teaching and research portfolios.

2.7 Conclusions

The role of the lab based PGD is critical in many higher-level institutions; however, they are often thought of as the 'forgotten tribe', or worse, casual 'slave labour' (McCready & Vecsey, 2013). The PGD should instead, be celebrated as being a 'distinctive tribe' at the interface of student, researcher and teacher (McKiggan-Fee, *et al*., 2013). This unique position should be harnessed in lab teaching as, if utilised correctly, the benefits extend beyond the undergraduate student.

However, to achieve this, the PGD must be suitably equipped with the skills required to enhance the learning experience of the undergraduate, they must teach in a stimulating and research orientated environment, and they should be supported by their mentoring academic and institution. In order to assure the quality of teaching and learning, it is critical that the HEIs support their novice academic through specialised courses that would dovetail into a structured PhD. This approach would be beneficial to the postgraduate, through the development of life long and transferable skills; the undergraduate, as they benefit from the trained PGDs' experience; and the HEI, as the staff-student ratio would be more favourable. This approach, although not perfect, would centralise this forgotten tribe of PhD researcher and celebrate their skills as key to knowledge development and enhancement within the higher education environment.

2.8   Alignment between literature and research project overview

The intrinsic case study outlined in this thesis will focus on how to support postgraduate demonstrators (PGDs) to develop the key pedagogical skills that will assist them in demonstrating undergraduate teaching labs. Through supporting this PGD development, it is hoped to centralise the PGD in the undergraduate teaching lab and set in place the foundations for a move towards undergraduate teaching labs that encompass aspects of tailored research in the School at the centre of the intrinsic case study.

Aligned to the primary research question, this research also aims to investigate what pedagogical skills are considered key to assisting PGDs in the teaching lab and can these skills be developed and enhanced through suitable training within the SoFSEH, within the CoS&H in DIT. The literature outlined in this chapter will be used as a starting point to identify the key pedagogical skills required by the PGDs within this intrinsic cases study (Section 2.6). Additionally, previous PGD models of training will be examined to identify which are appropriate for adoption and adaption for this intrinsic cases study (Section 2.5.1 and 2.5.2).

The aims of this research will be achieved by developing, executing and evaluating a short, bespoke pedagogical training course for all PGDs in the SoFSEH (Section 3.3 and 3.5)

The initial part of this research will comprise an information gathering exercise to compile the current roles and responsibilities of the PGD according to all the major stakeholders (the undergraduate students, the postgraduate demonstrators, academic staff, technical staff and School Management) and compare these findings to the current literature (Section 4.0). This data, and ancillary collated information, will be examined and analysed to identify the current gaps in PGD pedagogical training. This gap analysis will be used to design a short, bespoke training course adapted to the requirements of those involved in this intrinsic case study (Section 4.2).

The effect of the training course will be evaluated by surveying the key stakeholders utilising previously published approaches as a basis for evaluation. Data will be collected both quantitatively and qualitatively and will be analysed and framed in terms of the research question (and associated sub questions; Section 4.3).

The key findings of this research will lead to recommendations for practice within the School locally and also disseminated at a wider level to add to the existing literature in this area of research (Section 5.1). The training course, once evaluated, will be additionally examined in terms of suitably as a module on the DIT structured PhD course, which currently does not have an introductory pedagogy courses specifically for technical and practical demonstrators.

3.0   Introduction

This chapter will detail the philosophical view of the researcher, the rationale behind the methodologies adopted leading to the methods of data collection, interpretation and analysis.

3.1   Overview of Research

3.1.1 Research Problem

The research described here explores the key lab pedagogical skills required by, and the supports provided for, PGDs within the SoFSEH, within the CoSH in DIT. Initially the research focussed on the identification of the key and appropriate pedagogical skills required by PGDs. Concurrently, the most suitable support system to provide these skills was investigated through survey of the key stakeholders; the postgraduate demonstrators, School management, academics involved in undergraduate lab teaching, technical staff involved in supporting lab provision and undergraduate students. Provision of a bespoke training course based on the key skills required, as identified by the stakeholders, attempted to provide the desired pedagogical support. This bespoke training course was evaluated post-delivery by the key stakeholders to ascertain if it addressed the original research problem of how best to support postgraduate demonstrators and provide them with the necessary skills to effectively demonstrate lab practicals to undergraduate students.

3.1.2 Research Objectives

The research objectives lead naturally from the research problem and can be classified into three main areas based on this intrinsic case study based in the SoFSEH, within the CoSH in DIT:

1. Identification of the key laboratory pedagogical skills required by postgraduate demonstrators.

2. Classification of the key pedagogical skills required by postgraduate demonstrators into those that can be enhanced through suitable training and those that require an alternative approach.

3. Investigation, through appropriate evaluation, if a bespoke training model is a suitable means of providing and enhancing the key laboratory pedagogical skills required by postgraduate demonstrators.

3.1.3 Theoretical Perspective

Before embarking on a research journey, it is appropriate to carry out a philosophical self-study; to be clear on ones own perspective in terms of research viewpoint and knowledge outlook. This research project is based on a social constructivist ontological perspective and the epistemological basis is interpretivism (Denzin and Lincoln, 2000). These selections directly influenced the methodology and methods implemented and also affected the analysis and appreciation of the data and findings produced. The researchers personal background as a researcher and educator based in the hard sciences influenced these positions. It is pertinent to detail a study's ontology and epistemology prior to the methodology and methods selection (Grix, 2002). During question-led research, the ontological stance of the research is formed first; this is the researchers' position and is influenced by the researchers' personal view of the world and research space. The researchers' epistemology follows logically from their ontological stance and is based on the knowledge of the research space (Grix, 2002). A researchers' methodology, methods and sources are directly influenced by the researchers' ontological perspective and the study's epistemological basis (Crotty, 2008; see also 3.2.1). As the research is based on social constructivism and interpretivism, understanding is created by the researcher's interaction with the world and the research subjects. Aligned to this concept, that understanding of a research space is constructed by the researcher in conjunction with the research subjects, is the view that the research evidence is interpreted by the researcher to bring about further meaning and understanding (O'Donoghue, 2007).

3.2   Research Design

3.2.1 Methodology Rationale

The research questions, and sub-questions, limit the research boundary to a specific case and as such the methodology was an intrinsic case study, which appropriately examined the research question (Noor, 2008; Tellis, 1997). By following this methodology, the key pedagogical skills identified, their classification and the effect of the proposed intervention (the postgraduate demonstrator training workshops) were explored in the context of the case it was developed for. This chimes with Cousins' work in this area in which the case study can be divided into three approaches; intrinsic, instrumental and collective (Cousin, 2005). An instrumental case study may have been suitable here; for these situations the research explores one case as an instance in order to project clarity in general on a topic. However, this was not chosen as the methodology for the current research question and aligned sub-questions. The most appropriate case study type for the current research question was deemed to be intrinsic, as the researchers interest is in understanding the case at hand.

The case at hand involves a medium sized group (n<30) of postgraduate demonstrators who carried out teaching and demonstrating duties with undergraduate students within the SoFSEH, CoSH, DIT. These demonstrators have previously completed a degree in a related scientific topic to which they teach or demonstrate. The majority of demonstrators were registered PhD students within the School (65%). Supplemental demonstrators were employed on an *ad-hoc* basis and these were generally postgraduate researchers from other Schools within the CoSH (25%), DIT or local Universities (e.g. Dublin City University; 5%). Post-doctoral scientists were employed as demonstrators on rare and specific occasions (e.g. to demonstrate a specific set of advanced labs; 5%). A core output of this research was the delivery of a pedagogic training course to these demonstrators with the specific aim of enhancing their teaching and learning skills for the undergraduate science lab.

In order to deliver an appropriate training model a preliminary investigation, through stakeholder survey, identified the key roles and responsibilities of the postgraduate demonstrator, as well as the current skills gaps in their pedagogical training. The initial training took place prior to the start of the PGD demonstration duties and was be followed up by targeted 'just-in-time' workshops on specific, and timely, pedagogical skills. After the PGDs received their training to close these skills gaps, they carried out their teaching and demonstrating duties for one semester (Semester One, 2014/2015 academic year). A post-semester survey followed up with all the stakeholders that contributed to the preliminary investigation. This sets the final boundary of this intrinsic case study.

In this case study, the researcher was a research-active scientist whose scientific research was primarily positivist; focussing on quantitative data. Switching to a social science research paradigm, with an anti-positivist perspective was challenging; however, previous pedagogical studies (Ryan 2013a, 2013b, 2013c) primed the researcher. Adopting an alternative research paradigm can be demanding, but simultaneously rewarding and enlightening. The complementary combination of both qualitative and quantitative data was used to validate the emergent trends and improved the reflexivity of the research (Malterud, 2001).

The researcher also adopted the role of an 'insider-researcher' based on previous experience and prior integration into the community of lab demonstrating. The researcher has experience of lab demonstrating from an undergraduate perspective (4 years), a postgraduate outlook (3 years) and an academic viewpoint (6 years). This varied experience gave the researcher an insider's view of three of the four key stakeholders within this case study; however, this intimate knowledge could lead to researcher bias. Appropriate methodology leading to data triangulation was used to circumvent this bias, with the benefit of the insider-researcher deemed an advantage to this research (Chavez, 2008).

Cousin (2005, p.422) suggests that case studies should aim to achieve '*thick descriptive data*' capture and this was achieved through mixed data collection methods. Both qualitative and quantitative data were used to gauge the effect of the effect of the pedagogical training. Furthermore, the *perceived* PGD development of key pedagogical skills was investigated through semi-structured discussion fora. There was no comparison to previous PGD groups; however, experienced PGDs were able to review prior training models to the current training approach. The effect of PGD training was analysed by the key stakeholders after one semester of demonstration and recommendations for practice within the SoFSEH extrapolated and detailed.

3.3   Methods

Research data on key pedagogical skills required by PGDs, the classification of these skills and the effect of a pedagogical training model to enhance these skills in the PGDs, in this intrinsic case study, were collected both quantitatively and qualitatively to achieve a rich and thick description of the case at hand. Additionally, complementary qualitative and quantitative data converged and allowed for data triangulation, thus enhancing the validity of the emergent themes. This approach also aligns to the interpretivist position adopted in this study. This combination of quantitative (based adapted versions of previously published surveys addressing all stakeholders) and qualitative stakeholder opinions, evaluations and perceptions underpinned the analysis of the primary research question and sub-questions. PGDs, specifically, and all stakeholders in general, were the source of the data analysed.

3.3.1 Quantitative Data collection

Quantitative data is data that can be easily numerated and 'counted' and is often viewed as a clear-cut source of 'hard' data (Pope & Mays, 1995). This method of data collection is particularly well suited to surveys that have a limited number of responses in which participants must select one (or more) options. There is no scope here for open-ended responses. Quantitative data lends itself to large data set collection and statistical analysis can carried out

on this type of data due to its ease of enumeration and manipulation (Sandelowski, 2000).

In this study, quantitative data was collected from a number of stakeholders employing adapted versions of previously published surveys. The use of adapted, previously published surveys (Hughes & Ellesfson, 2013; Marbach-Ad, *et al*., 2012; Marsh, 1982) adds depth to the study; and although comparisons between this intrinsic case-study and other research is not advisable, it does provide a source of trustworthy and trialled survey questions. The undergraduate stakeholders were anonymously surveyed through an in-class survey employing personal response devices (Clickers) to collect the undergraduate student responses (invited participants n=90, actual n=66). The undergraduate survey focussed on detailing the key pedagogical skills appropriate for PGDs within the SoFSEH, DIT. The questions were divided into three sections.

The first set of survey questions was developed based on Marbach-Ad and co-workers (2012) evaluation of a GTA training course and the perceived effects on undergraduate lab learning (see Appendix 1). The second set of questions was adapted from Marsh's (1982) Student Evaluation of Educational Quality (SEEQ) survey (see Appendix 2). The adaption focussed on replacing typical teaching evaluation questions, with demonstration evaluation. In the majority of cases this was simple replacement of terms (e.g. '*lecturer*' replaced by '*demonstrator*'; '*lecture*' replaced by '*lab*'). In total, 13 of the standard 32 survey questions were deemed appropriate to this study and were adapted and used. The third question set were modified from Hughes and Ellefson (2013) Cognitive Learning Evaluation (CLE) survey, which itself was based on a Krathwohl's revised Blooms Taxonomy (2002). The undergraduate student stakeholders carried out the entire six-question CLE survey. The only adaption of the survey was the examples described as part of the survey statements. Alternative, local examples were chosen to allow ease of understanding by the undergraduate student stakeholders (see Appendix 3).

Stakeholders (see Table 3.1) were anonymously surveyed employing an online survey system (www.polldaddy.com). Postgraduate stakeholders were surveyed before and after the training course based on an adapted version of

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Boman's (2013) Teaching Assistant Self Efficiency Scale (TSE; Appendix 4) and Attitudes Towards Teaching (ATT; Appendix 5) surveys. TSE survey adaption took the form of changing terms (i.e. '*GTA*' was replaced with '*demonstrator*') and the selection of the most appropriate surveys questions from the 34-point survey. In this study, 21 of Boman's 34 standard questions were used in both the pre- and post-training survey. ATT survey modification again concentrated on re-phrasing to suit this case study, with 9 out of Boman's 13 standard questions were deemed appropriate for use. A combined postgraduate, technical, academic and management stakeholder quantitative survey focussed on detailing the key pedagogical skills appropriate for PGDs within the SoFSEH, DIT, based on prior work carried out by DeChenne and colleagues (2012; Appendix 6).

Table 3.1: Summary of stakeholder participation in online surveys. Postgraduate stakeholders were surveyed before (pre) and after (post) participation in the training module.

Stakeholder Group	Prospective Participants	Actual Participants
Postgraduate	27	9 (pre), 7 (post)
Technical	5	0
Academic	16	8
Management	3	1
Total	51	18

3.3.2 Qualitative Data Collection

Qualitative data can provide a description and understanding of a situation or behaviour. It can be described as soft, but rich data. Specific cases are the subject of qualitative data and generalisations beyond the case in question are not recommended. Exploration of the scenario in question, based on contextual analysis of words, forms the foundation of qualitative data (Edmunds & Brown, 2014). Data validation is paramount in qualitative data collection; data dependability, including such approaches as data triangulation, enhances data validity (Cohen *et al*., 2007). Qualitative data collection methods used in this case study included focus groups, descriptive survey and personal and participant reflection.

3.3.2.1 Discussion Fora

Qualitative data collated through formal discussion with stakeholders from the postgraduate, technical, academic and administrative groups informed the fundamental qualitative data for this case study. A semi-structured approach was taken during the stakeholder discussion fora and the participants were provided with the trigger questions at least one week before the discussion group. Providing participants with the trigger questions before the discussion forum allows time for a deeper, and a more critical, analysis of the question and ultimately a richer response in the discussion forum. Initial discussion fora focused on the identification of the key pedagogical skills required by postgraduate demonstrators. Trigger questions here were framed based on Luft and co-workers (2004) previous work in this area (see Appendix 7). Post-training discussion fora focussed on the evaluation of the training course and the trigger questions here were developed during the course of this research (see Appendix 8). Discussion fora were digitally recorded and saved as a password protected *.mp3* file on the researchers personal computer. In all cases, discussion fora were partially transcribed after several deep reviews of the recorded discussion. Pertinent points were transcribed *verbatim* and the participants were numerically coded to protect anonymity.

The selection process for the discussion groups was based on a targeted, but convenient sampling approach. The fundamental limitation to participation was the requirement to, in some way, assist in the delivery (preparation or organisation) of undergraduate labs. Postgraduate stakeholders participated in a separate discussion forum to the technical, academic and management stakeholders. The pre-training discussion fora were facilitated by the researcher; whilst the post-training fora were facilitated by an independent academic.

3.3.2.2 Free text survey

Primarily to allow participation by those who could not attend, but also to supplement the technical, academic and management stakeholders' discussion forum, a short online survey (hosted by www.polldaddy.com), populated with free text questions was used (see Appendix 9). This survey allowed those that could not attended the discussion forum (and also those

that could) a way to detail their opinions. The use of free text survey can lead to divergent themes emerging; however, when correctly framed, the responses can allow participants to expand and elaborate on specific areas that they feel are important and are a source of rich data (O'Cathain & Thomas, 2004).

3.3.2.3   Research Participants Reflective Blogs

PGDs involved in this intrinsic case study were encouraged to note a series of short reflective blogs and these provided a rich data source during the training course evaluation. Personal participant reflections were blogs (approximately 1,000 words per blog) written by participants reflecting on their learning journey, the training model and their application of the skills developed during the training. The participants were guided in the general layout of a reflective blog; however, the content was not prescribed (Orland-Barak, 2005). Participants provided informed consent for the use of these blogs as artefacts and primary data sources for this study.

3.3.2.4   Researcher Reflective Diary

The researcher maintained a reflective diary detailing the research experience. This reflective diary focussed on two main areas; reflection post delivery of each training session and general reflections during the research case study timeframe. Reflections on the delivery of the training course were scaffolded using Gibbs' Reflective Cycle (1988); general reflections (or 'memos-to-self') were more informally documented.

Table 3.2 Summary of methods of data collection aligned to research objectives. Pertinent references are also cited. See Figure 1.1 for a schematic of this table and Appendices 1-9 for additional information.

Research Objective	Data Collection Method	Reference
1	Undergraduate Survey	Hughes & Ellesfson (2013) Marbach-Ad *et al.* (2012); Marsh, (1982)
1	Postgraduate Survey	Boman (2013)
1	Academic, Management and Technical staff Survey	DeChenne *et al.* (2012)
1	Pre-training course Postgraduate Discussion Forum	Luft *et al.* (2004)
1	Pre-training course Postgraduate Discussion Forum	Luft *et al.* (2004)
2	Determination of "trainable" skills	This study
3	Post-training course Academic, Management and Technical staff Survey	This study
3	Post-training course Postgraduate Discussion Forum	This study
3	Post-training course Postgraduate Survey	Boman (2013)
3	Participants reflective blogs	Orland-Barak (2005)
3	Researchers reflective diary	Nadin & Cassell (2004).

3.3.3 Data Analysis

Pedagogical evaluation followed best ethical practices, and conformed to the Institutes Research Ethics Guidelines as outlined in the Ethical Considerations (Section 3.4).

Quantitative data were compiled into *Microsoft Excel for Mac* spread sheets; one sheet per question set from each online survey (undergraduate, PGD and

Academic/Technical/Management stakeholders). Basic statistical functions (typically sums and averages) were carried out using the Excel default parameters. *Microsoft Excel for Mac* was also used to graph manipulated data, with resultant graphs export faithfully to *Microsoft Word for Mac* for further analysis and discursive write-up.

Qualitative data were coded using into several key themes and sub-themes based on researcher interpretation influenced by Strauss and Corbin's (1990) Method of Constant Comparison and Braun and Clarke's (2006) six step approach to data analysis. In brief, this entailed data familiarisation, initial code generation, initial theme identification, thematic review, theme definition and final reporting. Participant reflective blogs were similarly coded with the additional influence of Findlay and co-workers (2010) thematic analysis of reflective journals. Data triangulation was utilised to ensure only valid themes were investigated and that the examples and findings cited were based on data from as broad a participant base as possible. Data saturation was observed, as per the qualitative coding method employed, and this indicated further iterative coding and thematic analysis was not required. An example of the coding and theme generation is outlined in Appendix 10.

3.4   Ethical Considerations

'Ethics are the principles and guidelines that help us to uphold the things we value' (Johnson & Christensen, 2012, p.99). Participant ethical welfare was paramount at all times during this research project. In line with best practice, the participants were protected following the guidelines of the DIT Research Ethics Committee (DIT, 2014). These guidelines include the core principles of ethics in research: voluntarily participation, fully informed consent, ability to withdraw, anonymity, do no harm to the participant or researcher, privacy, confidentiality and data storage (Boylan, 2012).

Active informed consent was requested prior to the start of each aspect of the research. As part of this informed consent the participants were provided with a detailed information sheet outlining the key aspects of the research along with information regarding data anonymization and storage, means of project dissemination and the voluntary nature of participation (see Appendix

11). As many of the PGDs were also registered PhD students within the School, it was made explicit on both the information sheet and verbally that participation was voluntary and withdrawal was permitted, without any explanation, without any affect on student standing within DIT. Participants were asked to sign the informed consent form if they are satisfied to participate and were given a photocopy of the completed consent form and information sheet (both participant and researcher signed). Participants under the age of eighteen were excluded from the research due to parental consent requirement; this was most likely to occur within the undergraduate stakeholder cohort. Data, both quantitative and qualitative, was collected confidentially and was immediately anonymised (if not so already based on method of collection) and stored in a locked cabinet (hard copy files) or on a password protected and encrypted personal computer in a locked office within DIT. The only person to with access to the raw data was the researcher and direct project supervisor, when requested. Future dissemination of the research findings and destruction of the raw data post-study will also follow ethical guidelines outlined above.

3.5 Design and Development of Bespoke Training Course

An analysis of the initial survey of the key stakeholders detailed the key pedagogical areas that the postgraduate demonstrators required additional support. These key skills aligned to, and were supplemented by, the key skills required by demonstrators as noted in the literature (Cho *et al*., 2010; Gardner, & Gail, 2011; Herrington & Nakhleh, 2003; Lockwood *et al*., 2014, Morrs & Murray, 2005). A short course was developed based on the defined skills requirements. The short course was delivered over four sessions and the key topics are outlined in Table 2.2. A full breakdown of each session is provided in Appendix 12. Each session was very interactive and focussed on socially constructing the defined key skills. Participants were encouraged to keep a reflective log of their use of their new skills in their demonstrating duties. Attendance was voluntary; however, attendees were paid the normal demonstration rate (approximately €16/hr) to compensate them for their time. No academic credit was given and certificates were awarded in recognition of the participants' completion of some, or all, of the course.

Table 3.3: Outline of the topics covered in the course workshop sessions and the duration of each session.

Session Number	Topics Covered	Duration (hours)
1	Concept of a Teaching Portfolio (15 mins) Introduction to Learning Theories (45 mins) Introduction to Active Learning (45 mins) Introduction to Group Work (45 mins) Introduction to Facilitation (30 mins) Introduction to Lab based Learning (1 hr)	4
2	Introduction to student assessment (45mins) Introduction to student feedback (45mins) Teaching review	1.5
3	Introduction to co-supervising final year projects (30 mins) Introduction to student diversity and inclusiveness (30mins) Teaching review	1
4	Feedback on Teaching and Continual Professional Development (45 mins) Certificate of Completion presentation	0.75

3.6   Delimitations and Limitations

The initial boundary of the case study was semester two of the 2013-2014 academic year (to survey all stakeholders and identify roles, responsibilities and current pedagogical skills gaps in the postgraduate demonstrators). Semester one of the 2014-2015 academic year bounded the training, teaching and evaluation of the postgraduate demonstrators, with Semester two given wholly to data analysis and writing. Due to the intensive nature of the project, the case study only focussed on postgraduate demonstrators from one School; thus reducing the comparative nature of the research and reinforcing the selection of an intrinsic case study methodology. This research is building on anecdotal evidence and practitioner experience, and as such can also be considered evaluative (Yin, 2003). Finally, to circumvent criticisms associated with qualitative data and case studies in general, the researcher implemented a defined method of data collection, data triangulation and appropriate data interpretation and analysis (Baxter & Jack,

2008; Strauss, & Corbin, 1990). Data collection was carried out using complementary quantitative and qualitative methods. Adopting such an approach enhanced the validity of the emergent themes through data triangulation (Jick, 1979). One of the major limitations of this study is the small population sample that formed the basis of this research. Data collected from PGDs based in one school, within a single higher education institution was central to this study. The number of PGDs employed each year within the School is limited and typically based on registered undergraduate numbers. Additionally, PGD participants were self-selected and volunteered to take part, which may have resulted in a bias toward motivated PGDs. Finally, engagement from the other stakeholders was limited due to the extensive activities that they are involved in at the time of participation (e.g. teaching duties for the academic stakeholders).

3.7 Timeline of the Research Process and the Research Process.

April – Jun (2014): Survey key stakeholders using previously published quantitative and qualitative methods.

July – Aug (2014): Analyse and evaluate key stakeholder surveys and detail roles, responsibilities and current postgraduate demonstrator pedagogical gaps. Design and develop a suitable training approach to close the identified gaps.

Sept –Dec (2014): Deliver training model. Facilitate demonstrator learning and engage with community of practice formation amongst PGDs, feedback and feedforward sessions aligned to 'just in time' workshops. Record observations and reflect on practice.

Oct-Nov (2014): Create post-intervention stakeholder survey and MCQ based on previously published literature. Build facilitated discussion forum to be delivered by colleague.

Dec (2014): Collect quantitative and qualitative data from stakeholders post intervention (and teaching).

Jan-April (2015): Review, analyse and interpret data according to best practice. Triangulate. Link to literature and seek to develop recommendations for practice within the School.

May - Jun (2015): Draft publication on findings, prepare MA thesis.

Note: Engagement with the literature was on going throughout.

4.0   Introduction

This chapter will detail the data collected as part of this intrinsic case study. It will also describe the analysis of this data and the meanings and research outcomes interpreted by the researcher. The chapter is divided into three sections aligned to the three research objectives:

1.   Identification of the key lab pedagogical skills required by postgraduate demonstrators.

2.   Classification of the key pedagogical skills required by postgraduate demonstrators into those that can be enhanced through suitable training and those that require an alternative approach.

3.   Investigation, through appropriate evaluation, if a bespoke training model is a suitable means of providing and enhancing the key lab pedagogical skills required by postgraduate demonstrators.

4.1   Identification of the key laboratory pedagogical skills required by postgraduate demonstrators

4.1.1 Undergraduate stakeholders.

The initial data collected took the form of likert-type surveys (undergraduate students) and discussion fora (academic staff, management, technical support and post graduate demonstrators) with the key stakeholders. This data collection took place in the academic year prior to the introduction of the bespoke training course and was specially designed to identify the key lab pedagogical skills required by the PGDs in the SoFSEH, DIT.

The undergraduate students (n=66) were surveyed using Clickers to collect the data anonymously. This sample group comprised two classes; one from a Level 6 Certificate and one from a Level 8 Honours degree. Different levels were chosen so as to give as broad an evaluation of the key lab pedagogical skills as possible. The researcher only had access to first year students that matched the required background and, therefore, a convenient sampling approach was executed. The likert-based survey was an adaption of three

prior studies (See Appendices 1, 2 and 3). The adaptions are noted in the Methodologies Section (see Section 3.3.1). The first set of likert-based survey questions were based on Marbach-Ad and co-workers (2012; see Figure 4.1) work that sought to identify the lab pedagogical skills perceived as important by the surveyed undergraduate student cohort.

Traits/Skills required in an effective PG demonstrator
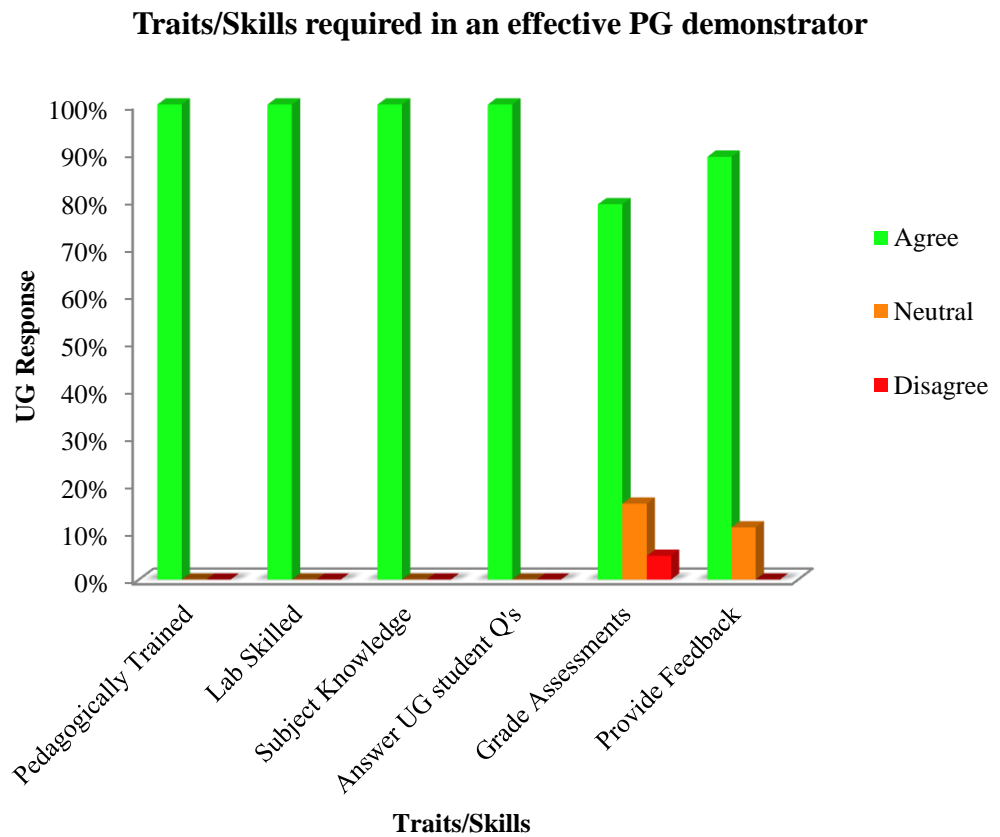
Figure 4.1: Graphical representation of the skills required to be an effective demonstrator as determined by undergraduate students (n=66).

It is clear from this data set that the undergraduate students believe that the PGD should be both technically and pedagogically trained. In addition to this the PGD should have subject knowledge and be able to answer student questions. However, this universal agreement diminishes when the students considered the skills of assessment and feedback provision. In general, these skills were perceived as the remit of the lead academic in the lab. It is interesting to note that the undergraduate students were not as against PGDs providing feedback as the PGDs grading their work, with 5% of those

surveyed indicating that grading should not be a PGD skill. The role of the PGD has been explored in the literature for over twenty years and its' evolution is clear. Aligned to the modified PGD skills survey carried out in this intrinsic study (Figure 4.1), Wood (1990) noted that the role of the PGD was to understand and show the technical aspects of lab work (and associated instrumentation), detail and explain any associated calculations and enforce the health and safety regulations. Wood (1990) suggested that the PGDs should circle the lab and assist in a friendly manner in the technical aspects of the lab; assessment, grading and feedback were not considered as tasks for the PGD.

Following on in this initial survey, the second set of questions were based on an adaption of Marshs' (1982) Student Evaluation of Educational Quality (SEEQ) survey, which sought to identify the satisfaction of the undergraduate cohort surveyed with the activities of the PGDs that they had encountered in the academic year to the point of the survey (see Appendix 2 and Figure 4.2). Under the majority of the headings (62%) the undergraduate student cohort surveyed was dissatisfied with the PGDs demonstrating activity. Areas where the undergraduate students were not satisfied included the PGDs providing meaningful answers and being discussion orientated, being enthusiastic and dynamic resulting in the undergraduates under developing an interest in the subject. However, on a more positive note, the PGDs were seen to be accessible, stimulating to talk to and welcomed student queries.

The activities examined here can be correlated with specific skill types (e.g. pedagogical, technical, subject specific, soft skills) and can also be classified into four themes (learning, enthusiasm, interaction and rapport). The undergraduate student satisfaction was least in the skills themed as enthusiasm and interaction. Following on from this the skills associated with learning and finally student rapport achieved a higher level of undergraduate satisfaction.

The final set of questions was based on a modified Cognitive Learning Evaluation (CLE) survey adapted from Hughes and Ellefson (2013; see

Appendices 3 and Figure 4.3). In this section the undergraduate students were asked to evaluate if the PGDs had assisted the undergraduates to develop specific lab skills. These skills can be aligned to the Blooms Taxonomy (knowledge, comprehension, application, analysis, synthesis and evaluation; Bloom, *et al*., 1956) and were presented to the undergraduate students in terms of hypothetical examples in order to contextualise the question.
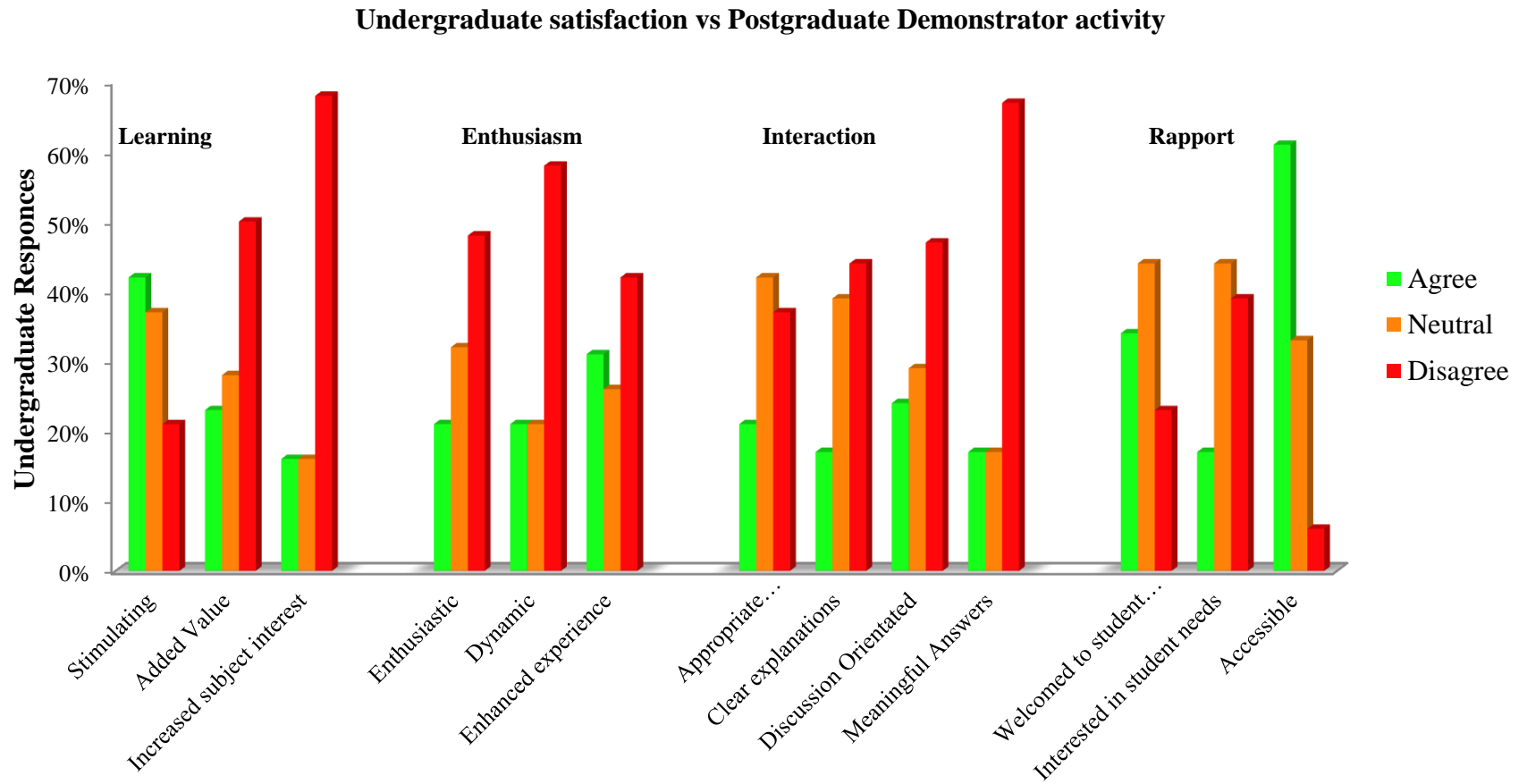
Figure 4.2: Graphical representation of the undergraduate students (n=66) satisfaction with the demonstrating activities of the postgraduate demonstrator. The areas can be collated into themes (learning, enthusiasm, interaction and rapport).

An increasing trend in students' disagreement with the concept that PGDs assisted in skill development is noted moving across the taxonomy from knowledge to evaluation. This correlates with a decreasing trend in agreement to the concept. One skill type that differs from the general trend is 'analysis'. This may be accounted for by a general practice noted in the labs examined in this intrinsic case study. It is common practice that the post-graduate demonstrator (and the lead lab academic) assists the undergraduate students to analyse the data they produce during a lab session. This typically takes place at the student lab bench towards the end of the lab session and is welcomed by the students as they prepare to 'write-up' their lab work. The data collected in this study contrasts with Hughes and Ellefson (2013) original study whereby students were satisfied with the PGD development of higher order thinking skills as part of the lab practical demonstration. However, it should be noted that Hughes and Ellefsons study was based on an inquiry-based approach to lab learning and would have been more suited to undergraduates developing higher order thinking skills in the lab.
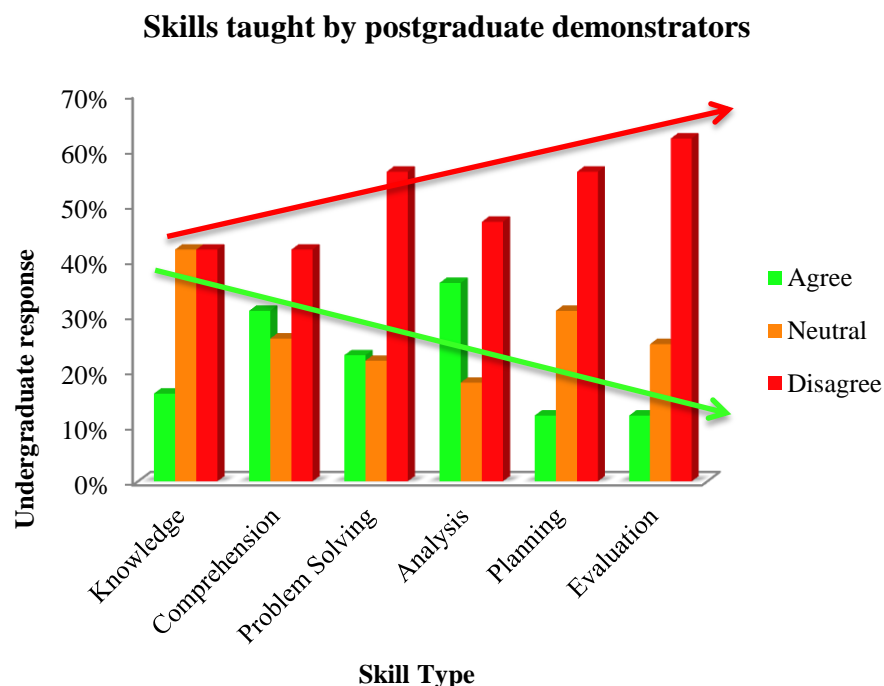
Figure 4.3: Graphical representation of the undergraduate students (n=66) perception of the higher order skills taught by the postgraduate demonstrator.

4.1.2 Academic staff, management and the technical support stakeholders

The academic staff, management and the technical support within the School hosting this intrinsic case study were also surveyed on their opinions as to the key pedagogical skills for a PGD. This group of stakeholders was surveyed through a semi-structured discussion forum and an aligned follow-up online survey (see Appendix 13). This dual approach was adopted in order to include as many stakeholders as possible. Qualitative data from the semi-structured discussion forum and the online survey were analysed and thematically coded into four themes; PGD responsibilities, Lab Learning, PGD Training and PGD personal development. These themes echoed prior studies in the area, primarily Luft and colleagues (2004).

4.1.2.1   Responsibilities of PGDs

The theme of PGD responsibilities emerged during the discussion forum by way of identifying the key pedagogical skills required by the PGD. Interestingly, the discussion immediately focussed on what was not the role of the PGD and the differentiation between a Senior Postgraduate Demonstrator (SPGD) and a 'traditional' Postgraduate Demonstrator (PGD). At the time of this discussion forum, School Management had just announced the new position of SPGD. The SPGD was envisaged as an advanced level demonstrator that would act as *de facto* lead academic in an undergraduate lab, thus releasing the academic from the lab to other scholarly and administrative duties. A member of the School Management clarified the Schools demonstrating vision as:

> (M1): "*From a management point of view, in three of four years I would like to see a system in place, through the structured PhD course; we are giving training in this whole area* [pedagogy] *and from a delivery of the content point of view, we have people that have been with us for a number of years that are appointed at the senior demonstrator capacity and they work with an academic to deliver the*

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practical components and then they have a team of demonstrators beneath them"

The academics involved in the discussion forum (n=5) and management (n=2) were quite clear and vocal about what should remain the remit of the academic involved in delivering the lab. These academic responsibilities could be summarised as curriculum development, lab planning and organisation, and quality assurance.

> (M1): "*Its getting that academic oversight, but not needing an academic present for every lab for every minute, but to be able to dip in and dip out to ensure quality by a randomised selection process.*".

> (L2): "*Essentially it's down to the academic to produce a blueprint for the SPGD and PGDs and that's what I want you* [SPGD/PGDs] *to do*".

Filtering down from these academic responsibilities, all the participants of the discussion forum (n=8; academic, n=5, managements, n=2 and technical, n=1) concluded that the role of the SPGD was to supervise the PGDs in the lab and that this responsibility would require training in organisation and good delegation and communication skills. The SPGD should not participate directly in demonstrating, but they should have the technical skills to oversee the lab procedure at hand and also to ensure the PGDs are suitably trained to execute the technical skills with precision and precision. Overall the key duty of the SPGD was to ensure the academic specified learning outcomes are achieved by the undergraduate students.

> (L2): "*The role of the SPGD is not to demonstrate, but it is to supervise the PGDs*"

Interestingly the discussion forum participants did not explicitly mention technical or procedural skills as important for PGDs, however, this may be because the PGDs were assumed to be technically skilled and suitable for the lab they were demonstrating. The online, aligned, follow-up survey completed anonymously by academics within the same School clearly indicates the key PGD responsibility is ensuring procedural accuracy by the undergraduate students in the lab. The responding academics (n=5) provided twenty-four examples of PGD responsibility and these were coded under five

emergent themes as outlined in Figure 4.4 (and Appendix 14). The two main areas of responsibility detailed from the respondents could be coded under two priority themes; procedural and (ensuring) safety. In an associated question in the same online survey, respondents were asked to provide adjectives to describe the roles and responsibilities of a typical PGD (see Figure 4.5). Again, to be technical competent is the most important PGD responsibility as indicated by the interpretive coding of the respondents adjective words (see Appendix 15). This echoes Woods (1990) previous commentary on PGD responsibilities in the lab; however, it also aligns to Scott and Maws (2009) summary of PGDs being the primary source of instructional guidance in the lab.

Overall, the analysis of this portion of the online survey suggests that academics that run labs expect the assisting PGDs to be responsible for the technical and procedural elements of the undergraduate lab; in terms of being technically competent themselves, but also being able to communicate these skills to the undergraduate student. Additional important areas of PGD responsibility are ensuring safety compliance and also providing assistance with some pedagogical tasks, under supervision, such as grading.

Plot of PGD repsonsiblities in the lab
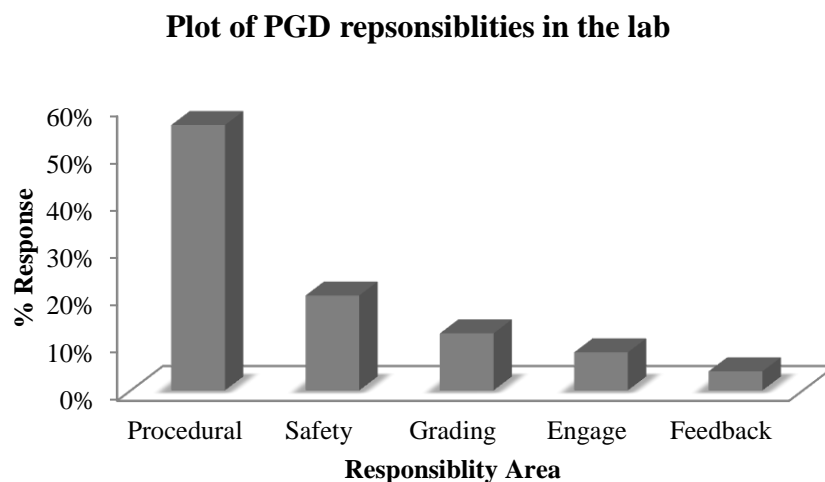
Figure 4.4: Schematic representation of the five emergent themes coded from academic (n=5) provided examples of PGD responsibility in the lab.

Plot of descriptive PGD laboratory responsiblity
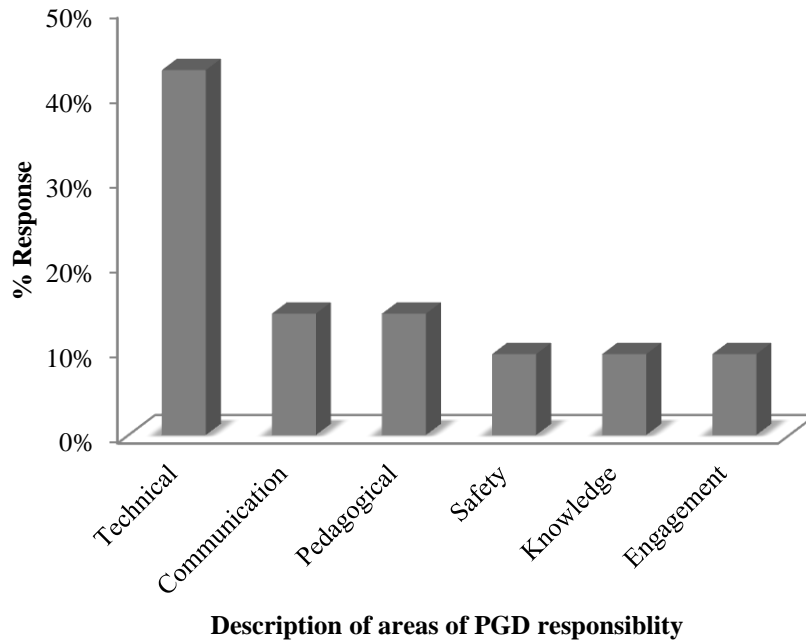
Figure 4.5: Schematic representation of the six emergent themes coded from academic (n=5) provided descriptive adjectives of a typical PGD and their associated responsibilities.

Although not noted as a particularly key descriptive adjective of PGD in the on-line survey, academics in the discussion forum did suggest a key PGD skill should be student engagement.

> (L3): *A demonstrator should come away from a lab saying 'yeah, I really got through to that student today', not, 'its just chaos, I can't get around to them all'.*

During the discussion forum the largest barrier to PGD engagement was noted as the high ratio of undergraduate students to PGD. All the academics agreed that the current ratio (of at least 16 UG students to 1 PGD) did not help undergraduate learning and placed additional stress on the PGDs. The academic staff taking part in the discussion forum suggested a reduced UG student:PGD ratio would mean the PGDs could better deliver on their roles and responsibilities, in a more effective and engaging manner.

> (L3): "*Before we define the roles, can we please get more of them! Undergrads are not getting the quality of training, because of the*

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shortage of PGDs. PGDs have to get around to each student and to spend time with the students; this is especially important as students are learning techniques".

(L2): *"One demonstrator per ten students is about right, one to sixteen is just too much, the demonstrators just can't handle it".*

4.1.2.2 Lab Learning

One of the biggest influences on the role of PGDs in undergraduate learning was noted as being the unfavourable PGD:UG student ratio, with one academic clearly outlining this problem.

(L3): *"One of the biggest influencers in UG learning is the lack of PGDs in the lab".*

However, other key issues that were not necessarily PGD orientated were also noted as contributing to influencing undergraduate lab learning. These issues could be categorised into three themes; facilities, equipment and curriculum design. Although beyond the scope of the PGD, and hence this research, it is important to note and recognise their important effect on undergraduate learning in the lab. Lack of equipment and poorly arranged and designed facilities are common problems in most teaching labs at undergraduate level and the School involved in this intrinsic case study is no different.

(L1):*"Lack of equipment is another key influencer, as students work in groups then one or two will do all the work while the others do nothing….just because there isn't 'one for everyone in the audience'"*

The lack of equipment and inappropriate facilities could be considered as issues to be addressed at a School, College or Institute level; however, appropriate curriculum design could alleviate some of these problems at a local level.

(M1): *"Assessment is the main driver of what, and how, students learn; so if there is a piece of equipment that they* [the UG] *knows they will be assessed on individually, then they will make sure they know how to use that piece of equipment before the assessment."*

Following on this suitable curriculum design theme; the discussion forum participants suggested that incorporation of more critical thinking in the lab could centralise the PGD in the lab. In order to achieve this the academics in the forum recommended that PGDs have a background in the subject they are teaching and that technology could be adopted to reduce the workload on the PGD in the lab and, thus, allow them to engage with the students at a deeper level.

> (L1): *"They* [PGD] *need to have a good background in the subject that they are teaching, they need to have a qualification in the area"*.

> (L1): *"Critical thinking could come from the ability to talk to an individual* [the PGD] *about the experiment, to be challenged on their experimental process, to ask them* [the UGs] *questions"*

> (L4): *"The use of technology could also help here; show the students a video of the technique or have QR codes of the side of an instrument where the students watch a video to remind them how to use the instrument just before they use it"*.

Previous studies investigating different teaching models to centralise the PGD in undergraduate learning include the use of inquiry-based lab learning (Roehrig *et al*., 2003), student centred instruction (Pentecost *et al*., 2012) and more recently reflective labs (Bautista *et al*., 2014). The centralising of the PGD resulted in a better learning experience for the undergraduate and also a better teaching experience for the PGD. However, integration of the PGDs into a more centralised role within the undergraduate teaching lab would; however, require the PGDs to take on more responsibility within the lab

> (L1):*"For critical thinking type labs you need the SPGD or the PGD to be more than just the health and safety person in the lab; and they need to be comfortable with this role"*.

The participants in the discussion forum also noted that this centralised role, with enhanced responsibility in the teaching lab, could be beneficial for both the UG students and the PGDs. The UGs would benefit from an alternative teaching approach within the lab from a skilled researcher in the discipline,

whilst the PGDs would be encouraged to develop their own teaching style and philosophy.

> (L1): *"The scientific method of teaching is very personal to an academic and it varies amongst everyone here, and I don't think we can sit down and prescribe 'this is the template we want to use in DIT' because it doesn't fit".*

> (L2): *"I agree, this would lead to a homogenous type of education…where in reality you* [the UGs] *should get a heterogeneous education, with variety of teaching styles".*

> (L1): *"These different teaching styles would give students* (UGs) *different perspectives on how to approach a problem, which feeds into the idea of developing critical thinking skills in students"*

> (M2): *The SPGD and the PGD needs to be given some freedom to teach, as it could be enriching for the UGs to learn from experienced researchers skilled in the instrument, much more than me"*

Although the academics were supportive of centralising the PGD in the teaching elements of a typical undergraduate lab, they were less enthusiastic about giving total autonomy to PGDs (or SPGDs) in terms of curriculum development. This links back to their already stated position that curriculum development was, essentially, an academic responsibility. However, some academics noted that currently within undergraduate labs PGDs are given localised-autonomy. PGDs are encouraged to deliver the content, which was designed and developed by the academic, in a manner that they deem appropriate.

> (L1): *"I would expect the SPGD and the PGD to follow the resources that I give them; however, I would give them some freedom to deliver the content in their own way…as long as they are not re-inventing the material I prescribed, or the learning outcomes, and they give the students the correct information. I don't care how we get to the desired endpoint* [UGs achieving their learning outcomes] *as long as we get to it".*

> (L1): *"Curriculum development is an academic role; however, how that curriculum is delivered, there is a little bit of freedom here for individuality. The Leaving Cert and the Junior Cert have a curriculum; but they are delivered a million different ways every day and they all sit the same exam".*

4.1.2.3   PGD Training

The academics that contributed to the discussion forum were clear that some tasks and responsibilities were not appropriate for PGDs (or SPGDs). Activities such as curriculum design, organisational planning and module development were all deemed to be 'academic' duties. Alternatively, the participating academics agreed that centralising the PGD in the undergraduate teaching lab would provide many benefits, but currently the PGDs are not appropriately skilled to take on this new, centralised role. PGD training was seen a crucial to the successful re-alignment of lab teaching responsibilities. Prior to this intrinsic case study, no training of any description was provided to the PGD within the SoFSEH.

> (L2): *"Most demonstrators are 'good'; it's just that they weren't trained. They don't know what they are at!"*

> (M1): *"I think training is important regardless of if we* [School of Food Science and Environmental Health] *follow a SPGD and PGD model or not. Training is something that will improve the experience no matter what structure we follow".*

It was noted that the provision of adequate and appropriate training would illustrate the value the School places on the PGD and their important teaching role within the undergraduate lab. Additionally, the introduction of a structured PhD, whereby PhD students take lecture-based modules for credit towards their PhD qualification, was approaching at the time of this study. School management and academic staff were aware of the need to develop suitable modules to be delivered for this PhD model and also the potential benefit of a pedagogy based module within the structured PhD. Development and integration of a pedagogy-type module into a PhD model within the School would again emphasise the importance of teaching and learning within the School and align to other national, and international, Higher Education institutions as well as best practice (Austin, 2002).

> (L2): *"Demonstrators will stay with us* [School of Food Science and Environmental Health] *if they feel valued and feel like they are getting a proper training*".

(M1): *"As part of the structured PhD, we can embed their* [the PGDs] *demonstrating as an assessable component; there is something developing here that if we grasp it and mould it now, we will have a much better model* [PGD model] *at the end than we have now".*

Specific areas of training that would assist PGDs in their demonstrating were highlighted by the academics that took part in the discussion forum. These areas were classified into four defined themes; feedback, grading, communication, teaching theory and academic processes.

(L1): *"One of the key aspects is the inclusion of feedback in this model".*

(L1): *"A big issue is the continuity of marking; there is a big discrepancy between one* [PGD] *marker and the next, even if you give them the same marking sheet".*

(L1): *"Communication skills and scientific communication skills, for example, talking to a group, talk in a way that is accessible to a student".*

(M2): *Some basic grounding in the educational processes; because they will have never heard about learning outcomes, for example, they might not know about the technical aspects of assessment or feedback. They need to be clear on their duties and roles and know the academic hierarchy and also the process…why do we assess?*

(M2): *"The training should cover the basics…so the PGDs can understand the academic processes".*

In the aligned online survey the academics (n=5) responded with a similar preference for topics where PGDs required training and support from a list of ten typical PGDs areas training topics (DeChanne *et al.*, 2012; see Appendix 6 and Figure 4.6). Technical training was ranked as the most important; however, other priority areas, which correlated with those noted in the discussion forum, included feedback and communication. This finding chimes with DeChanne and co-workers (2012) original research where activities associated with instructional training were perceived as more important than those related to learning development. Aligned to this, the discussion forum participants cited training in basic pedagogy and grading as being the least important areas to cover in a PGD training course. This,

however, did not correlate to the suggestions from the discussion forum. This deviation may be due to the online survey providing prescribed examples, which the participant rated in order of perceived importance. During the discussion forum, no hierarchy was placed on academic responses.

Priotity plot of PGD training topics.
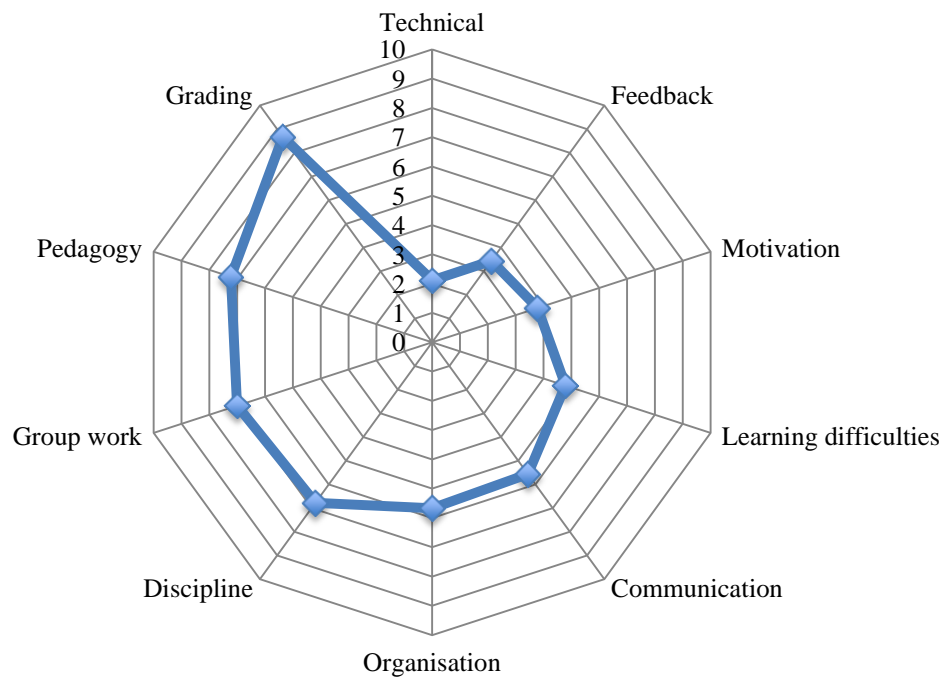
Figure 4.6: Schematic representation of the most important areas for PGD training as assigned by academics (n=5). The weighted rank was calculated as: (sum of (position * count) for each choice / total responses) + 1. Using this weighted ranking the lower the value, the higher the priority. Data presented collated based on online survey.

4.1.2.4 PGD Professional Development

It was clear that both academic staff and school management were enthusiastic about up-skilling and centralising the PGD within the undergraduate teaching lab. The benefits were obvious in terms of both the undergraduate learning and PGD development. However, a disconnect was evident when academic staff were asked if they mentored academically novice staff or PGDs. No staff member provided structured mentoring courses, and no official mentoring course was available within the School.

Socialisation of novice academics into the academic world is an important activity, particularly for PGDs entering a new institution or school. Through suitable socialisation; mentoring for example, novice academics can develop their understanding of the social and academic norms, appreciate the values and attitudes of academia and become aware of the academic culture (Weidman & Stein, 2003 and Austin *et al*., 2006).

In this intrinsic case study, academics cited that time constraints and increased workload on top of an already busy schedule were prohibitive to taking part in a mentoring scheme. Some academics also commented that there was no culture of mentoring within the School. Prior to the discussion forum the academics and management attended a presentation delivered by academics from another Irish university (Dublin City University) who currently deliver a mentored PGD training module. It was noted that the number of contact teaching hours and administrative workload was substantially different between this university and the School involved in this intrinsic case study.

> (L1)*"There are career differences in terms of staff that monitor the* [DCU] *system; we* [DIT academic] *won't be back to the level of 6 hours teaching a week'"*.

Despite the differing workloads, the development of a mentored PGD training model was seen a step towards a more sustainable approach in the delivery of practical classes, which would reduce the teaching workload on academics and allow them to focus on other scholarly activities.

> (M1): *"This is a step towards building a structure that is more sustainable for freeing up academic time to prioritise into research and other activities."*

Additionally, academics responding to the aligned online survey suggested other benefits to adopting a mentoring system including the sharing of good practice, the building of confidence in inexperienced colleagues and sharing experiences of local norms and other types of best practice.

4.1.3 PGD stakeholders

The final stakeholder group surveyed about the key skills required by a PGD were the PGDs. This took a similar format to the academic, management and technical staff survey and involved a semi-structured discussion forum (n=18 participants; see Appendices 7 and 16) and an aligned survey (n=10 participants; see Appendices 4, 5 and 6).

To ensure consistency of data analysis; qualitative data from the semi-structured discussion forum and the online survey were analysed and thematically coded into the same four themes that emerged from the academic stakeholder survey. Furthermore, the online survey also contained additional questions based on prior work in this area to specifically identify the key areas where the PGDs felt they required additional support and training. These questions were influenced by key publications such as DeChanne and colleagues (2012) and Boman (2013).

4.1.3.1   Responsibilities of PGDs

The general initial response to the question of PGD responsibility in the undergraduate lab was to assist the lecturer leading the lab and to help the undergraduates taking the lab, specifically focussing on the technical elements.

> (PGD1): *"Assist the lecturer on the technical parts of the lab"*

However, upon deeper reflection other responsibilities were noted and, overall, these could be categorised into four themes; technical demonstration, preparation, assessment and personal time management.

The PGDs were aware of their responsibility to be prepared for the undergraduate lab; however, this preparation was not always possible for several reasons and this often lead to PGD frustration and lack of confidence. Lack of preparation and organisation on the academics part was cited as the main reason for PGD under-preparedness; with additional problems being lack of PGD time and a heavy demonstrating workload.

(PGD2): *"It is our* [PGD] *responsibility to come to the lab prepared; however, most of the time we do not have the manual before the lab to read! If you have some experience* [of the lab] *you can get by, but if you don't you look like an ejit"*

(PGD5): *"Sometimes PGDs have to demonstrate two or three practicals in the same day and if you expect PGDs to prepare fully, more time is needed"*

Some PGDs were expected to provide assistance to the lead academic in terms of undergraduate assessment. This responsibility was, however, not common amongst the PGDs that took part in the discussion forum with one PGD detailing her experience of PGD-assisted assessment and how this lead to improved undergraduate preparation.

(PGD4): *"Asking the* [UG] *students to do something in the week between labs, and having the PGDs check it before the lab would mean that the* [UG] *students would actually do something and be more prepared for the lab.*

The PGDs were also aware that their teaching and demonstrating responsibilities were not always restricted to the teaching lab timetable and this required personal time management. For example, they were willing to give their time freely to undergraduate students that required additional support outside the normal timetabled hours.

(PGD3): *"If someone approached me after the lab I would give of my time to them to help them. And this has happened to me. It's just easier to do it then, than the following week when the student is even more lost".*

The PGDs that took part in the associated online survey also highlighted the key responsibilities as those associated with technical procedures and ensuring safety. These responsibilities were coded based on emergent themes during the analysis of the examples provided by the online survey participants (n=10 participants supplying n=43 examples; see Appendix 17 and Figure 4.7). It is interesting to note a correlation between the academic and the PGD coded examples of PGD responsibility in the lab, with procedural and safety responsibilities clearly the most important for both stakeholders. The PGDs did not perceive assessment associated pedagogical responsibilities, such as grading or providing feedback, as their

responsibility. However, this responsibility sub-set is further examined in the associated question in the same online survey, were the PGDs were asked to provide adjectives to describe their roles and responsibilities (see Figure 4.8). The importance of their teaching responsibilities was evidenced through the interpretive coding of the respondents adjective words (see Appendix 18). Here, respondents pedagogical responsibilities; described by adjectives such as teaching, learning and facilitate, were primarily noted (95% of the adjectives were in this sub-category) with pedagogical responsibilities associated with assessment less so. The hierarchical order of adjective described responsibilities were also not aligned between academic and PGD; for example PGDs place more emphasis on their engagement and interaction with the undergraduate students and less emphasis on knowledge content in comparison to the academic stakeholders.

Plot of PGD reponsibilities in the lab
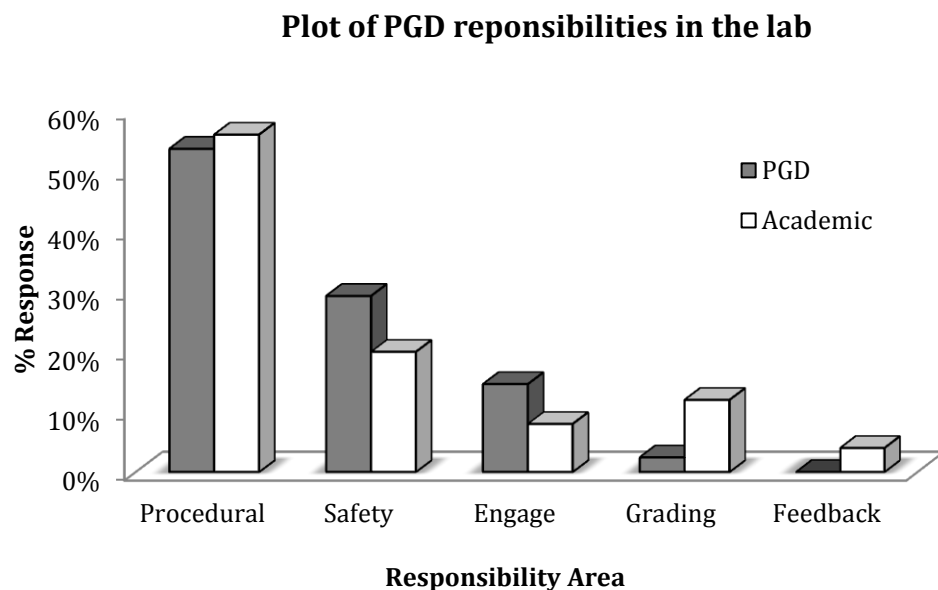
Figure 4.7: Schematic representation of the five emergent themes coded from PGD provided examples of PGD responsibility in the lab. The corresponding coded examples provided by the academics (see Section 4.1.2.1) are included for comparative purposes.

Plot of PGD descriptive laboratory responsibility
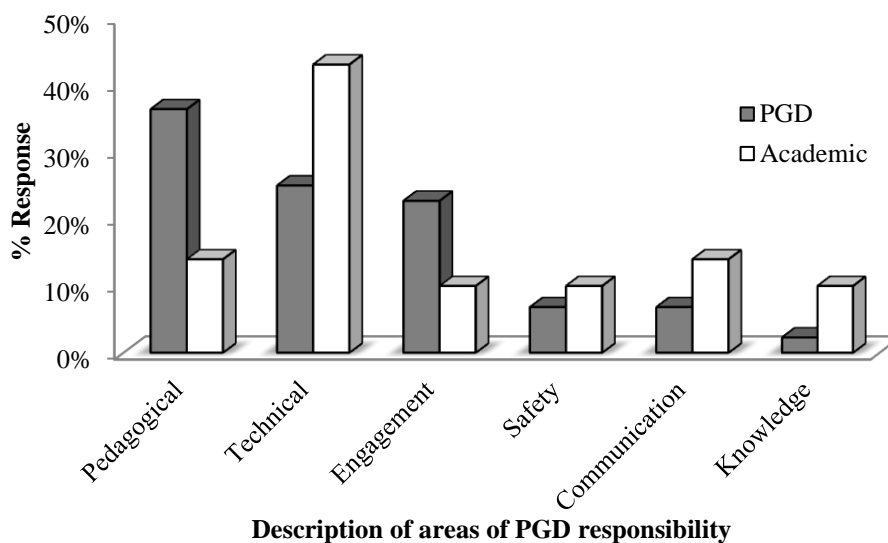
Figure 4.8: Schematic representation of the six emergent themes coded from PGD provided descriptive adjectives of a typical PGD and their associated responsibilities. The corresponding coded adjectives provided by the academics (see Section 4.1.2.1) are included for comparative purposes.

4.1.3.2   Lab Learning

A reason behind this reduced emphasis on knowledge maybe due to the PGDs demonstrating in disciplines that are not their own. Ideally, PGDs would demonstrate in areas related to their area of expertise or research; however, in this intrinsic case study this is not always the case. It is common practice within the School for demonstrators to be assigned demonstrating duties outside their discipline, particularly those demonstrating large, first year undergraduate labs. There are several reasons for this; however, the primary reason is logistical; there are simply not enough discipline specific PGDs available for each discipline. Table 4.1 outlines the discipline backgrounds of each of the PGDs available for demonstrating within the School during the timeframe of this intrinsic case study. There is an uneven distribution of PGDs in the areas of Microbiology and Nanotechnology (accounting for almost half of all the PGDs available; see Table 4.2). In comparison, PGDs with a background in Chemistry are poorly represented at just 10%. Within the School the types of PGDs, and their backgrounds, is transient and dependent on the number of research funding grants won by the relevant disciplines in any given year.

Table 4.1: An overview of the 22 PGDs available within the School during the time-frame of this intrinsic case study. The discipline area for each PGD is noted and also the number of years demonstrating experience.

Coded Name	Discipline Area	Years Exp
1	Food Science	2
2	Food Science	0.5
3	Biotechnology	2
4	Organic Chemistry	0
5	Microbiology	9
6	Polymer Chemistry	3
7	Nanotechnology	0.5
8	Nanotechnology	2
9	Biochemistry	2
10	Nanotechnology	1
11	Nanotechnology	0
12	Biotechnology	0.5
13	Microbiology	2
14	Microbiology	2
15	Nanotechnology	1
16	Microbiology	0
17	Microbiology	2
18	Food Science	6
19	Physics	3
20	Food Science	0
21	Maths	1
22	Biochemistry	4

Table 4.2: Summary of the % of PGDs (n=22) available within each discipline during the time-frame of this intrinsic case study.

Subject Discipline	PGD Number	PGD %
Microbiology	5	23%
Nanotechnology	5	23%
Food Science	4	18%
Biotechnology	2	9%
Biochemistry	2	9%
Organic Chemistry	1	5%
Polymer Chemistry	1	5%
Physics	1	5%
Maths	1	5%

Teaching, and demonstrating, in a discipline that is not their primary background was noted as very frustrating for the PGDs. During the discussion forum, several PGDs described how they felt like the undergraduates were the stakeholders that suffered most, as the PGD did not have the theoretical background to underpin and support their transferable technical skills within their demonstrating.

> (PGD1): *"Sometimes PGDs are asked to demonstrate in areas [of science] that are not their area of expertise. They will not be able to provide demonstrating, as this is not their area. It is not the PGDs fault; they just try their best. It is the [UG] student who suffers".*

> (PGD6): *"I'm a biologist but I demonstrate chemistry! It's ok as it's only first year chemistry, but I would feel more comfortable demonstrating in my own area. For example, the [UG] students would ask me a question and I wouldn't know the answer or where they hadn't covered the theory in lectures and I was expected to fill in the gap".*

Clarity over the role of the PGD in terms of teaching theoretical knowledge remained blurred within the forum group as the discussion evolved. Many of less experienced PGDs cited their role as primarily technical demonstration with no role in the delivery of the theory associated with the lab.

> (PGD2): *"Demonstrating is more to show students how to carry out a technique correctly and not necessarily the theory, this is the lecturers job. We need to be clear what we [the PGDs] can do in the lab. We have limited time, so we need to focus on what is important in the lab; the skills and techniques".*

> (PGD11): *"Demonstrating is practical, whereas teaching is theoretical"*

However, some of the more experienced demonstrators observed that their role was a mixture of theory and technical. This dual role, pseudo academic/demonstrator, can add additional pressure to the PGD to deliver content and also technical skills training to the undergraduate.

> (PGD9): *"I think that there is an overlap, students will ask you questions on the theory and also the practice…you need to be ready for both I like to link the theory to the practice. I do feel pressure to be able to do this…to understand both the theory and also the lab technique".*

Some of the other aspects that those taking part in the discussion forum noted as being important in influencing learning in the lab were academically controlled; including alignment of lab sessions to the theoretical section of the module, the availability of lecture content to the students and PGDs and the modernisation of the curriculum. Aligned to this was the importance the PGDs placed on their own preparedness to demonstrate, their relevant skills and how this influences undergraduate learning. The PGDs observed that underprepared PGDs resulted in a poor learning environment and undergraduate students not enjoying the lab session.

> (PGD3): *"It effects our ability also, if we walk into a lab underprepared, then we don't enjoy the lab, the* [UG] *students don't enjoy the lab"*

Similar to the Academic, Management and Technical staff forum, the PGDs also cited the high undergraduate student:PGD ratio as being a major inhibitor to learning in the lab. The high ratio places additional pressures on the PGDs to engage with large numbers of students during the time-limited lab session. The PGDs observed how the larger student numbers reduced the ability of the demonstrator (and lead academic) to deliver sufficient technical training. Due to the hands-on, one-to-one nature of practical teaching, increased student numbers without a concurrent increase in PGD number resulted in a reduced teaching and demonstrating provision and students struggling to achieve their learning outcomes.

> (PGD2): *In other colleges there are six or seven students per demonstrator. Here* [in DIT], *we* [the PGDs] *are faced with 36 students, or more, with only one demonstrator and the lecturer. It's not fair and it doesn't work.*

> (PGD8): *"I have noticed that in the last five years, the number of students have increased dramatically, however we* [the PGDs] *have not".*

> (PGD2): *"It breaks my heart; a student can't streak a plate correctly by the end of first year or third year students that cannot use a microscope correctly. They are graduating without being able to do the basic skills correctly because we* [the PGDs and academic staff] *cannot give them the time they need to get the skills".*

(PGD9): *"I think the best ratio of PGDs to UGs would be 1:8, which would mean one demonstrator per bench. In Microbiology, you need to be hands on to show the students the different methodologies correctly".*

On a more positive note, the PGDs surveyed were very in tune with how students learn best in the lab; many of the participants spoke from personal undergraduate experience and linked their learning style to how they currently demonstrate. PGDs detailed how they typically adopt kinaesthetic and behaviourist approaches to technical demonstrating.

(PGD12): *"Get all the students to do it! Get their hands dirty! Ideally each student do each part of the lab. Sometimes when they are working in twos or groups they don't all get the same experience".*

(PGD9): *"Show them and then get them to do it. If you show me something I will forget how to do it tomorrow, but if I learn how to do it, then do it, then I will remember for a lot longer".*

Other PGDs were influenced by the use of technology enhanced learning to supplement their face-to-face demonstrating time and this chimed with comments from the Academic, Management and Technical staff forum. These PGDs were aware of both the benefits and drawbacks to using generic lab demonstration videos.

(PGD7): *"Everything is on YouTube; no matter what you Google you will find a video on it. The students could use this to see what the technique is before they come to the lab".*

(PGD4): *"I find that you could watch a video online and think 'ah, that's easy'; and then struggle in the lab…or the video on YouTube isn't quite right or sometimes the incorrect technique is shown. The [UG] students need to be guided towards the better YouTube videos, especially first year students".*

During the hands-on technical demonstrating tasks, PGDs used a number of methods to motivate the students. These included being proactive and approaching students, engaging with students over the course of the lab, explaining things clearly and simply being approachable.

(PGD3):*"Demonstrators need to be approachable, you are not the lecturer, so you tend to get asked more questions that the students won't ask the lecturer".*

4.1.3.3 PGD Training

Despite the PGDs understanding of how students learn in the lab, they were clear in the areas that they felt they needed additional support. The inexperienced demonstrators were appreciative of any support and sought a mixture of generic training aligned to specific technical skills. However, the more experienced demonstrators conceded that technical skills training may not be appropriate for the PGD group as a whole, due to the diverse nature of their demonstrating duties and the fact that many PGDs would not be aware of their areas of demonstration until after the semester started. This would decrease the value of any specific pre-semester training.

(PDG6): *We could only find out the day before the lab what labs we are demonstrating, so specific technical training mightn't suit* [this training course].

A compromise was reached between the PGDs and this suggestion formed the approach taken in the training course outlined in this intrinsic case study, with some areas covered outlined in Table 4.3.

(PGD7): *"I think it would be a good idea to have an overview session at the start of the semester, and then as we need things we can have sessions on them during the semester"*

Table 4.3: Summary of specific training areas requested by PGDs during discussion forum.

Training Area	Coded Name	Example Quotation
Feedback and Grading	4	*"I've never assessed, or given feedback to a student, so I would like some assistance with this. Maybe not straight away, but when I need it"*
Feedback and Grading	2	*"I mark student reports; I'm happy with that as I have the grade sheet…but I wouldn't be confident in giving feedback to students".*
Generic Demonstrating	5	*"I'm not sure what training I need, as I don't know what I will be demonstrating yet. Perhaps some general information on how to demonstrate better".*
Final Year Projects	1	*"I think that we* [the PGDs] *should have some input into the content and when it* [the training] *takes place. I know I would like some suggestions on how to deal with final year project students, but they don't come into my lab until a few weeks into the semester".*

In the aligned online survey the PGDs (n=10) prioritised training topics where PGDs required training and support from a list of ten typical areas in which PGDs are generally provided training in (DeChanne *et al*., 2012; see Appendix 6). In comparison to the academic opinion, which as quite polarised, the PGD prioritisation was more evenly distributed (see Figure 4.9). All elements ranged around the average priority weighting of 5.5 (±1.5). Some topics were assigned similar weighting in by both groups (academics and PGDs); however, several topics varied greatly. For example, PGDs put a higher priority on topics such as pedagogy, group work and grading and a lower priority on feedback. This is despite explicit requests for training in feedback during the discussion forum. However, as with the academic discussion, no hierarchy was placed on PGD responses to areas requiring training.

Priority plot of PGD training topics
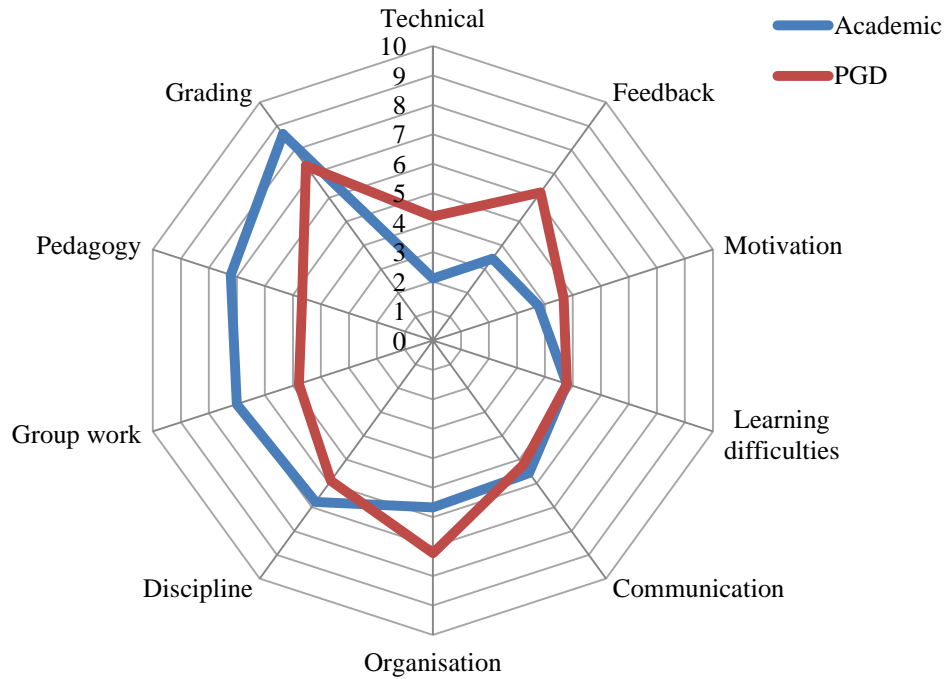
Figure 4.9: Schematic representation of the most important areas for PGD training as assigned by PGDs (n=10, blue line). The weighted rank was calculated as: (sum of (position * count) for each choice / total responses) + 1. Using this weighted ranking the lower the value, the higher the priority. The corresponding academic responses are detailed in red with the weightings calculated in using the same formula. Data presented collated based on online survey.

In order to investigate further the PGDs confidence in their demonstrating skills and to identify any further areas that required training or support; the PGD cohort were asked to complete a modified, online version of Boman's (2013) Teaching Assistant Self Efficiency Scale (see Appendix 4). Overall the PGDs surveyed (n=9) as part of this intrinsic study were, in the majority, not confident in their demonstrating skills (see Figure 4.10). Although this is a small survey number, it accounts for 41% of the available PGDs during the study's timeframe.

The overall summary is based on the PGD responses to a twenty-one point survey. Drilling into the summary, the elements corresponding to the least PGD confidence relate to problem solving, providing feedback and lab organisation (see Table 4.4). However, more worrying is the fact that almost half of the PGDs were not confident in their general demonstrating ability.

Just under half of PGDs were somewhat confident in their ability to demonstrate technical procedures. However, when this is considered in terms of the PGDs own perceived role (technical and procedural assistance, see Section 4.1.3.1) it is concerning that PGDs are not fully confident in their technical ability. As discussed previously, this may be due to the PGD demonstrating in disciplines that are not the background of the PGD. Finally, over half of the PGDs surveyed were very confident in aspects related to student engagement and developing their demonstrating style.

Plot of Overall PGD Confidence in Demonstrating
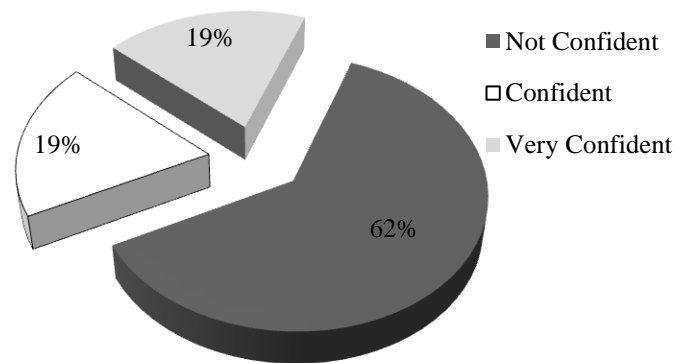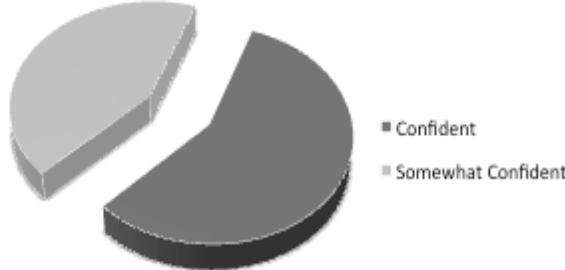
Figure 4.10: Overall summative analysis of Boman's (2013) modified Teaching Assistant Self Efficiency Scale. This teaching scale summary was based on the PGD confidence rating (n=9) in response to a twenty-one part survey.

Table 4.4: Individual breakdown of PGD responses (n=9) to Boman's (2013) modified Teaching Assistant Self Efficiency Scale, summarised as areas perceived as not confident, somewhat confident and very confident.

Not Confident	
• Motivating students • Organising lab demonstrations • Providing feedback • Problem solving • Handling disruptive students • Overall demonstration ability	■ Confident ■ Not Confident *Average: 48% Not Confident*
Somewhat Confident	
• Referring students to suitable services • Giving technical demonstrations • Setting lab objectives • Responding to student questions • Responding to academic problems • Teaching students from different backgrounds	■ Confident ■ Somewhat Confident *Average: 43% Somewhat Confident*
Very Confident	
• Asking questions • Using student evaluation • Showing respect for students • Making changes to demonstration style • Responding to academic problems.	■ Not Confident ■ Very Confident *Average: 53% Very Confident*

Within the same online survey, the PGDs also responded to a modified Attitudes Towards Teaching (ATT) survey, adapted from Boman's work. (2013; see Section 3.3.1 for adaption and Appendix 5 for complete survey). In this survey the PGDs attitude towards their demonstrating was examined (see Table 4.5). A clear theme that emerged from the data was the PGDs were intrinsically motivated to demonstrate; the financial return for demonstrating is not the only reason they demonstrate. The rate of pay for postgraduate demonstrators was €16/hr during this intrinsic case study. For comparison the minimum hourly wage for an experienced adult during this intrinsic case study was €8.65/hr (Citizens Information, 2015). Within the School PGDs have traditionally supplemented their research stipend by carrying out demonstrating and ancillary teaching duties; however, in this intrinsic case study this was not the primary reason for demonstrating. Correspondingly, the PGDs that responded were not demotivated by the low rate of pay. The majority PGDs noted that they have sufficient time to complete their demonstrating duties, however this contradicts PGD commentary from the discussion forum where they felt under pressure and un-able to prepare fully when demonstrating several labs in the one day. The PGDs may have, however, interpreted this question as 'do they have enough time to complete their demonstrating duties whilst still fulfilling their research requirements'. Overall the majority of PGDs looked forward to their demonstrating duties and they acknowledged that demonstrating would develop skills that would enhance their future careers. The respondents also clearly indicated that they are willing to up-skill, self-improve and evolve their demonstrating duties and they were willing to take a more autonomous teaching role in the lab.

4.1.3.4   Professional development.

The PGDs that took part in the survey and discussion forum noted that they did not receive any official professional development or academic mentoring. A small number commented that they received limited feedback on their demonstrating at the end of each semester. Participants noted that feedback, and feedforward, on demonstrating should be a two-way dialogue

between academic and PGD with the ultimate goal being an enhanced learning lab.

Table 4.5: A heat map plot of PGD responses (n=9) to Boman's (2013) modified Attitudes Towards Teaching (ATT) survey. The percentage response is noted within each cell and the darker the colour, the higher the percentage agreement.

	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE
I am looking forward to my demonstrating duties	22%	44%	33%	0%
I do not think I will have enough time to do a good job in my demonstration duties	11%	11%	78%	0%
I constantly strive to improve myself as a demonstrator	44%	44%	11%	0%
The only reason I demonstrate is because it is a requirement of my research contract	0%	13%	13%	75%
I am not motivated to do a good job of demonstrating duties because I am not paid enough	0%	11%	11%	78%
I do not want to learn more about how to teach effectively	0%	0%	11%	89%
My teaching experience will help me achieve my career goals	56%	33%	11%	0%
If I had the choice I would spend most of my time doing research rather than teaching	25%	13%	50%	13%
If I had the chance to teach a lab as the sole instructor, I would look forward to the opportunity	56%	0%	22%	22%

4.1.4 Summary of Findings: Identification of the key lab pedagogical skills required by postgraduate demonstrators

Overall, the key findings from each key stakeholder within this section of the intrinsic case study can be summarised as follows:

Undergraduate stakeholders

- UG feel that PGDs not fulfilling demonstration role fully
- Decreased efficiency with skills associated with increased Blooms Hierarchy
- UGs not gaining from experience of a 'professional researcher'
- Grading/Feedback perceived as being 'academic' duties

Management, Academic and Technical stakeholders

- Clear need for PGDs to be technically competent
- Requirement for 'other' training
- Apparent contradictions in skill requirement prioritization
- Academic/Management enthusiastic about enhancing PGD role

Postgraduate Demonstrator stakeholders

- PGDs seeking any kind of training support
- Very frustrated: Logistics, Organisation, Communication
- Skill prioritization aligned to staff/management, T+L emphasised more
- Misalignment of discipline-specific skills reducing PGD role
- PGDs are intrinsically motivated to demonstrate
- Want to improve their demonstration/teaching skills
- Not confident in many of the basic demonstrating skills
- Skill requirement contradictions noted (discussion *vs* survey)

The key skills required by PGDs as identified by all the key stakeholders are outlined in Table 4.6.

Table 4.6: Summative overview of the skills required by PGDs as identified by all the key stakeholders based on the data collected in this section of the research.

Undergraduate stakeholders
Add value to learning experience
Increase subject area interest
Enthusiasm
Provide clear explanations
Discussion orientated
Provide meaningful answers
Interested in student needs
Problem solving skills
Analytical skills
Planning skills
Evaluation skills
Management, Academic and Technical stakeholders
Technical skills
Health and Safety
Grading
Student engagement
Providing Feedback
Communication
Pedagogical
Knowledge
Engagement
Academic Processes
Feedback
Teaching Theory
Motivation
Organisation
Discipline
Group Work
Dealing with learning difficulties
Postgraduate Demonstrator stakeholders
Technical skills
Health and Safety
Knowledge
Engagement
Pedagogical
Feedback and Grading
Generic Demonstrating Skills
Final Year Projects
Communication
Learning difficulties
Discipline
Group Work
Organisation
Motivation

4.2 Classification of the key pedagogical skills required by postgraduate demonstrators into those that can be enhanced through suitable training and those that require an alternative approach.

The skills required by PGDs, as identified by all the key stakeholders in Section 4.1.4 (and Table 4.6), were analysed, grouped and prioritised based on researchers perceived ability to enhance these skills through workshop-based training (see Tables 4.7, 4.8 and 4.9). In general, the rationale used to gauge the appropriateness of the desired skill to be taught in the proposed model of training was the suitability of the desired skill for the entire PGD cohort (Goodlad, 1997). Technical skills and discipline knowledge, along with health and safety, were not deemed appropriate for this training model and were not included in the training plan.

Technical training and discipline knowledge were not included in this training model as each discipline, and each lab within each discipline, has unique technical skills and knowledge requirements. Here, the technical officer or lead academic should provide training for each lab session. Health and Safety was not included as, with technical skills, each lab session is unique and discipline specific. Additionally, a more comprehensive health and safety training course is available within the institution.

Once grouped and prioritised, specific workshops were designed and developed to assist the PGDs to enhance the desired skills (see Appendix 12 for a full breakdown of each session). Each training session varied in length, with the first session lasting 4 hours and each subsequent session being shorter on a sliding scale, with the last session lasting 45 minutes. The timing of the sessions within the semester took on board the PGDs request for a 'just-in-time' approach to their skills development (Romiszowski, 1997). Subsequently, the first session covered the majority of the theoretical aspects of demonstrating and took place before the teaching semester started. Over the course of the semester the other sessions aligned to the typical demonstrating activities that the PGDs were involved in.

A webpage was developed to support the training course and included notes from the workshops, additional reading material and a reflective blog space for participants (see Appendix 20). The final session was a reflective time to showcase the PGDs learning journey and to highlight future continual professional development the PGDs could undertake.

Table 4.7: Grouped skills requirement with highest priority. All skills where interpreted as 'Pedagogy' based. The stakeholder(s) who detailed the skill requirement and the training session that was used to develop the skill(s) are detailed also. See Appendix 12 for more details on each session.

Group Theme	Pedagogy	
Priority	1	
Skill Requirement	**Stakeholder(s)**	**Training Session (TS)**
Add value to learning experience	UG	TS1, TS2, TS3
Problem solving skills	UG	TS1, TS2, TS3
Analytical skills	UG	TS1, TS2, TS3
Planning skills	UG	TS1, TS2, TS3
Evaluation skills	UG	TS1, TS2, TS3
Grading	AMT	TS2
Pedagogical	AMT / PGD	TS1, TS2, TS3
Academic Processes	AMT	TS1
Feedback	AMT	TS2
Teaching Theory	AMT	TS1
Group Work	AMT / PGD	TS1
Dealing with learning difficulties	AMT / PGD	TS3
Feedback and Grading	PGD	TS2, TS3
Generic Demonstrating Skills	PGD	TS1, TS2, TS3
Final Year Projects	PGD	TS3

Table 4.8: Grouped skills requirement with second tier priority. All skills where interpreted as 'Communication' based. The stakeholder(s) who detailed the skill requirement and the training session that was used to develop the skill(s) are detailed also. See Appendix 12 for more details on each session.

Group Theme	Communication	
Priority	2	
Skill Requirement	**Stakeholder(s)**	**Training Session (TS)**
Provide clear explanations	UG	TS1
Discussion orientated	UG	TS1
Provide meaningful answers	UG	TS1
Organisation	AMT / PGD	TS1, TS2, TS3
Discipline	AMT / PGD	TS3
Communication	AMT / PGD	TS1, TS2, TS3

Table 4.9: Grouped skills requirement with third tier priority. All skills where interpreted as 'Engagement' based. The stakeholder(s) who detailed the skill requirement and the training session that was used to develop the skill(s) are detailed also. See Appendix 12 for more details on each session.

Group Theme	Engagement	
Priority	3	
Skill Requirement	**Stakeholder(s)**	**Training Session (TS)**
Enthusiasm	UG	TS1
Motivation	AMT / PGD	TS1, TS2, TS3
Engagement	AMT / PGD	TS1, TS2, TS3

4.3 Investigation, through appropriate evaluation, if a bespoke training model is a suitable means of providing and enhancing the key lab pedagogical skills required by postgraduate demonstrators.

The PGDs that participated in the training course were the primary evaluators of the effectiveness of the training model to enhance their lab pedagogical skills once the training course was delivered. A second evaluation source were members of the Academic, Management and Technical staff who had direct contact with the PGDs who followed the course. The undergraduate student stakeholders were not included in the post training course evaluation as the initial cohort of undergraduate students stakeholders were not demonstrated to by demonstrators who followed the training course and therefore any data collected would not enhance the evaluation of this training course.

4.3.1 Academic, management and technical staff evaluation

After the completion of the PGD training course and a semesters teaching; academic, management and technical staff (n=16) were asked to provide feedback on their experience with PGDs who participated in the training course. The respondents (n=4) provided written descriptions of their experience of the PGD in their teaching lab under the two main headings; was there any noticeable difference in the PGD in terms of demonstrating and are there any other areas that require additional training (see Appendix 19). Of the four respondents, two declined to provide any description due to conflict of interest. Of the two respondents that did provide evaluative feedback the overall opinion was a noted positive development in the PGD.

> (L1): *Positive changes - active engagement with students, ability to guide students in their lab work. Demonstrator was never idle and required very little instruction from the lecturer, as she was always prepared coming into labs.*

> (L2): *I observed very positive changes in* [the PGD] *from the perspective that she was much more involved than before and willing to take the initiative in dealing with student issues/questions. If there was a negative…sometimes I felt like the students didn't know who the lecturer was!*

The academics that responded with evaluative feedback also noted the requirement for all PGDs to participate in some form of PGD training. Based on their experience with different demonstrators, the academics observed a clear distinction between those demonstrators that participated in this training course and those that did not have any training in pedagogical skills for labs.

> (L1) *"I have worked with other demonstrators this year (who had not received this training) and I would recommend they undertake this training course to improve their approach to demonstrating. They were unprepared coming into the lab, reluctant to help students, remained stationary in one place throughout or followed the lecturer around showing no initiative"*.

> (L2): *"Compared to* [the PGD that undertook the training course]*, other demonstrators that I have work on social skills and how to interact with students and also to prepare ahead of the lab session therefore be equipped with the knowledge to assist the students and lecturer properly"*.

Although from a very small sample number (n=2); the positive comments on PGD development, specifically highlighting areas that were covered in the training courses (e.g. engagement, organisation and appropriate student interaction and guidance) are indicative of an overall positive PGD development experience. The benefits noted here also echo previous research in the area of PGD training for lab teaching. Jensen and co-workers (2005) noted that the primary development in PGDs after suitable training was an enhanced understanding of *how* to teach in the lab and not just *what* to teach. In this intrinsic case study, this aligns to the PGDs progression from simply instructional and practical demonstration towards adaption of different teaching approaches suitable for the different learners in the lab.

4.3.2 PGD evaluation

This positive trend was reflected in more detail when the comments of the primary evaluators, the PGDs, were examined and analysed. The PGDs evaluated the training course in two ways; a semi-structured discussion forum (see Appendix 8) and an aligned online survey (see Appendices 4 and 5). An additional source of evaluative data was the participant personal reflections posted to the training courses community of practice blog (see Appendix 20).

PGDs (n=4) that attended the semi-structured discussion forum evaluated the training course and their responses were coded under three themes; the training model adopted and the PGD community of practice that evolved over the course of the training course, the pedagogical skills developed and future training.

4.3.2.1 Training model adopted and PGD community of practice

In general the PGDs that participated in the discussion forum reflected the same positive opinion of the PGD training course as the academics. The participants noted how attending the course had benefits for all PGDs regardless of their level of experience or lack of prior training.

> (PGD1): *"It gave a good introduction to how to start demonstrating and what are the problems faced by demonstrators and we worked on how we could improve it"*.

> (PGD2): *"For me, as an experienced demonstrator, it gave me a different perspective on area I had never thought of. Scenarios I had come across, but different approaches to them"*.

The provision of any form of training was appreciated by the PGDs and this chimes with Sharpe's (2000, p.132) study where training, when introduced first, was seen as '*something for those thrown in the deep end* [of teaching]'. This appreciation turned into tangible personal development as the PGD discussion forum participants remarked how they developed many of the

skills that they felt they needed to develop, with the level of development exceeding their original expectations.

> (PGD3): *"When I first started the class* [training course] *I felt scared and a bit overwhelmed as I didn't have a clue about things such as 'how would I deal with running a lab or assessing assignments'...but the class brought me through these, and other areas, in a good way"*.

The just-in-time model of training delivery was seen as a suitable approach and the PGD participants observed how they gained immediate value from the training course. The PGDs noted that they were able to put the skills they were developing in the workshops into practice in their demonstrating duties during the semester. This trend was also evident in the participants reflective blogs hosted on the training courses supporting webpage.

The reflective blogs were used by some participants as a way to record and reflect on their learning experience in the training course and how these new skills were integrated into their every day teaching and demonstrating duties. Participants that blogged (n=5), submitted between one and three blogs over the course of the training course. Blogs were hosted on a private web-space with access restricted to participants of the training course. This space evolved into an on-line community of practice where PGDs could share best practice and experience. It also became a sand-pit of ideas where PGDs could note skills they wanted to develop further after the workshops and chart their skill development progression.

> (PGD 5) Blog One: *"Gagne's nine events of instruction was an approach I really engaged with at the* [PGD Training] *session and is definitely an approach I intend to use to aid me in my demonstration duties"*.

> (PGD 5) Blog Two: *"Unfortunately I did not get enough notice of what lab I was demonstrating in order to prepare my nine events instruction"*.

All the participants of the discussion forum agreed on the benefits of reflection and reflective writing; however not all participants posted a reflective blog. Some participants commented that they preferred to 'lurk' in the online shadows and admitted to reading all the blogs posted and learning from them and this echoes with Preece and co-workers (2004) finding that lurking enhanced community based learning. Confidence in ones self, the

perceived inability to write reflectively and the fear of posting to a community page were highlighted as reasons why most of the participants in the discussion forum did not post to the community reflective space.

> (PGD3): "*I found it good to read PGDs from other Schools within the College. They gave me a different perspective also. They were very good. I read with great interest all the postings on the site; but I still couldn't bring myself to post to it! I certainly learnt from the other postings. I learnt that we are all in the same boat; the experiences are quite universal, even if you are only new to demonstrating*".

This community of practice was also noted as one of the reasons PGDs attended the face-to-face training workshops. PGDs wanted to meet their demonstrating colleagues, learn from each other and share learning resources.

> (PGD4): "*Yes, I find it is good to chat with the new demonstrators as they have new ideas on how to teach certain labs. They have great energy. We can also share resources with each other, for example, XXX* [another PGD] *gave me some examples of reports from her class and I asked my students to see what they thought of them. My students soon realised the standard they had to write to once they saw their peers work*".

The PGDs participated in the training course for a number of other reasons summarized into three areas; skill development, value added activity and career enhancement. The training course was based on group participation facilitated through group activities in each workshop and reflects Cassisdy and colleagues (2014) finding the PGDs learn pedagogical skills very effectively through social constructivist approaches. Most of the participants in the discussion forum were relatively inexperienced (<1 year) demonstrators and their primary reason for attending the training course was to develop their demonstrating skills.

> (PGD3): "*I just thought that it was a great idea. I was nervous about starting off demonstrating, this was great….I was starting off from zero and an needed to learn how to do it right….this really helped me with that*".

The more experienced demonstrators attributed their participation to career development and the benefit they observed after the first session

(PGD2): *"I really got a lot from the first session that I could apply straight away. This encouraged me to come back and every class I tried to improve my demonstrating using the things we covered in class* [training workshop]. *I could see myself in more of a academic role in the future now".*

Despite being paid the hourly demonstration rate for attendance, and in line with the pre-training course survey; the PGD participants of the discussion forum noted that financial reward was not the driving force behind their participation in demonstrating or attending the training course. An alternative approach, and more in line with the structured PhD model, one participant suggested accreditation in place of payment for attendance and completion of the course.

(PGD2): *"I wasn't expecting to get paid for attending this training; I am developing myself. I would like to further investigate certification in this area. Perhaps, if no payment is available, then some sort of certification should be awarded upon completion".*

4.3.2.2   Pedagogical skill development

In general, the participants of the PGD training course enhanced specific skills that they perceived as being important in PGD demonstration. Additionally, the PGDs evolved their own teaching philosophy and became reflective practitioners. Indeed, reflection was noted by the majority of participants in the discussion forum as a skill they developed through participation in the training course. This was not a skill defined as important by any of the stakeholders; however, reflection and reflective practice is a cornerstone for educationalists (Mann *et al*., 2009). PGDs were encouraged to reflect on their learning during the training workshops and also on their practice as they implemented and trialled their developing pedagogical skills. The online blog space grew as a repository for participants to share their reflections and encouraged best practice. This virtual community of practice evolved from, and built on, the face-to-face community of practice fostered in the training workshop.

(PGD2): "[The researcher] *asked questions during the training, and I had never thought about them before. I tried to think about them more and apply them in my demonstrating. It was very useful, I became more approachable and I became more engaged with my students".*

(PGD3): "*The first two classes there were lots of us there, it was really interesting to talk with those that were more experienced than you; or even speaking with people from different backgrounds to get their perspective on demonstrating. It's good to share problems and solutions*".

Learning within a community of practice can be beneficial to all participants as members of the group develop their understanding together. Sharing learning tools, establishing teaching 'norms' and expanding their use of the language of learning can pull the community together and simultaneously raise the communities standard (Brown *et al.*, 1989). This moves away from the traditional '*teacher as individual*' approach to personal development, towards a social constructivist approach to learning and personal development which is particularly well suited to PGD training and development (Dotger, 2011, p.158).

Participants in the discussion forum commented on how they socially developed specific skills that they perceived as important. The skills mentioned encompassed all aspects of pedagogy and aligned to the highest priority training theme (as outlined in Section 4.2). The skills developed included grading assessable and non-assessable components, contextualising lab skills for students, adopting to different learning styles in the lab and prioritising student supports.

(PGD3): "*Something I started doing after the first class with* [the researcher] *was to give my students a quick oral quiz before they started, so I knew they where they stood in terms of understanding. It actually speeded-up the subsequent lab-work as I could spend more time with those that were struggling and those that were fine continued on with their lab-work…and this built the students confidence also.* [The researcher] *emphasised the real-life applicability of questions. This also made me better at explaining things, as I had to think about the different ways each of my students could learn*".

Additionally, understanding the importance of preparation was detailed by some of the less experienced PGDs. Sharing best practice within the PGD community allowed the more inexperienced PGDs to learn from the more experienced PGDs. This dove-tailed with the development of the specific

skills outlined previously to give all PGDs a good foundation to build their own teaching and demonstrating style.

> (PGD3): *"I fell better equipped, rather than just winging it. I feel more organised and prepared in my mind. I felt I became more structured after seeing example approaches and speaking to other PGDs in class [training workshop]"*.

> (PGD4): *"I really enhanced my communication skills and helped me to connect with my students. I am also more structured and organised. I developed my own pedagogical ideas. It is useful to study the different pedagogical ideas"*.

An emergent trend from the discussion forum was the enhanced self-worth the participants felt after completing the training course and putting their new skills into practice. The PGDs felt empowered and this was reflected in their more centralised role in the lab. They no longer saw themselves as an extra pair of hands, a health and safety enforcer or an unwilling participant in undergraduate learning. This chimes with an objective of the training course outlined in the academic, management and technical staff pre-training discussion forum; whereby the PGDs would feel a better sense of worth if the School invested in them and supported them in their demonstrating.

> (PGD 2): *"I feel I became more useful in the lab"*.

> (PGD4): *"This is a great opportunity that the* [School] *provided for us; not every School has this course"*.

Following on from their enhanced feeling of self-empowerment, the biggest change noted by the participants was their confidence in their own demonstration abilities.

> (PGD3): *"I just felt more confident, as I felt that I had prepared myself"*.
> (PGD2) *"I found more confidence in myself; I took on more responsibilities, such as marking, because I felt confident in myself"*.

A similar trend is noted in the results from the aligned online survey. PGD participants (n=7) repeated the modified Teaching Assistant Self Efficiency

Scale (Boman, 2013). A noticeable change in PGD confidence is observed in the PGDs overall confidence in their demonstrating ability (see Figure 4.11). This dramatic increase in confidence may be due to a better understanding of teaching theory, a more defined skill set focussed on demonstrating or a combination of all the elements covered during the training course. Previous training courses in the biosciences for novice teachers have also reported increased self-confidence as a primary outcome of dedicated teacher training workshops (Gartland, 2013).

Overall PGD confidence in carrying out demonstrating duties
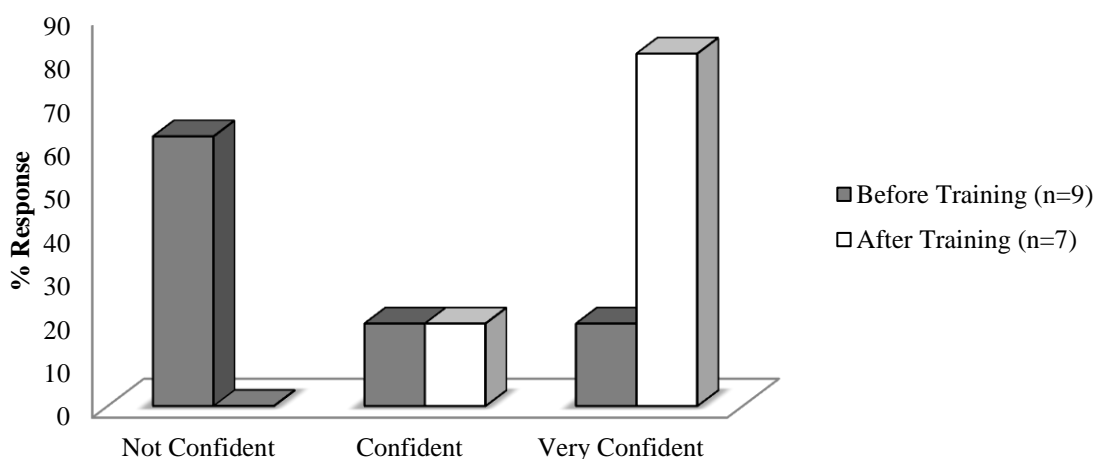
Figure 4.11: Overall summative analysis of Boman's (2013) modified Teaching Assistant Self Efficiency Scale. This teaching scale summary was based on the PGD confidence rating before training (n=9) and post training (n=7) in response to a twenty-one part survey.

A deeper examination of the twenty-one individual aspects of the survey shows several areas of large opinion change after the training course (see Table 4.10). The areas of greatest change in self- efficacy align to topics discussed and developed in the training course such as engagement, communication, grading and providing feedback. Improved self-efficacy in teaching has been linked to between teaching practices such as designing better learning scenarios, seeking out engaging examples to contextualise the students learning, motivating students more, and being more resilient when faced with challenges in their teaching (Parker, 2014). Development of teaching efficacy is strongly influenced during the first exposure to teaching duties (Hoy, 2000) and for many STEM academics this takes place during their own time as postgraduate demonstrators. Developing a strong

awareness and confidence in ones own teaching ability is crucial for PGDs during their day-to-day demonstrating duties, but it will also form a strong foundation upon which to build their own academic career on.

Table 4.10: A heat map summary detailing the individual breakdown in percentage differences in PGD response (Pre-training n=9 and Post-training n=7) to Boman's (2013) modified Teaching Assistant Self Efficiency Scale. The darker the colouring, the larger the percentage difference between pre and post-training response.

	Not confident	Somewhat confident	Confident	Very Confident	Completely confident
Give a lab demonstration	0%	-30%	-8%	17%	21%
State goals and objectives clearly for lab	-11%	-33%	17%	6%	21%
Motivate student interest in a lab	-33%	-8%	14%	10%	17%
Encourage class participation	-22%	-8%	-19%	3%	46%
Communicate at a level that matches students' ability to comprehend	-22%	14%	-19%	6%	21%
Respond to students' questions during labs	0%	-33%	6%	21%	6%
Respond to students' answers during labs	-11%	-11%	-19%	49%	-8%
Plan an organized lab demonstration	-44%	3%	17%	-8%	32%
Provide constructive feedback on lab assignments and lab reports	-33%	-11%	-5%	3%	46%
Show respect for student ideas and abilities	0%	0%	-19%	-16%	35%
Assign grades to students' lab assignments or reports based on a grading rubric	-22%	-11%	10%	-8%	32%
Manage student disagreements with you	-33%	-11%	21%	32%	-8%
Model problem solving skills for students	-22%	-22%	35%	6%	3%
Teach students from different cultural backgrounds	-11%	-33%	6%	6%	32%
Ask open, stimulating questions	-22%	-22%	3%	10%	32%
Refer students with personal problems/learning difficulties to appropriate Institute centres	-22%	-19%	3%	32%	6%
Respond to students' academic problems during labs	0%	-33%	17%	6%	10%
Handle disruptive behaviour by students during class	-22%	-8%	6%	17%	6%
Use student evaluations to improve your teaching	-22%	-11%	-8%	10%	32%
Think about your own teaching and make necessary changes to improve it	-22%	-22%	0%	35%	10%
Overall confidence in your ability to carry out your demonstrating responsibilities	-22%	-22%	17%	-8%	35%

4.3.2.3   Future development and pedagogical training evolution

Although the PGDs the participated in the discussion forum had a positive experience overall; some negative aspects remain. Logistical issues and the perceived *status quo* for PGDs despite up-skilling were noted as continuing negative attributes associated with demonstrating. In the pre-training forum the PGDs noted their frustration with poor communication, inadequate logistics and insufficient PGD organization. Having completed the training course and developed the skills that required developing, the PGDs felt that although they had improved themselves, the demonstration system in which they operated had not advanced.

> (PGD2): *"The four sessions covered a lot more than what I was expecting, so it was good. How you could implement this with the lecturer* [running the lab] *would also be important in the future. This needs a change in lecturers' attitudes to PGD also, as some lecturers are very open to change; however, some are not. Aside from this, it is important the demonstrators demonstrate in areas that they are familiar with… in this way they could add to the lecturer in the lab".*

During the discussion forum, participants were asked what areas of demonstrating required additional training. The responses clearly outline a change in PGD perception of their role in the lab. Areas suggested that required additional training focussed on pedagogical development and reflection. This is in contrast to the PGDs original perception that their duties were to ensure health and safety and provide technical assistance to the lead academic. After being exposed to alternative teaching and learning approaches, and after trialling and reflecting on their use, the PGDs were prepared to move forward in specific areas of their pedagogical development. The language and examples that the PGDs used to describe the new skills they would like to develop is also indicative of the PGDs new appreciation of teaching and learning. The PGDs suggestions for future training to incorporate advanced topics in many of the aspects of the current training course; group work, real life examples, peer sharing and seeing their role in teaching as important, and this again highlights the positive experience the PGDs had.

(PGD2): *"How could we optimise a lab manual? PGDs could be the common link between different classes taking the same module with different academic staff. PGDs could be used in the development or enhancement of a manual. PGDs could form a teaching team and the team could work together to develop the manual and lab"*.

(PGD2): *"Language of feedback; how to be encouraging but still to give constructive feedback. Some more examples from real life, perhaps we could bring some samples from our demonstrating to practice on and we receive feedback on our feedback"*.

(PGD3): *"I would like to be able to bring ideas to an academic or the teaching team. Perhaps some time to think and develop some of these ideas would be good and have group work and Barry to help with developing our ideas"*.

(PGD3): *"Perhaps looking alternative ways to assess students might be good. You can still assess for skills that are required, but using alternative approaches. We could design one perhaps as part of the class* [training workshop]?"

It is clear that the PGDs in this intrinsic case study feel that, although they have developed specific skills, they still have gaps in their knowledge. Previous studies have cited how introductory GTA (Graduate Teaching Assistant) training is limited in its ability to specifically address all the training requirements of the GTA (or PGD equivalent; Rushin *et al.,* 1997). Follow-up training is often delivered to allow the novice teacher to hone their discipline specific skills. One method to achieve this would be the use of 'Lesson Study' as a social constructivist approach to trainee development using real-life, contextualised class problems to develop specific discipline skills during the teaching of that discipline (Fernandez, 2002). The positive use of this approach in STEM (Science, Technology, Engineering and Maths) has been shown to result in positive changes in the trainee's ability to engage students with discipline content in a practical way (Pektas, 2014).

A continuing role out of this training course, and future expansion to include discipline specific development, will require careful consideration of the sustainability and financial viability of the course. The discussion forum participants were clear that, going forward, this training model (or some

variation) should be maintained. Discussion forum participants suggested that participation in the course could be an annual (or bi-annual event) and in line with other training requirements within the Institution, such as manual handling and basic first aid. Participants suggested that refresher training would allow PGDs to prepare for demonstrating different modules (or student levels) each year. This again exemplifies the new outlook of PGDs that participated in the training course; they appreciate the importance of self-preparation.

> (PGD3): *"Refresher every year would be good; if you knew what you were demonstrating; then you could approach the scenarios in class with a different perspective to prepare for the new year ahead"*.

A further suggestion to align the training course to the Institution's structured PhD would also aid in sustainability; both in financial terms and also by way of encouraging participation. Certification of the learning achieved by the PGDs during their training will centralise the training course and show the value of the training not only to the PGDs, but also to potential employers post graduation. This is in line with current recommendations from national policy makers (DES, 2011) and also the community as a whole (Robinson & Hope, 2013).

> (PGD3): *"In the future this module would be really good as part of a structured PhD. For 5 or 10 credits, that would give worth to the effort and work put into the module"*.

In order to maintain the current training course, sustainability will have to be built into the course. Creative and innovative approaches to course delivery will achieve a level of sustainability; however, recognition and accreditation of the training will form the cornerstone of the future of the course.

5.0   Conclusions

The need to provide suitable training for those that teach in further and higher level education has been discussed at length (see Postareff & Nevgi, 2015, for a recent summary). Indeed, it has been noted that "*college teaching is the only profession requiring no formal training of its practitioners*" (Allen & Rueter, 1990, p.9). In comparison to other areas of teaching (Montessori, primary and second level) there is no absolute need to hold a teaching qualification to teach at third level; instead experience is often used to develop teaching philosophy and personal style. Educators at third level can be divided into experienced and novice academics; the novice academics are often not supported in their transition from a research-intensive path to a role that incorporates teaching duties. One of the least supported group of third level educators are the Postgraduate Demonstrators (PGDs); however, these are most often tasked with the challenging task of teaching practical skills to the larger, early year undergraduate classes. This intrinsic case study examined the roles and responsibilities of PGDs within an Irish third level institution, as defined by the key stakeholders in undergraduate lab teaching. A bespoke training course was developed to enhance the key pedagogical skills associated with undergraduate lab teaching and the effect of this training course was evaluated.

In this intrinsic case study the perceived roles and responsibilities of the PGD varied depending on the stakeholder; however, a common thread is the requirement for PGDs to be able to deliver a high standard of technical skills demonstration. The PGDs and the Academic, Management and Technical stakeholders agreed that aspects such as engagement, lab safety and communication were all skills that were important in a PGD. However, PGDs placed a higher emphasis on pedagogical competency than the Academic, Management and Technical stakeholders. Indeed, the PGDs placed pedagogical capability as the most important skill a PGD should possess, yet the PGDs in this intrinsic case study did not typically receive any training in this area. Additionally, PGD stakeholders noted their lack of confidence in many basic demonstrating tasks, both technical and

pedagogical. The first section of this research clearly indicated the need for PGDs to receive training and support in many aspects associated with demonstrating, including fundamental pedagogical training.

The provision of pedagogical training has been shown to have a positive effect on academics at all levels (Jensen, 2011; Postareff *et al*., 2008 and Gallego, 2014). In this case study a similar trend was evidenced. The PGDs noted that following the bespoke pedagogical training course had, in their opinion, a positive influence on their demonstrating and lab provision in general. Additionally, academic stakeholders also noted, from their perspective, the positive effect the training course had on the pedagogical roles carried out by PGDs. PGD training has previously been noted to focus on technical skills training, to the detriment of pedagogical training (Luft *et al*., 2004). However, in this study, pedagogical training formed the basis of the course, with limited technical training. Aligned to Jensen and colleagues (2005) philosophy of focussing on how to teach, not what to teach; this training course developed the PGDs pedagogical skills across a number of key areas, as defined by the PGDs themselves. A social constructivist model was adopted in the training course outlined in this study and this allowed a community of practice to grow between the PGDs, both in the face-to-face workshops and the online reflective space. Ultimately, the PGDs felt a greater sense of self-worth, increased confidence in their demonstrating abilities and they became a more central player in undergraduate lab learning.

In this intrinsic case study the initial typical PGD lab tasks involved facilitating learning through technical demonstration and enforcing health and safety. However, following the training course outlined in this study, roles with increased responsibility including guided grading and liaising between different groups and the lead academic, were taken by the PGD. With continual training and appropriate support PGDs can continue to take a more central role in the undergraduate teaching lab. For example, roles outlined by Cassidy and co-workers (2014); such as lone instructor, mentor for new PGDs, course developer, collaborator and scholar will come within

the skill set of the PGDs with continued training and development. This would allow the undergraduate labs to evolve towards a more research centred model that the PGD could enhance and add value to. The continued provision of this training course requires the support of the all the stakeholders outlined in this study. Additionally, creative and innovative approaches to the courses delivery and evolution, along with integration into the structured PhD model, will weave PGD pedagogical training into the fabric of the Institution.

5.1 Recommendations

Management:

Align the PGD to their core discipline

In this intrinsic case study PGDs were often required to demonstrate outside their discipline area. This reduces the effectiveness of the PGD, as they are not experienced neither in the technical, nor the theoretical aspects of the required discipline. Aligning the PGD to the their core discipline when demonstrating would allow the PGD to be more comfortable in their demonstrating duties as they are subject experts in lab work in this discipline. This will add value to the undergraduate learning experience.

Reduce the PGD to UG ratio

A major inhibitor to student learning, noted across all the stakeholders, was the ratio of PGDs to undergraduates in labs. The typical ratio being 18 UGs to every PGD. Recommendations to reduce this to 8 UGs to every PGD would mean that in a typical lab within the School where this intrinsic case study took place, one PGD would demonstrate to one bench of students. However, this recommendation would require additional, trained and discipline specific PGDs that would place an additional financial strain on the Schools budget.

Lead Academics:

Mentoring of academically novice staff

A culture of PGD mentoring is fostered and adopted. This could take the form of weekly (or bi-weekly) meetings between the lead lab academic and the PGDs demonstrating the lab. Feedback and feedforward on teaching roles could be provided during these meetings in term. Meetings before and after term could focus on incorporating the PGD into the development of new labs or resources for current labs. Collaborative lab development should involve a two-way dialogue between lead academic and PGD (Bomotti, 1994).

Development of two-way, cross hiearchical feedback/forward channels.

Enhancing the quanitity and quality of feedback received by the PGD will improve the PGD development and lead to a superior learning experience. Feedback, and feedforward, should come from all the stakeholders, particularly the undergraduates, peer PGDs and lead academics. Examples of appropriate feedback mechanims include mid- and end of term guided reviews for undergraduate feedback and more discursive refletions with peer PGDs (through a community of practice) and lead academics (through a defined mentoring programme; Luft *et al*., 2004 and Cox *et al.*, 2011).

Evolution to, and adoption of, research centred undergraduate labs

Once a suitable cohort of PGDs trained in the basics of pedagogy emerges from iterative training, an opportunity exists to evolve towards research centred undergraduate labs. Many benefits are associated with such an approach to lab learning (Healey & Jenkins, 2009). The adoption of alternative lab pedagogical paradigms requires not only suitable training to up-skill those delivering the new approach; but also a strong mandate for change and leadership guide and foster this evolution.

PGDs:

Support the development of a community of practice amongst PGDs.

A community of practice evolved holistically during this research; however, a greater and more structured emphasis on developing, enhancing and sustaining such a community would be beneficial to the participants. Such a community would allow the participants to support each other's personal development and, in conjunction, contextualise their learning within a socially constructed environment. Linking the face-to-face learning events with the online space associated with the module can allow the community of practice to grow and sustain itself, even if the participants are not based within the same School or College.

Training Co-ordinator:

PGD training should be accredited and integrated into the structured PhD model

In this research, it was noted that PGDs were intrinsically motivated to demonstrate and also, to participate in the training course. However, accrediting the training course, through a structured PhD, would add extra value to participation and simultaneously provide the PGD with beneficial training and credit towards their PhD. By adopting such an approach, the value-added benefit to completing the training will not be limited to just demonstrating within the host School. PGDs would enhance their interpersonal skill set, develop life-long learning traits and connect with a community of practice. By integrating into the structured PhD model, the module will be more widely available and thus a greater diversity of participants can be recruited both within the CoSH within DIT, but also other Colleges that use PGDs within practical teaching. There is scope to broaden the participation to other HEIs, which do not have a similar support module for their PGDs, as part of a memorandum of understanding or as a certificate of professional development. It is worth noting that the training course outlined in this intrinsic case study has been put forward for validation as a module on the DIT structured PhD course and as a separate certificate of professional development.

Provide continual generic and discipline specific PGD training

The PGDs that participated in this intrinsic case study had not received any prior pedagogical training. They appreciated the training course provided as part of this study; however, they observed that they need continual training and up-skilling. Additional future generic pedagogical training should focus on areas such as curriculum development and reflective writing. Discipline specific training should focus on demonstration standardisation across aspects such as discipline instrumentation, calculations and techniques.

Training model iteration and practical implications.

The model adopted a 'just-in-time' approach to skills provision; the topics covered were delivered in line with when they were most needed (e.g.

feedback skills training was provided mid-way through the semester when the PGDs would most likely be required to provide feedback on undergraduate submitted assignments). This model worked well; however, it is recommend to engage each PGD group in an initial needs analysis to detail the areas they felt they need most support and when they needed it. This co-operative approach, where the specific areas within the curriculum are co-designed with the PGDs enhances participation and engagement. Additional practical considerations include the scheduling of the face-to-face sessions. It proved difficult to find a timeslot that allowed all participants to attend all sessions (due primarily to their demonstrating duties). To circumvent this, it is recommended to run face-to-face session during non-teaching weeks (e.g. before the start of the semester or reading weeks) or after teaching hours (e.g. evening classes). Finally, incorporation of different facilitators for the various aspects of the curriculum could add further value, as the PGDs would be exposed to alternative teaching and learning approaches.

6.0   References

Allen, R. R., & Rueter, T. (1990). Teaching assistant strategies: An introduction to college teaching. Dubuque, IA: Kendall/Hunt.

Austin, A. E. (2002). Preparing the next generation of faculty: Graduate school as socialization to the academic career. *The Journal of Higher Education*, 73, 94-122.

Austin, A. E. & McDaniels, M. (2006). Preparing the professoriate of the future: Graduate student socialization for faculty roles. *Higher Education; Handbook of Theory and Research, 21,* 397-456.

Bautista, N. U., Schussler, E. E. & Rybczynski, S. M. (2014). Instructional Experiences of Graduate Assistants Implementing Explicit and Reflective Introductory Biology Labs. *International Journal of Science Education*, 36, 1184-1209.

Baxter, P. & Jack, S. (2008). Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers. *The Qualitative Report,* 13, 544-559.

Beaton, F., Bradley, S. & Cope, S. (2013). Supporting PGDs who teach: Foreword. *Practice and Evidence of Scholarship of Teaching and Learning in Higher Education*, 8, 83-92.

Bloom, B.S., Engelhart, M.D., Furst, E.J., Hill, W.H. & Krathwohl, D.R. (1956). Taxonomy of educational objectives: The classification of educational goals. Handbook 1: Cognitive domain. New York: David McKay

Bok, D. (1982). Beyond the ivory tower: Social responsibilities of the modern university. Cambridge, MA: Harvard University Press.

Boman, J. S. (2013). Graduate student teaching development: Evaluating the effectiveness of training in relation to graduate student characteristics. *Canadian Journal of Higher Education,* 43, 100-114.

Bomotti, S. S. (1994). Teaching assistant attitudes toward college teaching. *Review of Higher Education*, 17, 371-393.

Boylan, F. (2012). Research Ethics [Lecture]. MSc. In Applied eLearning. Dublin Institute of Technology, Mount St, 15th May, 2012.

Buck, L. B., Bretz, S. L. & Towns, M. H. (2008). Characterizing the level of inquiry in the undergraduate lab. *Journal of College Science Teaching*, 38, 52-58.

Braun, V. & Clarke V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3, 77-101.

Brauner, A., Carey, J., Henriksson, M., Sunnerhagen, M. & Ehrenborg, E. (2007) Open-ended assignments and student responsibility. *Biochemistry and Molecular Biology Education*, 35, 187–192.

Brew, A. (2010). Imperatives and challenges in integrating teaching and research. *Higher Education Research & Development*, 29, 139-150.

Brown, J.S., Collins, A. & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18, 32-42.

Cassidy, A., Dee, J., Lam, V. K., Welsh, A. & Fox, J. (2014). Teaching Assistants Thrive in a Collaborative Team: A TA Development Case Study.*Transformative Dialogues: Teaching & Learning Journal*, 7,1-14.

Chavez, C. (2008). Conceptualizing from the inside: Advantages, complications, and demands on insider positionality. *The Qualitative Report*, 13, 474-494.

Cho, Y., Kim, M., Svinicki, M. D. & Decker, M. L. (2011). Exploring teaching concerns and characteristics of graduate teaching assistants. *Teaching in Higher Education*, 16, 267-279.

Cho, Y., Sohoni, S. & French, D.P. (2010). Need assessment for graduate teaching assistant training: identifying important but under-prepared roles. In *Proceedings of the 2010 Midwest Conference of the American Society for Engineering and Education.*

Citizens Information. (2015). Minimum rates of pay in Ireland. Retrieved on 5/2/2015 from http://www.citizensinformation.ie/en/employment/employment_rights_and_conditions/pay_and_employment/pay_inc_min_wage.html

Cohen, L., Manion, L. & Morrison, K. (2007). Validity and Reliabliity. In L. Cohen, L. Manion & K. Morrison (Eds), *Research Methods in Education* (6th Edition; pp. 133-164). London: Routledge Falmer.

Cousin, G. (2005). Case Study Research. *Journal of Geography in Higher Education*, 29, 421-427.

Cox, M. F., Hahn, J., McNeill, N., Cekic, O., Zhu, J., & London, J. (2011). Enhancing the quality of engineering graduate teaching assistants through multidimensional feedback. *Advances in Engineering Education*, 2, 1-20.

Crotty, M. (1998). *The Foundations of Social Research: meaning and perspective in the research process*. London, UK: Sage Publications.

Dance, A. (2013). Graduate students: Structured study. *Nature*, 493, 259-261.

DeChenne, S.E., Enochs, L.G. & Needham, M. (2012). Science, technology, engineering, and mathematics graduate teaching assistants teaching self-efficacy. *Journal of the Scholarship of Teaching and Learning*, 12, 102-123.

DES. (2011). Department of Education and Skills National Strategy for Higher Education to 2030. Dublin: Stationery Office. Retrieved on 14/11/2013 from www.hea.ie/sites/national_strategy_for_higher_education_2030.pdf

Denzin, N.K., & Lincoln, Y.S. (2000). Introduction: The discipline and practice of qualitative research. In N.K Denzin, and Y.S. Lincoln (Eds.), *Handbook of Qualitative Research* (pp.1-30)*.* London, UK: Sage Publications.

DIT. (2014). Dublin Institute of Technology Research Ethics Committees Homepage; retrieved on 17/06/2014 from http://www.dit.ie/researchandenterprise/ethicsindit.

DIT. (2011). DIT Postgraduate Regulations. Retrieved on 28/11/2013 from http://www.dit.ie/media/documents/study/postgraduateresearch/PG%20Regulations%20Edition%206%20FINAL.pdf

Dolan, E. & Johnson, D. (2009). Toward a holistic view of undergraduate research experiences: an exploratory study of impact on graduate/postdoctoral mentors. *Journal of Science Education and Technology*, 18, 487-500.

Domin, D.S. (2007). Students' perceptions of when conceptual development occurs during lab instruction. *Chemistry Education Research and Practice*, 8, 140-152.

Dotger, S. (2011). Exploring and developing graduate teaching assistants' pedagogies via lesson study. *Teaching in Higher Education*, 16, 157-169.

Dunne, J. & Ryan, B.J. (2012). Learning in the Science Lab: a New Approach. *Irish Journal of Academic Practice*, 1, Article 2.

Edmunds, S. & Brown, G. (2014). Undertaking Pedagogic Research using Qualitative Methods. In M. Grove And T. Overton (Eds) *Getting Started in Pedagogic Research within the STEM*. Birmingham: University of Birmingham STEM Education Centre, pp. 21-29.

ENQA. (2005). Standards and Guidelines for Quality Assurance in the European Higher Education Area. European Association for Quality Assurance in Higher Education. Helsinki, Finland.

Feldon, D.F., Peugh, J., Timmerman, B.E., Maher, M.A., Hurst, M., Strickland, D., Gilmore, J.A. & Stiegelmeyer, C. (2011). Graduate Students' Teaching Experiences Improve their Methodological Research. *Science*, 333, 1037-1039.

Ferguson, C. W. & Sanger, P. A. (2011). Facilitating Student Professional Readiness through Industry Sponsored Senior Capstone Projects. In *American Society for Engineering Education*. American Society for Engineering Education.

Fernandez, C. (2002). Learning from Japanese approaches to professional development: The case of lesson study. *Journal of Teacher Education*, 53, 393-405.

Findlay, N., Dempsey, S. & Warren-Forward, H. (2010). Developing a qualitative framework for analysis of student journals. *The Radiographer*, 57, 34–39.

Foote, K. T., Neumeyer, X., Henderson, C., Dancy, M. H. & Beichner, R. J. (2014). Diffusion of research-based instructional strategies: the case of SCALE-UP. *International Journal of STEM Education*, *1*, 1-18.

Forfas. (2010). The role of PhDs in the Smart Economy. Retrieved on 25/02/2015 from http://www.forfas.ie/media/asc091215_role_of_phds.pdf

French, D. & Russell, C. (2002). Do graduate teaching assistants benefit from teaching inquiry-based labs? *BioScience*, 52, 1036-1041.

Gallego, M. (2014). Professional development of graduate teaching assistants in faculty-like positions: Fostering reflective practices through reflective teaching journals. *Journal of the Scholarship of Teaching and Learning*, 14, 96-110.

Gardner, G.E. & Gail, J.M. (2011). Pedagogical Preparation of the Science Graduate Teaching Assistant: Challenges and Implications. *Science Educator*, 20, 31-41.

Gartland, K.A., Perkins, J., Shearer, M.C., Tierney, A.M. & Wilson, J.J. (2013) 'Novice Teachers' Views of an Introductory Workshop about Teaching in the Biosciences. *Bioscience Education*, 21, 42-53.

Gibbs, G. (1988) Learning by Doing: *A guide to teaching and learning methods*. Oxford: Further Education Unit Oxford Polytechnic.

Goodlad, S. (1997). Responding to the perceived training needs of graduate teaching assistants. *Studies in Higher Education*, *22*, 83-92.

Grix, J. (2002). Introducing students to the generic terminology of social research. *Politics*, 22, 175-186.

Halme, K., Lindy, I., Piirainen, K. A., Salminen, V. & White, J. (2014). *Finland as a Knowledge Economy 2.0: Lessons on Policies and Governance*. World Bank Publications, Washington, USA. pp 30-35, 85-90 and 100-120.

Hazelkorn, E. (2014). Rebooting Irish Education: Policy challenges for challenging times. *Studies in Higher Education*, 39, 1343-1354.

Hazelkorn, E. (2012). Restructuring the higher education landscape. *World University News*, 240.

Hazelkorn, E. & Moynihan, A. (2010). Ireland: The challenges of building research in a binary higher education culture. In *The Research Mission of Higher Education Institutions outside the University Sector*. Netherlands: Springer. pp.175-197.

HEA. (2012). Higher Education Key Facts and Figures (2011/2012). Retrieved on 21/11/2013 from www.hea.ie/sites/default/files/hea_key_facts_figures_1112.pdf

Healey, M. (2005). Linking research and teaching exploring disciplinary spaces and the role of inquiry-based learning. In Barnett, R. (ed) *Reshaping the university: new relationships between research, scholarship and teaching* (pp. 67-78). Milton Keynes, UK: McGraw Hill / Open University Press.

Healey, M. & Jenkins, A. (2000). Kolb's Experiential Learning Theory and Its Application in Geography in Higher Education. *Journal of Geography*, 99, 185-195.

Healey, M. & Jenkins, A. (2009). Developing undergraduate research and inquiry. The Higher Education Academy. York, UK.

Herrington, D. G. & Nakhleh, M. B. (2003). What Defines Effective Chemistry Lab Instruction? Teaching Assistant and Student Perspectives. *Journal of Chemistry Education*, 80, 1197-1205.

Higgins, R., Hartley, P. & Skelton, A. (2002). The conscientious consumer: reconsidering the role of assessment feedback in student learning. *Studies in Higher Education*, 27, 53-64.

Hofstein, A. (2004). The lab in chemistry education: Thirty years of experience with developments, implementation, and research. *Chemistry Education Research and Practice*, 5, 247-264.

Hofstein A. & Lunetta, V. (1982). The role of the lab in science teaching: neglected aspects of research. *Review of Educational Research*, 52, 201-217.

Hofstein A. & Lunetta, V. (2004). The lab in science education: foundations for the twenty- first century. *Science Education*, 88, 28-54.

Hoy, A. W. (2000). Changes in teacher efficacy during the early years of teaching. In Procreedings from the *annual meeting of the American Educational Research Association*, New Orleans, LA.

Hughes, P.W. & Ellefson, M.R. (2013). Inquiry-based training improves teaching effectiveness of biology teaching assistants. *PLoS ONE*, 8, 1-14.

IUA. (2014). Irish Universities PhD Graduates' Skills. Retrieved on 25/02/2015 from http://www.4thlevelireland.ie/publications/Graduate_Skills_Statement.pdf

IUQB. (2009) Good Practice in the Organisation of PhD Courses in Irish Universities (2nd Addition). Retrieved on 25/02/2015 from http://www.iuqb.ie.webhosting.heanet.ie/GetAttachment3bf0.pdf?id=f6086812-ad36-4aaa-b38e-09f292be3af4

IUQB. (2005) Good Practice in the Organisation of PhD Courses in Irish Universities. Retrieved on 25/02/2015 from http://www.iheqn.ie/_fileupload/Publications/IUQB_PhD_Guidelines_76409287.pdf

Jackson, W. K. & Simpson, R. D. (1983). A survey of graduate teaching assistant instructional improvement programs. *College Student Journal*, 17, 220-224.

Jensen, J. (2011). Higher education faculty versus high school teacher: Does pedagogical preparation make a difference? *Journal of College Biology Teaching*, 37, 30 – 36.

Jensen, M., Farrand, K., Redman, L., Varcoe, T. & Coleman, L. (2005). Helping graduate teaching assistants lead discussions with undergraduate students. *Journal of College Science Teaching*, 34, 20 - 24.

Jick, T.D. (1979). Mixing Qualitative and Quantitative Methods: Triangulation in Action. *Administrative Science Quarterly*, 24, 602-611.

Johnson, B. & Christensen, L.B. (2012). Research Ethics. In B. Johnson and L.B. Christensen (Eds), *Educational Research: Quantitative, Qualitative, and Mixed Approaches* (pp. 97-129). London, UK: Sage Publications.

Johnstone, A.H. & Al-Shuaili, A. (2001). Learning in the lab: some thoughts from the literature. *University Chemistry Education*, 5, 1-10.

Knottenbelt, M., Housell, D. & Kreber, C. (2009) Graduate Teaching Assistants as Novice Academic Practitioners: Perceptions and Experiences of Teaching. Research Report. Centre for Teaching, Learning and Assessment,Department of Higher & Community Education, University of Edinburgh, UK.

Krathwohl, D.R. (2002). A Revision of Bloom's Taxonomy: An Overview. *Theory into Practice*, 41, 212–218.

Larson, R. C., Ghaffarzadegan, N. & Xue, Y. (2014). Too Many PhD Graduates or Too Few Academic Job Openings: The Basic Reproductive Number R_0 in Academia. *Systems Research and Behavioral Science*, 31, 745-750.

Lazarowitz, R. & Tamir, P. (1994). In D.L. Gable (Ed.), *Handbook of Research on Science* Teaching *and Learning* (pp. 94-128). New York: Macmillan Publishing Co.

Lichtenberger, B. (2013). The Roadmap from Quality Assurance in Courses and Teaching towards Quality Development as a Strategic Instrument of University Management. *Acta Universitatis Danubius*. Communicatio 7, no.2.

Lockwood, S.A, Miller, A.J. & Meghan M. Cromie. (2014). Preparing Future Biology Faculty: An Advanced Professional Development Program for Graduate Students. *The American Biology Teacher*, 76, 17-21.

Love, G. (2011). Ireland: a strong knowledge economy. *Nature*, 477(7366), 538-538

Luft, J. A., Kurdziel, J. P., Roehrig, G. H. & Turner, J. (2004). Growing a garden without water: Graduate teaching assistants in introductory science labs at a doctoral/research university. *Journal of Research in Science Teaching*, 41, 211–233.

Mahmood, T. & Darzi, A. (2004). The learning curve for a colonoscopy simulator in the absence of any feedback: no feedback, no learning. *Surgical Endoscopy And Other Interventional Techniques*, 18, 1224-1230.

Malterud, K. (2001). Qualitative research: standards, challenges, and guidelines. *The lancet*, *358*(9280), 483-488.

Mann, K., Gordon, J. & MacLeod, A. (2009). Reflection and reflective practice in health professions education: a systematic review. *Advances in Health Sciences Education*, *14*, 595-621.

Marbach-Ad, G., Schaefer, K.L., Kumi, B.C., Friedman, L.A., Thompson, K.V. & Doyle, M.P. (2012). Development and Evaluation of a Prep Course for Chemistry Graduate Teaching Assistants at a Research University. *Journal of Chemistry Education*, 89, 865–872.

Marsh, H. W. (1982). SEEQ: A reliable, valid and useful instrument for collecting students' evaluation of university teaching. *British Journal of Educational Psychology*, 52, 77-95.

McAlpine, L. & Emmioğlu, E. (2014). Navigating careers: perceptions of sciences doctoral students, post-PhD researchers and pre-tenure academics. *Studies in Higher Education*, 39, 1-16.

McCready, R. & Vecsey, S. (2013). Supporting the Postgraduate Demonstrator: Embedding development opportunities into the day job. *Practice and Evidence of Scholarship of Teaching and Learning in Higher Education*, 8, 104-111.

McDonnell, C., O'Connor, C. & Seery, M.K. (2007). Developing practical chemistry skills by means of student-driven problem based learning mini-projects. *Chemical Education Research and Practice*, 8, 130 – 139.

McKiggan-Fee, H., Walsh, L., Hacking, C. & Ballantyne, G. (2013). Postgraduates who teach: a forgotten tribe? Not here! *Practice and Evidence of Scholarship of Teaching and Learning in Higher Education*, 8, 159-173.

Metcalfe, J. S. (2010). University and business relations: Connecting the knowledge economy. *Minerva*, 48, 5-33.

Moore, S., O'Neill, G. & Barrett, T. (2008). The Journey to High Level Performance: Using knowledge on the novice-expert trajectory to enhance higher education teaching. In B. Higgs & M. McCarthy (Eds.), *Emerging Issues II: The Changing Roles and Identities of Teachers and Learners in Higher Education in Ireland.* Cork: NAIRTL.

Morrs, K. & Murray, R. (2005). *Teaching at University. A guide for Postgraduates and Researchers.* London, UK: Sage Publications.

Muzaka, V. (2009). The niche of graduate teaching assistants (GTAs): perceptions and reflections. *Teaching in Higher Education*, 14, 1-12.

Nadin, S. & Cassell, C. (2004). The use of a research diary as a tool for reflexive practice: Some reflections from management research. *Qualitative Research in Accounting & Management*, 3, 208-217.

Neary, M. & Winn, J. (2009). *The student as producer: reinventing the student experience in higher education.* In: M. Neary, H. Stevenson, & L. Bell, (Eds.). *The future of higher education: policy, pedagogy and the student experience* (pp. 126-138). London: Continuum.

Noor, K.B.M. (2008). Case Study: A Strategic Research Methodology. *American Journal of Applied Science*, 5, 1602-1604.

O'Cathain, A. & Thomas K.J. (2004). "Any other comments?" Open questions on questionnaires - A bane or a bonus to research? *BMC Medical Research Methodol*ogy, 4, 25- 32.

O'Connor, M. (2013). Higher Education Policy. Lecture, MA in Higher Education, Dublin Institute of Technology, Dublin, Ireland. 30th October, 2013.

O'Donoghue, T. (2007). Introduction. In *Planning Your Qualitative Research Project: An Introduction to interpretivist research in education* (pp 16-32). London, UK: Routledge Publishers.

Orland-Barak, L. (2005). Portfolios as evidence of reflective practice: What remains 'untold'. *Educational Research*, 47, 25-44.

Park, C. (2002). Neither fish now fowl: the perceived benefits and problems of using Graduate Teaching Assistants (PGDs) to teach undergraduate students. *Higher Education Review*, 35, 50-62.

Park, C. (2004). The graduate teaching assistant (PGD): lessons from North American experience. *Teaching in Higher Education*, 9, 349-361.

Park, C. & Ramos, M. (2002). The donkey in the department? Insights into the Graduate Teaching Assistant (GTA) experience in the UK. *Journal of Graduate Education*, 3, 47-53.

Parker, P. (2014). An Examination of the Impact of Pedagogical Preparation, Teaching Experience and Future Career Plans on Mathematics Graduate Teaching Assistants' Efficacy. *PhD Dissertation*, Georgia State University, USA.

Pektas, M. (2014). Effects of lesson study on science teacher candidates' teaching efficacies. *Educational Research and Reviews*, 9, 164-172.

Partridge, L., Hunt, L. & Goody, A. (2013). Future-proofing university teaching: An Australian case study of postgraduate teacher preparation. *Practice and Evidence of Scholarship of Teaching and Learning in Higher Education*, 8, 112-131.

Pentecost, T. C., Langdon, L. S., Asirvatham, M., Robus, H. & Parson, R. (2012). Graduate teaching assistant training that fosters student-centered instruction and professional development. *Journal of College Science Teaching*, 41, 68-75.

Pickering, M. (1998). Report on the NEACT conference: The chemistry lab and its future. *Journal of Chemistry Education*, 65, 449-450.

Pope, C. & Mays, N. (1995). Qualitative research: reaching the parts other methods cannot reach: an introduction to qualitative methods in health and health services research. *British Medical Journal,* 311, 42-45.

Postareff, L. & Nevgi, A. (2015). Development paths of university teachers during a pedagogical development course. *Educar*, 51, 37-52.

Postareff, L., Lindblom-Ylanne, S. & Nevgi, A. (2008). A follow-up study of the effect of pedagogical training on teaching in higher education. *Higher Education*, 56, 29-43.

Preece, J., Nonnecke, B. & Andrews, D. (2004). The top five reasons for lurking: improving community experiences for everyone. *Computers in Human Behavior*, 20, 201-223.

Ramsden, P. & Moses, I. (1992). Associations between research and teaching in Australian higher education. *Higher Education*, 23, 273-295.

Robinson, T.E. & Hope, W.C. (2013). Teaching in higher education: Is there a need for training in pedagogy in graduate degree programs? *Research in Higher Education Journal*, 21, 1-11.

Romiszowski, A. (1997). Web-based distance learning and teaching: Revolutionary invention or reaction to necessity? In B. Khan (Ed.), *Web-based instruction* (pp. 25–37). Englewood Cliffs, NJ: Educational Technology Publications.

Rose, A. K., & Spiegel, M. M. (2012). Cross-country causes and consequences of the 2008 crisis: early warning. *Japan and the World Economy*, 24, 1-16.

Rushin, J.W., DeSaix, J., Lumsden, A., Streubel, D.P., Summers, G. & Berson, C. (1997). Graduate teaching assistant training: A basis for improvement of college biology teaching and faculty development? *American Biology Teacher*, 59, 86-90.

Russell, J. E., D'Costa, A. R., Runck, C., Barnes, D. W., Barrera, A. L., Hurst-Kennedy, J. & Schlueter, M. (2015). Bridging the Undergraduate Curriculum Using an Integrated Course-Embedded Undergraduate Research Experience (ICURE). *CBE-Life Sciences Education*, 14, ar4.

Ryan B.J. (2013a). Making Connections: Networked Mindmaps as a student centred assessment for learning. *Journal of Perspectives in Applied Academic Practice,* 2, 30-39.

Ryan B.J. (2013b). A walk down the red carpet: students as producers of digital video-based knowledge. *International Journal of Technology Enhanced Learning*, 5, 24-41.

Ryan B.J. (2013c). Line up, line up: using technology to align and enhance peer learning and assessment in a student centred foundation organic chemistry module. *Chemistry Education Research and Practice*, 14, 229-238.

Sandelowski, M. (2000). Focus on research methods-whatever happened to qualitative description? *Research in Nursing and Health*, 23, 334-340.

Scott, J. & Maw, S.J. (2009). The Role of the Postgraduate Student in Delivering Bioscience Teaching. *Bioscience Education*, 14, 3-10.

Sandi-Urena, S., Cooper M.M. & Gatlin, T.A. (2011). Graduate teaching assistants' epistemological and metacognitive development. *Chemistry Education Research and Practice*, 12, 92–100.

Schuck, S. & Kearney, M. (2008). Classroom-based use of two educational technologies: A sociocultural perspective. *Issues in Technology and Teacher Education*, 8, 394-406.

Sharpe, R. (2000). A framework for training graduate teaching assistants. *Teacher Development*, 4, 131-143.

Skeff, K. M. (1988). Enhancing teaching effectiveness and vitality in the ambulatory setting. *Journal of General Internal Medicine*, 3, S26-S33.

Strauss, A.L. & Corbin, J. (1990). Basics of qualitative research: Techniques and procedures for developing grounded theory. (2nd Ed). Thousands Oaks, CA: Sage.

Tellis, W. (1997). Application of a case study methodology. *The Qualitative Report*, 3, 1-17.

Trani, E. P. & Holsworth, R. (2010). The indispensable university: Higher education, economic development, and the knowledge economy (pp. 1-25). Plymouth, UK: R&L Publishers.

Vincent-Lancrin, S. (2004). Building future scenarios for Universities and Higher Education: an international approach. *Policy Futures in Education*, 2, 245-263.

Watson, W. R. & Watson, S. L. (2013). Exploding the ivory tower: Systemic change for higher education. *TechTrends*, *57*(5), 42-46.

Wenstone, R. & Burrett, R. (2013). Postgraduates who teach. National Union of Students (pp. 7-29). London; UK.

Weidman, J. C. & Stein, E. L. (2003). Socialization of doctoral students to academic norms. *Research in Higher Education*, *44*, 641-656.

White, H. B., Benore, M. A., Sumter, T. F., Caldwell, B. D. & Bell, E. (2013). What skills should students of undergraduate biochemistry and molecular biology programs have upon graduation? *Biochemistry and Molecular Biology Education*, 41, 297-301.

Willmott, C.J.R., Clark, R.P. & Harrison T.M. (2003). Introducing undergraduate students to scientific reports. *Bioscience Education*, (e-journal), 1-10.

Wood, E. (1990). Lab Practical Classes in Biochemistry Courses. *Biochemical Education*, 18, 9-12.

Yin, R. K. (2003). *Case study research: Design and methods* (3rd Ed. pp. 97-129). London, UK: Sage Publications.

Appendix 1

Survey of undergraduate student stakeholders. This survey was developed based on work by Marbach-Ad and co-workers (2012). For each question, the undergraduate student stakeholders were asked to gauge their agreement with the statement on a five-point scale (Very important, Important, Neutral, Not important and Not very important).

How important do you rate the following for your demonstrator:

1. To be well trained and effective teachers.
2. To be competent in the lab skills.
3. To be prepared in terms of subject content knowledge.
4. To be able to answer your questions.
5. To be able to mark your work.
6. To be able to give you suitable feedback.

Adapted Student Evaluation of Educational Quality (SEEQ) survey employed during the evaluation of undergraduate student stakeholders. This survey was adapted from Marsh (1982). For each question, the undergraduate student stakeholders were asked to gauge their agreement with the statement on a five-point scale (Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree).

1. Discussions with the demonstrators were intellectually challenging and stimulating.
2. The demonstrators helped me learn something that I consider valuable.
3. My interest in the subject has increased as a consequence of the lab demonstrators.
4. The demonstrator was enthusiastic about the teaching lab.
5. The demonstrator was dynamic and energetic during labs.
6. The demonstrator enhanced the lab with appropriate use of humour.
7. The demonstrator's style of communication held my interest during class. The demonstrator's explanations were clear.
8. The demonstrator encouraged me to participate in discussions.
9. The demonstrator encouraged me to ask questions and I was given meaningful answers.
10. The demonstrator made me feel welcome in seeking help/advice.
11. The demonstrator had a genuine interest my needs.
12. The demonstrator was adequately accessible to me during the lab.
13. The demonstrator explained things to me in a relevant and easy to understand way.

Appendix 3

Modified Cognitive Learning Evaluation (CLE) survey. This survey was adapted from Hughes and Ellefson (2013). For each question, the undergraduate student stakeholders were asked to gauge their agreement with the statement (and corresponding abstract and common examples) on a five-point scale (Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree).

1. My demonstrator helped me learn knowledge skills.
    Abstract Example: recalling information.

    Common Example: learning how to read molecular weights from the periodic table.

2. My demonstrator helped me learn comprehension skills.
    Abstract Example: comparing or contrasting two ideas.

    Common Example: learning to restate a word problem using equations.

3. My demonstrator helped me to learn problem-solving skills.
    Abstract Example: Applying knowledge to find a solution to a specific problem.

    Common Example: learning to select the appropriate statistical test for an analysis.

4. My demonstrator helped me to learn analytical skills
    Abstract Example: determining causes and identifying relationships.

    Common Example: learning to trouble shoot at lab protocol.

5. My demonstrator helped me to learn how to plan my lab work
    Abstract Example: Creating a strategy by using ideas in a new way.
    Common Example: Learning to design a new lab protocol from first principles.

6. My demonstrator helped me to learn evaluation skills.
    Abstract Example: Using critical reasoning to make specific judgements about ideas.

    Common Example: Learning to identify the most relevant approach to design a set of experiments.

Modified Teaching Assistant Self Efficiency Scale (TSE) survey adapted from Boman (2013). For each question, the postgraduate demonstrator stakeholders were asked to gauge their agreement with the statement on a five-point scale (Not confident, Somewhat confident, Confident, Very confident and Completely Confident).

If you were given the opportunity to perform the following teaching tasks, please rate how confident you would be in your ability to accomplish these tasks:

1. Give a lab demonstration
2. State goals and objectives clearly for lab
3. Motivate student interest in a lab
4. Encourage class participation
5. Communicate at a level that matches students' ability to comprehend
6. Respond to students' questions during labs
7. Respond to students' answers during labs
8. Plan an organized lab demonstration
9. Provide constructive feedback on lab assignments and lab reports
10. Show respect for student ideas and abilities
11. Assign grades to students' lab assignments or reports based on a grading rubric
12. Manage student disagreements with you
13. Model problem solving skills for students
14. Teach students from different cultural backgrounds
15. Ask open, stimulating questions
16. Refer students with personal problems or learning difficulties to appropriate Institute centres
17. Respond to students' academic problems during labs
18. Handle disruptive behaviour by students during class
19. Use student evaluations to improve your teaching
20. Think about your own teaching and make necessary changes to improve it
21. Overall, how confident were you in your ability to carry out your responsibilities as a demonstrator

Modified Attitudes Towards Teaching (ATT) survey adapted from Boman (2013). For each question, the postgraduate demonstrator stakeholders were asked to gauge their agreement with the statement on a five-point scale (Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree).

Please indicate your agreement or disagreement with the following statements about your attitudes toward teaching.

1. I look forward to my demonstrating duties
2. I do not think I would have enough time to do a good job in my demonstration duties
3. I constantly strive to improve myself as a demonstrator
4. The only reason I demonstrate is because it is a requirement of my research contract
5. I am not motivated to do a good job of demonstrating duties because I am not paid enough
6. I do not want to learn more about how to teach effectively
7. My teaching experience will help me achieve my career goals
8. If I had the choice I would spend most of my time doing research rather than teaching
9. If I had the chance to teach a lab as the sole instructor, I would look forward to the opportunity

Appendix 6

An adapted version of the key skills of postgraduate demonstrators in undergraduate labs (adapted from DeChanne and colleagues (2012). The postgraduate demonstrator, technical, academic and management stakeholders were asked to rank each skill in a priority one to ten (one being the most important and ten being the least).

Please rank these postgraduate demonstrator skills in order of importance for demonstrating undergraduate labs.

- Organisational skills
- Communicating with lead academic in lab
- Technical knowledge
- Teaching and learning methods and styles
- Motivating students
- Providing feedback for students
- Facilitating group discussions
- Teaching students with different skills/knowledge
- Managing disruptive students
- Grading

Appendix 7

Trigger questions used during the initial discussion fora to identify the key skills of postgraduate demonstrators in undergraduate labs based on Luft and colleagues (2004) prior work in this area. The trigger questions were themed and open ended.

Technical, Academic and Management Forum Trigger Questions.

1. What is the role of the PGD?
2. What is the essential knowledge of a PGD?
3. Why is this knowledge essential?
4. What are the important factors effecting UG learning?
5. What is the best method of scientific lab instruction?
6. How do you motivate students to learn?
7. What areas should be covered in a PGD training course (e.g. technical, pedagogical etc.).
8. Can you give examples where this training would be most useful and when it should take place.
9. Do you mentor academically novice staff? If so, what tasks do you do? If not, why not?

Postgraduate Demonstrator Forum Trigger Questions.

1. What is the role of the PGD?
2. Teaching and Demonstrating, what do you think is the difference?
3. What are the important factors effecting UG learning?
4. What is the best method of scientific lab instruction?
5. How do you motivate students to learn?
6. What areas should be covered in a PGD training course (e.g. technical, pedagogical etc.).
7. Can you give examples where this training would be most useful and when it should take place.
8. Can you give examples where this training would be most useful and when it should take place.
9. Do you receive feedback on your work from students? Staff?
10. Do you have a chance to influence the curriculum?
11. Are you given autonomy in your teaching lab? Would you like autonomy?
12. Do you feel stimulated in the teaching labs?
13. Can you link your demonstration duties to your own research?
14. What frustrates you/motivates you? Why?
15. Do you feel like you are part of the teaching community in DIT?

Appendix 8

Trigger questions used during the post-training discussion fora to evaluate the bespoke postgraduate demonstrator training course. The trigger questions were themed and open ended.

<u>Technical, Academic and Management Forum Trigger Questions.</u>

1. Did you notice any pedagogical changes in your postgraduate demonstrators?
2. If so, describe these changes and were they positive/negative?
3. What PGD skills do you still think require enhancement in the PGDs that you have worked with?
4. Do you think these skills can be improved through training?

<u>Postgraduate Demonstrator Forum Trigger Questions.</u>

1. Did the training course meet your expectations?
2. What areas exceeded your expectations?
3. What areas did not reach your expectations?
4. What influenced your engagement with the PGD training?
5. Should time be allocated to allow attendance/engagement?
6. Should it be paid or unpaid?
7. Do you feel more prepared and supported in your PGD duties after completing the PGD course?
8. Describe any new skills you developed or any existing skills you enhanced after completing the PGD training course?
9. Can you give examples?
10. Do you feel more confident in your abilities as a PGD after completing the PGD training course? Why?
11. What skills do you still think require enhancement?
12. Can these skills be improved through training?
13. Do you post your reflections to the CoP site?
14. Why, or, why not?
15. Do you think you can learn from CoPs?
16. Why or why not?
17. If you engaged with the CoP page did it encourage any further reflection, change mind etc.?

Appendix 9

Free text questions, collated online through www.polldaddy.com, focussing on the identification of key pedagogical skills for the postgraduate demonstrator, examples of best practice and suitable methods to achieve these skills.

1. List five words that you associate with role(s) of the Postgraduate Demonstrator?
2. List five responsibilities of the postgraduate demonstrator:
3. How do you motivate students to learn? Briefly, detail one example and why you think it is effective. Would a postgraduate demonstrator be able to replicate this approach?
4. How could you effectively mentor academically novice staff? What are the current benefits and barriers to this type of mentoring?

Appendix 10

Braun and Clarkes (2006) six-step approach to thematic data analysis entailed data familiarisation, initial code generation, initial theme identification, thematic review, theme definition and final reporting. An example of this approach is schematically outlined below.

Data familiarisation, transcription and immersion

Initial open coding of transcript

Grouping & initial theme identification

Thematic review

Theme definition & reporting

PGD Responsibilities
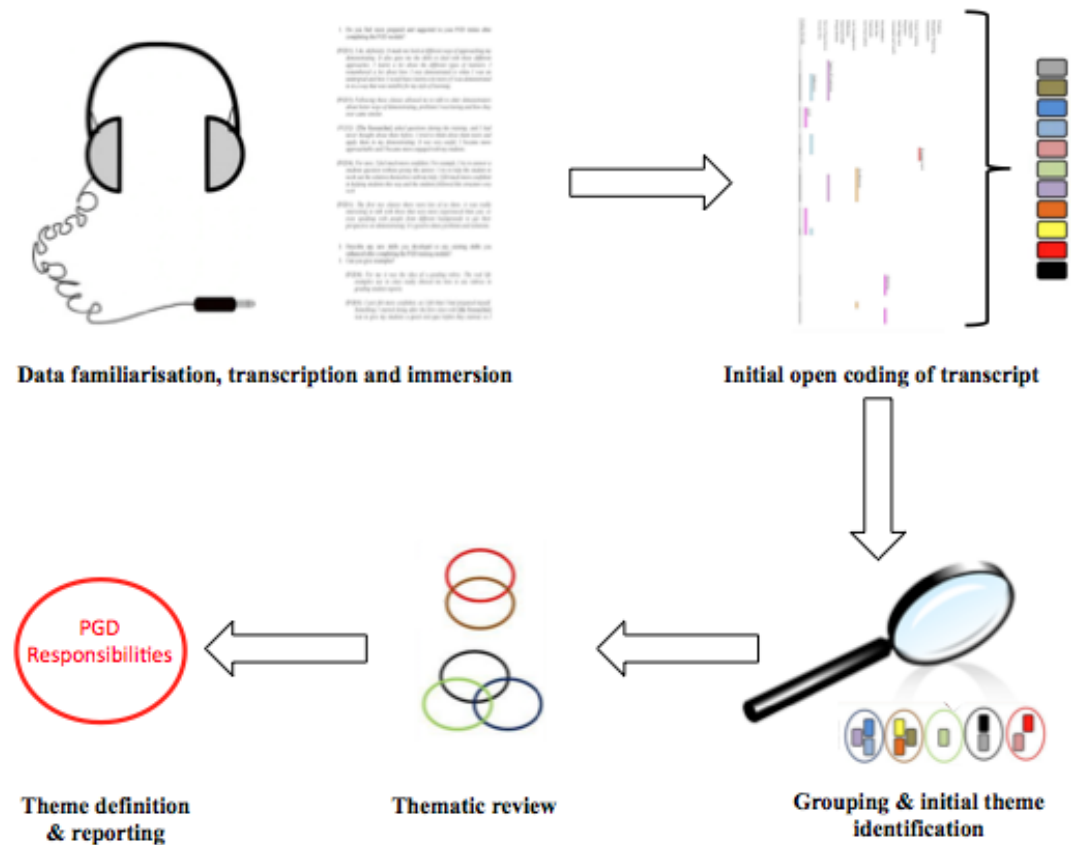
Example of 'Coding to Themes':

(PGD4): *I really enhanced my communication skills and helped me to connect with my students. I am also more structured and organised. I developed my own pedagogical ideas. It is useful to study the different pedagogical ideas.*

Initial coding: Communication, Approachable, Preparedness, Organisation, Teaching, Career Development, (Reflection).

Grouped: Skills and Pedagogy

Themed: Pedagogical skills development

Theme definition: Skills enhanced by undertaking PGD bespoke training.

Research Project Participants Information Sheet.

Contact Details: Dr. Barry Ryan (barry.ryan@dit.ie, 01-4024379)

Project Title.

An investigation of the role of the postgraduate demonstrator in undergraduate learning in the science lab.

Brief Overview of Project Aims and Deliverables.

The aim of this project is to maximise student learning in undergraduate labs by developing the postgraduate demonstrators skill in assessment and teaching strategies, devising and implementing appropriate and timely feedback processes, and integrating '*discovery learning*' into their skill-set. To comprehensively ascertain the outcomes of the project, the participants (and stakeholders) will be asked to voluntarily complete a short questionnaire, MCQ and/or discuss their opinions in a group forum sessions before and upon completion relevant semester(s). The project will run over the academic year 2014-2015.

Background.

During the initial postgraduate training sessions and undergraduate labs participants will be made aware that there will be new pedagogical training methodologies trialled over the course of the course and your feedback would be vital in improving the process for subsequent years. This information sheet relates to the collection of this feedback (data).

Data Collection Methodology.

Feedback will be collated by means of a short questionnaire and MCQ, based on standard questions commonly employed in teaching and learning feedback forms. Participation will take approximately 15 minutes.

Additional feedback will be collected by means of two informal, semi-structured group discussion forums. Participation will take approximately 1 hour per session.

Group discussions will be recorded as an MP3 file (via a microphone connected to a recording device). Recording of the discussion forum is to allow the researcher accurately reflect on the students comments after the discussion has ceased.

Data collated may be used in future publications in peer-reviewed journals; data will be anonymised during collection for subsequent publication.

Data Storage and Maintenance.

Electronic data collected will be stored on the researchers computer; which is password protected and located in a locked office.

Hard copy data collected will be stored in a locked filing cabinet, also located in a locked office. All forms of data will be securely maintained for ten years, in line with best practice for research records.

Information Outcome.

Any feedback provided during the research projects' data collection will in no way affect your standing with DIT, or elsewhere. Feedback will be collected during a non-teaching associated time.

Consent.

Completing the questionnaire is voluntary; completion (or non-completion) will not affect your standing within DIT.

Signing the consent form indicates that you are willing to participate in this data collection, subsequent analysis and potential dissemination.

You are encouraged to ask any questions you may have about the research.

You are free to withdraw at any time, i.e. during any part of the feedback collecting process. Again, this will not affect your standing within DIT.

CONSENT FORM

Researcher's Name: Barry Ryan	Title: Dr.

Faculty/School/Department: School of Food Science and Environmental Health.

Title of Study: An investigation of the role of the postgraduate demonstrator in undergraduate learning in the science lab.

To be completed by the volunteer participant. *(delete as necessary)*

1. Have you been fully informed/read the information sheet about this study? YES/NO

2. Have you had an opportunity to ask questions and discuss this study?   YES/NO

3. Have you received satisfactory answers to all your questions?   YES/NO

4. Have you received enough information about this study and any associated
   health and safety implications if applicable?   YES/NO

5. Do you understand that you are free to withdraw from this study?
   - at any time,
   - without giving a reason for withdrawing,
   - without affecting your future relationship with the Institute.   YES/NO

6. Do you agree to take part in this study the results of which are likely to be published?
   YES/NO

7. Have you been informed that this consent form shall be kept in the confidence of the
   researcher?   YES/NO

Signed_____   Date _____

Name in Block Letters   _____

Signature of Researcher _____   Date _____

Please note:

- The researcher concerned must sign the consent form after having explained the project to the subject and after having answered his/her questions about the project.

Appendix 12

Detailed breakdown of Bespoke Training Course.

Workshop One: 4 hrs (2 x 2hrs, pre semester 1: WB 08/09/2014, WK1).
Concept of a Teaching Portfolio: 15 mins
o   Non-assessed collection of practice based evidence.
o   Benefits [ACTIVITY]
o   Examples and Tools.

Intro to Learning Theories 45mins
o   Point of Learning Theories and Benefits
o   Overview of Common LT with examples (Concept Map) [ACTIVITY]
o   Learning Styles [ACTIVITY]
o   Review of:
o   Experiential Learning
o   Constructivism
o   Constructive Alignment (with LOs)
Reflective prompts.

Intro to Active Learning: 45mins
o   Literature Evidence and practitioners examples [ACTIVITY]
o   Case Study: Gagne's Nine Events of Instruction (7/9)
o   Examples of Active Learning [ACTIVITY]
Reflective prompts.

Intro to Group Work: 45mins
o   Why group work and practitioners examples [ACTIVITY]?
o   Aims of group based learning.
o   Methods for facilitating group-based learning [ACTIVITY]
Reflective prompts.

Intro to Facilitation: 30mins
o   Key facilitation skills [ACTIVITY]
o   How to answer a question without giving the answer!
o   Questioning to develop critical thinking [ACTIVITY].
Reflective prompts.

Intro to Lab based Learning: 1hr
o   Roles and responsibilities [ACTIVITY]
o   Aims of lab based learning.
o   Health and Safety and other pre-requisites [ACTIVITY]
o   Questioning (and facilitating) strategies in the lab [ACTIVITY]
o   Common concerns and problems in the lab
o   Community of Practice development?
Reflective prompts.

Workshop Two: 1.5 hrs (early semester 1: WB 29/09/2014, WK3).
Intro to student assessment (45mins)
o   Key principles of assessment [ACTIVITY]
o   Roles and responsibilities
o   Types of assessment
o   Authentic assessments and Constructive Alignment [ACTIVITY]
o   Assessment rubrics

Intro to student feedback (45mins)
o   Key principles of feedback [ACTIVITY]
o   Examples and methods for student feedback (e.g. Sandwich approach).
o   Dealing with plagiarism [ACTIVITY]

Reflective prompts.
    Review of Teaching

Workshop Three: 1 hr (mid semester 1: WB 20/10/2014, WK6).
Intro to co-supervising final year projects (FYP): 30 mins
o   Before, during and after FYP: Roles and responsibilities [ACTIVITY]
o   Research at undergraduate level [ACTIVITY]
o   Managing your research portfolio

Intro to student diversity and inclusiveness: 30mins
o   Roles and Responsibilities [ACTIVITY]
o   Student interactions: etiquette and best practice [ACTIVITY]
o   Intro to inclusive teaching and DIT support structures

Reflective prompts.
Review of Teaching

Workshop Four: 45 mins (end semester 1: WB 24/11/2014, WK11).
Feedback on Teaching and Continual Professional Development: 1hr
o   Reflective Practice review [ACTIVITY]
o   Self-, Staff- and student-evaluation
o   Models of Professional Development and the next step

'Completion of Training' Certificate presentation.

Appendix 13
Academic Interview Transcript

A partially transcribed, and fully coded, transcript from the semi-structured discussion forum involving academic staff, management and the technical support within the School hosting the intrinsic case study. Coding was carried out manually, influenced by Braun and Clarke's (2006) six-step approach to data analysis. *Nvivo* (V.10, QSR software) was used to visualise the codes aligned to the text and *SimpleMind* (V.1, ModelMaker Tools) was used to concept map the emergent themes.

Theme: RESPONSIBILITIES
What is the role of the PGD?
(L1)   "If we don't embed the role of the SPGD and the PGD clearly we are in trouble straight away"

(L1)   "I don't envisage postgrads being SPGD"

(L1)   *"The SPD has to be very competent; otherwise it will create more work for me [academic staff]"*

(L2)   *"There is a radical difference between what the SPD and the PGD do [in class, and based on the fact that the contracts are exactly the same]"*

(M1)   *"From a management point of view, in three of four years I would like to see a system in place, through the structured PhD programme, we are giving training in this whole area [pedagogy] and from a delivery of the content point of view, we have people that have been with us for a number of years that are appointed at the senior demonstrator capacity and they work with an academic to deliver the practical components and then they have a team of demonstrators beneath them"*

(L3): *"They [responsibilities] have to be consistent across all the years".*

Sub-theme: Academic Responsibilities
(L1):   *"The lab and the lab schedule as an academic set up so I know from week to week what labs are running so I can tie lectures in, so technicians and PGDs know what they are coming into....what we expect the learning outcomes for the lab to be, to that whoever is taking the lab will know that by the end of the lab the student should be able to do X, Y and Z. I think we [academics] need to feed into a marking scheme for the SPGD so they know what we expect".*
"I would take a selection of labs and spend 15-20mins in the lab, talking to students to ensure everything is ok".

(M1):   *"Its getting that academic oversight, but not needing an academic present for every lab for every minute, but to be able to dip in and dip out to ensure quality by a randomised selection process.".*

(L2):   *"Essentially it's down to the academic to produce a blueprint for the SPGD and that's what I want you [SPGD] to do".*

(M1):   *"This [blueprint] should be available at the start of the semester and they [academic and SPD] sit down and go through practical-by-practical exactly what you [academic] want done".*
(INT):   *This [blueprint] be available as a one-package lot at the start of the semester?*
All: *Yes.*

Sub theme: SPGD Responsibilities:
(L2):   *"The SPGD ensures that the desired activity takes place. They will organise and run the PGDs. They will train [technically] the demonstrators"*

(T1):   *"The academic would plan the [lab] schedule each week....but the key is to select SPD that the technicians will respect and engage with. How does the academic supervise the SPD?"*
(L2):   *"The role of the SPGD is not to demonstrate, but it is to supervise the PGDs"*

Sub theme: PGD Responsibilities:
(L3):   *"Before we define the roles, can we please get more of them!"*
"Undergrads are not getting the quality of training, because of the shortage of PGDs [1 PGD and 1 Academic/SPD per 32 students]".
PGDs have to get around to each student and to spend time with the students; this is especially important as students are learning techniques".
(L2):   *"One demonstrator per ten students is about right, one to sixteen is just too much, the demonstrators just can't handle it".*
(M1):   *"One of the difficulties here is the number of PhD students and people willing to act as PGDs; and this is also noted in the University sector as they are struggling to run labs at the moment for the same reason [falling PhD numbers]".*
(L3):   *A demonstrator should come away from a lab saying 'yeah, I really got through to that student today', not 'its just chaos, I can't get around to them all'.*
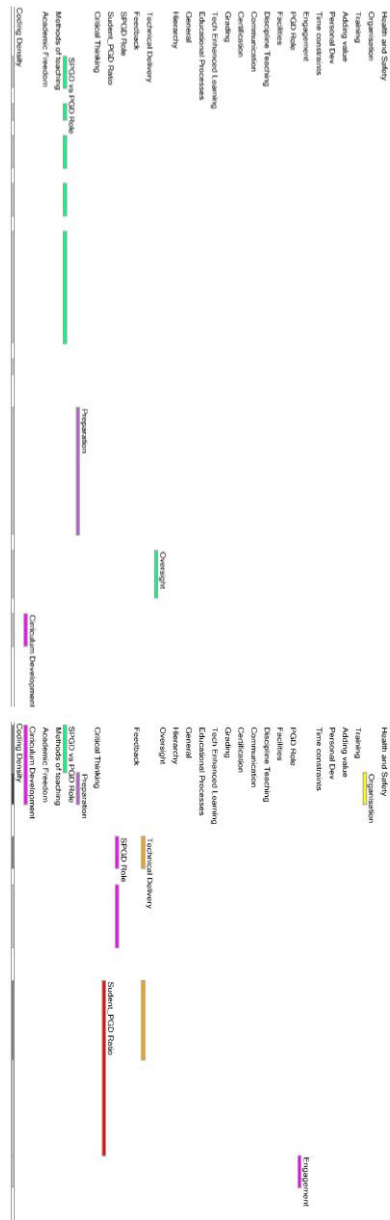
Theme: LEARNING

What is the essential knowledge of a PGD?
Why is this knowledge essential?
What are the important factors effecting UG learning?
What is the best method of scientific laboratory instruction?
How do you motivate students to learn?

(L1): "They need to have a good background in the subject that they are teaching, they need to have a qualification in the area".

(L4): "If it was seen over time that a PGD could get promoted to SPGD, that might act as a motivational approach to the model"

(L3): "One of the biggest influencers in UG learning is the lack of PGDs in the lab"

(L1): "Lack of equipment is another key influencer, as students work in groups then one or two will do all the work while the others do nothing...just because there isn't 'one for everyone in the audience'"

(M2): "One of the biggest issues is how to avoid the passenger in the group during lab work"

(M1): "Assessment is the main driver of what, and how, students learn; so if there is a piece of equipment that they [the UG] knows they will be assessed on individually, then they will make sure they know how to use that piece of equipment before the assessment."
"The learning outcome is key; if the learning outcome is clear and assessed correctly, then the student must learn how to use the piece of equipment".

(M2): Having an appropriate and exact manual is important too, so the students know exactly what they have to do.

(L4): The use of technology could also help here; show the students a video of the technique...or have QR codes of the side of an instrument where the students watch a video to remind them how to use the instrument just before they use it. But that raises the question, what is the best method of scientific instruction? Are we training monkeys at that stage? Or is there any level of critical thinking? Or is it just a matter of ticking boxes?"

(L1): That critical thinking could come from the ability to talk to an individual [the PGD] about the experiment, to be challenged on their experimental process, to ask them [the UGs] questions"

(L4): One idea might be the trial oral interviews at the end of a lab; they could be very quick, for example, 'tell me what you learnt today', but it will put a little pressure on the students to make sure that they develop a true understanding of the lab and actually engage."

(M1): This could be a role for the SPGD in the lab, if they are freed from 'demonstrating' then they could go around the lab and carry out this assessment activity'.
"Sometimes labs don't have to be heavy on the critical thinking, some labs are just about getting the correct techniques instilled in the UGs, particularly in first year labs"

(L1): "For critical thinking type labs you need the SPGD or the PGD to be more than just the health and safety person in the lab; and they need to be comfortable with this role".

(L1): "The scientific method of teaching is very personal to an academic and it varies amongst everyone here, and I don't think we can sit down and prescribe 'this is the template we want to use in DIT' because it doesn't fit".

(L2): "I agree, this would lead to a homogenous type of education...where in reality you [the UGs] should get a heterogeneous education, with variety of teaching styles".

(L1): "These different teaching styles would give students (UGs) different perspectives on how to approach a problem, which feeds into the idea of developing critical thinking skills in students"

(L1): I would expect the SPGD and the PGD to follow the resources that I give them; however, I would give them some freedom to deliver the content in their own way...as long as they are not re-inventing the material I prescribed, or the learning outcomes, and they give the students the correct information. I don't care how we get to the desired endpoint [UGs achieving their learning outcomes] as long as we get to it".

(M2): The SPGD and the PGD needs to be given some freedom to teach, as it could be enriching for the UGs to learn from experienced researchers skilled in the instrument, much more than me"

INT: *Should the SPGDs and PGDs have an input into curriculum development?*

(L1): The curriculum development is an academic role; however, how that curriculum is delivered, there is a little bit of freedom here for individuality. The Leaving Cert and the Junior Cert have a curriculum; but they are delivered a million different ways every day and they all sit the same exam".
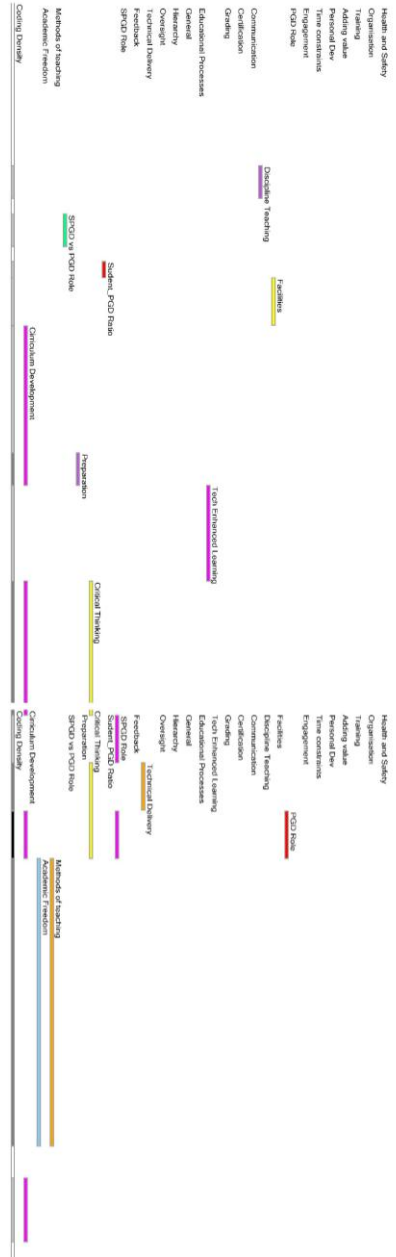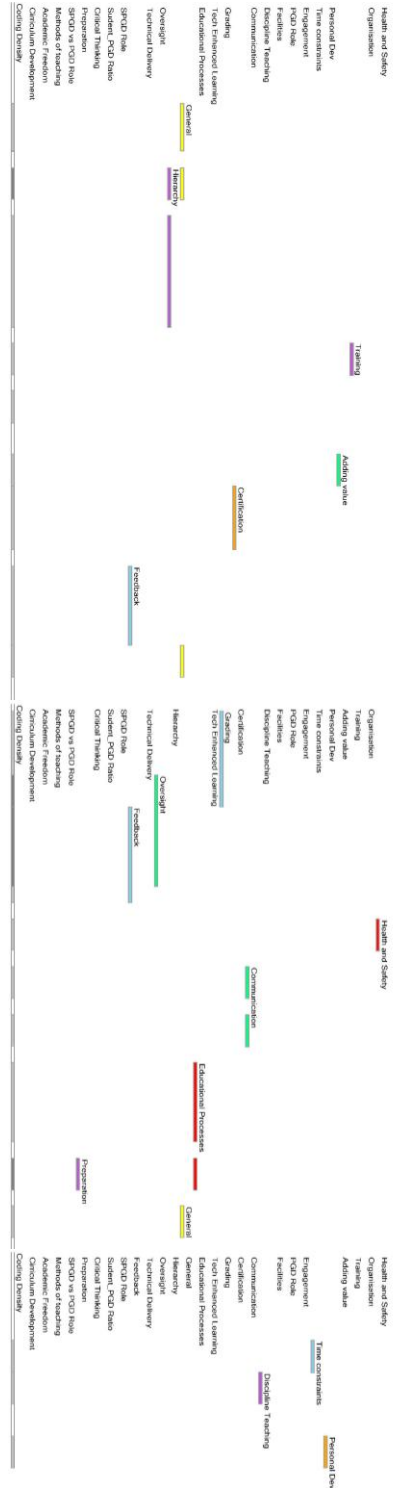
Theme: TRAINING

What areas should be covered in a PGD training programme (e.g. technical, pedagogical etc.). Can you give examples where this training would be most useful and when it should take place.
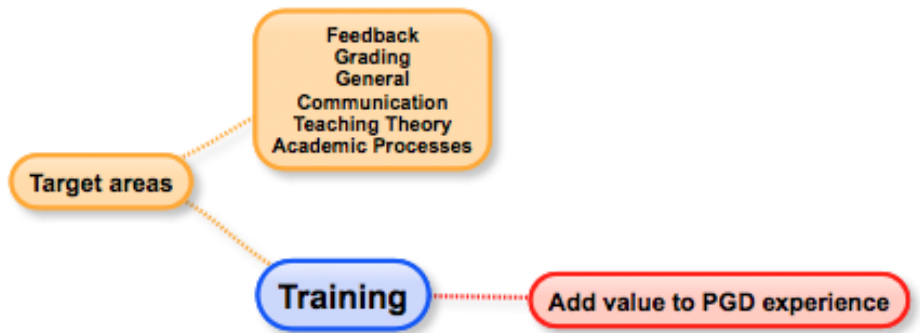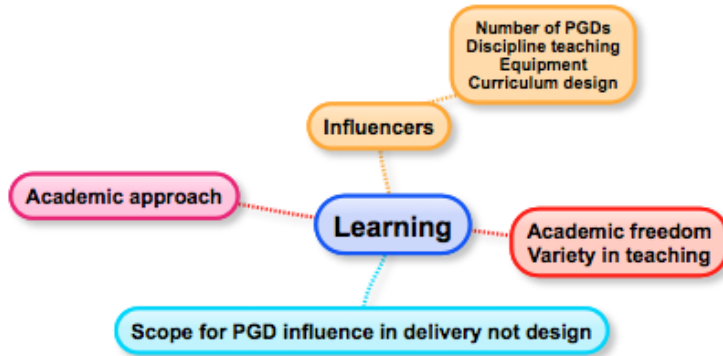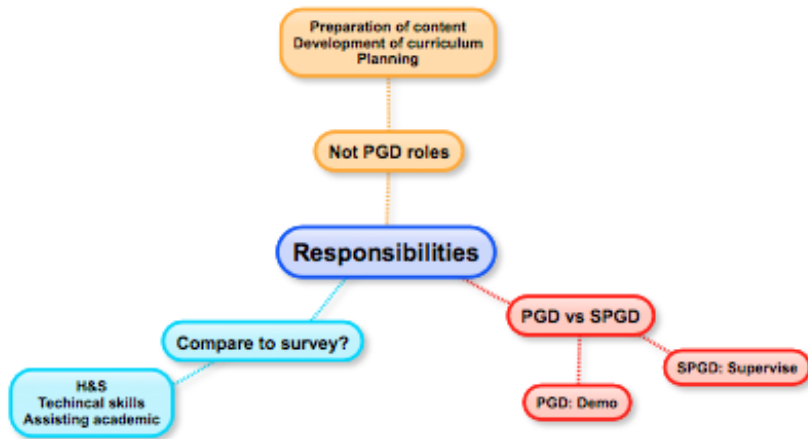
(M1): *"I think training is important regardless of if we [SoFSEH] follow a SPGD and PGD model or not. Training is something that will improve the experience no matter what structure we follow".*

(L1): *"Do we need to look at training our SPD first? Embed them in to the system and then train the PGD".*

(M1): *"Training will focus on the day-to-day teaching activities; however, the senior demonstrators responsibility is something that the academic with responsibility for that module will identify as they go through the practicals; for example 'these are the practicals that are being delivered, this is what must be covered in these' and you [the academic] has academic oversight as you have had this conversation with the SPGD and the SPGD can then enter the lab and instruct the PGD".*

(T1): *"It's about selecting good SPDs; if you select good demonstrators there will be little training required".*

(M1): *"Perhaps it would be good to review the PGDs and SPDs performance after six weeks."*

(L1): *"It would probably be better for supervising academics to contact their SPD on a weekly basis, particularly in this first year of the pilot".*

(L2): *"Demonstrators will stay with us [SoFSEH] if they feel valued and fell like they are getting a proper training".*

(M1): *"As part of the structured PhD, we can embed their [the PGDs] demonstrating as an assessable component; there is something developing here that if we grasp it and mould it now, we will have a much better model [PGD model] at the end than we have now".*

(L1): *"One of the key aspects is the inclusion of feedback in this model. As it stands, you [the academic] has turned into a pseudo-demonstrator due to the low numbers of PGDs. This has an effect on feedback to the UGs".*

(M2): *"You could train the SPGD in how to provide conventional feedback and this could relive some of the pressures".*

(L2): *"Most demonstrators are 'good'; it's just that they weren't trained. They don't know what they are at!"*

(L1): *A big issue is the continuity of marking; there is a big discrepancy between on [PGD] marker and the next, even if you give them the same marking sheet".*

(L4): *"The lecturer will surely have to oversee the marking and provide guidance to the PGD".*

(M2): *At the end of the day, you [the academic] is the internal examiner, you need to ensure the standard of the marking"*

(L1): *"The SPGD, or the PGD, is going to have to do a lot of the feedback to the students, because they are the ones marking. It makes more sense for them to give the feedback. It could mean a weekly sit down to review that range with the supervising academic, but that could work as a quality control/assurance mechanism".*

(T1): *Are the PGDs prepared to give this feedback? When will they give it?*

(L5): *"Some level of knowledge of the health and safety of a lab; accident report forms".*

(L1): *"Communication skills and scientific communication skills, for example, talking to a group, talk in a way that is accessible to a student".*

(L5): *"How to deal with troublesome students, and things such as students coming in smelling of alcohol".*

(M2): *Some basic grounding in the educational processes; because they will have never heard about learning outcomes, for example, they might not know about the technical aspects of assessment or feedback. They need to be clear on their duties and roles and know the academic hierarchy and also the process...why do we assess.*

(L4): *"The PGD should have access to the modules Webcourses and be aware of standardised methods to make sure everyone is using the same approach".*

(M2): *"The training should cover the basics...so the PGDs can understand the academic processes".*

Theme: PERSONAL DEVELOPMENT

Do you mentor academically novice staff? If so, what tasks do you do? If not, why not?

(L1): *"There are career differences in terms of staff that monitor the [DCU] system; we [DIT academic] won't be back to the level of 6 hours teaching a week".*
"Their PGDs [DCU] come from their degrees and know exactly what is going on in the labs"
"There is the potential to create more work if this is not done correctly".

(M1): *"This is a step towards building a structure that is more sustainable for freeing up academic time to prioritise into research and other activities."*

Responsibilities

- Preparation of content
  Development of curriculum
  Planning
  - Not PGD roles
- Compare to survey?
  - H&S
    Techincal skills
    Assisting academic
- PGD vs SPGD
  - PGD: Demo
  - SPGD: Supervise

Learning

- Influencers
  - Number of PGDs
    Discipline teaching
    Equipment
    Curriculum design
- Academic approach
- Academic freedom
  Variety in teaching
- Scope for PGD influence in delivery not design

Training

- Target areas
  - Feedback
    Grading
    General
    Communication
    Teaching Theory
    Academic Processes
- Add value to PGD experience

Personal Dev.

- Barriers
  - Time constraints
    Workload
- Positives
  - System Development

An online survey completed anonymously by academics within the School of Food Science and Environmental Health provided examples of PGD responsibility in undergraduate teaching labs. The responding academics (n=5) provided twenty-four examples of PGD responsibility and these were coded under five emergent themes as outlined below.

Coded Name	Example of Responsibility	Coded Theme
1	Insure student safety	Safety
1	Relate correct lab procedures	Procedural
1	Enage with students	Engage
1	Correct assessments/asignments	Grading
1	Motivate students	Engage
2	Assist me in running the lab	Procedural
2	Ensure safe operation of equipment and chemicals	Safety
2	Provide oral feedback to students	Feedback
2	Help explain experiment to students	Procedural
2	Help students with results management	Grading
3	Teaching/ Educate	Procedural
3	Enhance students lab skills	Procedural
3	Describe underlying principles	Procedural
3	Assess students ability	Grading
3	Assist in data processing and interpretation	Procedural
4	Safety management	Safety
4	Good technique	Procedural
4	Advice	Procedural
4	Instruction	Procedural
4	Assistance to staff	Procedural
5	Ensure H&S	Safety
5	Ensure Lab rules adhered to	Safety
5	Guidance on practical element	Procedural
5	Assistance in process including calculation	Procedural
5	Instruments etc demonstartion correct method	Procedural

Appendix 15

An online survey completed anonymously by academics within the School of Food Science and Environmental Health provided adjectives to describe the PGD responsibilities in undergraduate teaching labs. The responding academics (n=5) provided twenty-four adjectives of PGD responsibility and these were coded under six emergent themes as outlined below.

Coded Name	Adjective	Coded Theme
1	Enthusiasim	Engagement
1	Professionalism	Engagement
1	Clarity	Communication
1	Ability	Technical
1	Communication	Communication
2	Safety	Safety
2	Demonstrate	Technical
2	Observe	Engagement
2	Assess	Pedagogical
2	Oral Feedback	Pedagogical
3	Assistant	Technical
3	Crowd control	Communication
3	Vary in ability	Technical
3	Vary in interest	Engagement
3	Extra pair of hands	Technical
4	Instruction	Technical
4	Technique	Technical
4	Answering questions	Knowledge
4	Calculations	Knowledge
5	Safety	Safety
5	Support	Technical
5	Guidance	Technical
5	Correction	Pedagogical
5	Demonstration	Technical

Appendix 16

A partially transcribed, and fully coded, transcript from the semi-structured discussion forum involving PGDs (n=18) from within the School hosting the intrinsic case study before the introduction of the training course. Coding was carried out manually, influenced by Braun and Clarke's (2006) six-step approach to data analysis. *Nvivo* (V.10, QSR software) was used to visualise the codes aligned to the text and *SimpleMind* (V.1, ModelMaker Tools) was used to concept map the emergent themes.

Room 14a, Cathal Brugha St, 13th June 2014.
Notes and Participants (18 PGDs).

Theme: RESPONSIBILITIES
What is the role of the PGD?

(PGD1): *"Assist the lecturer on the technical parts of the lab"*

(PGD2): *"The lecturer in charge of the practical shows you [the PGD] what to do, I we [the PGD] show the students. This could take place five minutes before the lab, or the day before, or the week before…it depends on the lecturer. Unfortunately, some of the time we [the PGDs] are not sure what we are supposed to do as the lecturer hasn't provided the manual or any indication what we [the PGD and the UGs] will be doing in the lab"*

(PGD2): *"It is our [PGD] responsibility to come to the lab prepared; however, most of the time we do not have the manual before the lab to read! If you have some experience [of the lab] you can get by, but if you don't you look like an ejit"*

(PGD3): *"If someone approached me after the lab I would give of my time to them to help them. And this has happened to me. It's just easier to do it then, than the following week when the student is even more lost".*

(PGD4): *I did my UG in [another IT in Dublin] and the PGDs used to speak to us at the end of lab about next weeks lab and we would be ready then to prepare, like, read the manual, ahead of the next lab. We had small tasks to do and the PGDs would check that we had them done before the start of the next lab. The labs used to be three hours, and the last half hour was given over to this".*

(PGD4): *"If I had the manual, I [as a PGD] would prepare for the lab on the day, but also prepare the following lab. I could then prepare the [UG] students in the way I used to be prepared by the PGDs who demonstrated to me. However, most of the time I don't have the manual!"*

(PGD4): *"Asking the [UG] students to do something in the week between labs, and having the PGDs check it before the lab would mean that the [UG] students would actually do something and be more prepared for the lab. I've seen it work, and it would mean the lab would run easier also, so I [as a PGD] would have no problem doing this in a lab. The only issue would be time, as the labs here [DIT Cathal Brugha St] are only 2 hours and we had 3 hours in [another IT in Dublin].*

(PGD5): *"Sometimes PGDs have to demonstrate two or three practicals in the same day and if you expect PGDs to prepare fully, more time is needed"*

Theme: LEARNING
Teaching and Demonstrating; is there a difference or are they same?

(PGD2): *"Demonstrating is more to show students how to carry out a technique correctly and not necessarily the theory, this is the lecturers job. We need to be clear what we [the PGDs] can do in the lab. We have limited time, so we need to focus on what is important in the lab; the skills and techniques".*

(PGD11): *"Demonstrating is practical, whereas teaching is theoretical"*

(PGD9): *"I think that there is an overlap, students will ask you questions on the theory and also the practice…you need to be ready for both I like to link the theory to the practice. I do feel pressure to be able to do this…to understand both the theory and also the lab technique".*

What is the essential knowledge of a PGD?

(PGD1): *"Sometimes PGDs are asked to demonstrate in areas [of science] that are not their area of expertise. They will not be able to provide demonstrating, as this is not their area. It is not the PGDs fault, they just try their best. It is the [UG] student who suffers".*

(PGD6): *"I'm a biologist but I demonstrate chemistry! It's ok as it's only first year chemistry, but I would feel more comfortable demonstrating in my own area. For example, the [UG] students would ask me a question and I wouldn't know the answer or where they hadn't covered the theory in lectures and I was expected to fill in the gap".*

What are the important factors effecting UG learning?

(PGD6): *"In the last semester; the labs and lectures were not aligned at all. This meant that the students were lost, they didn't know why they were doing certain experiments, they hadn't got the theory yet and they couldn't see the reason behind the experiment".*

(PGD6): *I would like to see what the students are covering in lectures so I can try and knit the lab together with what they are doing in class…but they [UGs] didn't have the lab manual ahead of the lab and I didn't have access to their notes…of course we [PGDs and UGs] wouldn't be prepared!"*

(PGD3): *"It effects out ability also, if we walk into a lab underprepared, then we don't enjoy the lab, the [UG] students don't enjoy the lab"*

(PDG7): *"Maybe it depends on the lecturer, last semester I got access to the manual and Webcourses and it worked out fine"*
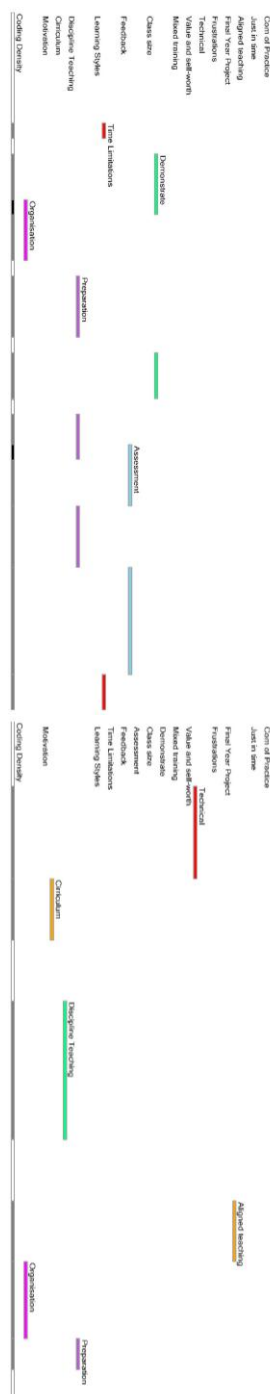
(PGD3): *I demonstrate in [another campus within the College of Science DIT] and all labs are three hours. It just means that things aren't as rushed and we have time to suit with the [UG] students and we can help them then."*

(PGD2): *"The layout of the lab is not great sometimes. The 'backbenchers' tend to be the disruptive students and they are generally furthest away from the lecturer. We [PGDs] are often left to deal with these students. This can be a noisy, cluttered part of the lab [fumehoods are located here and final year project students work in this area of the lab also]".*

(PGD2): *In other colleges there are six or seven students per demonstrator. Here [in DIT], we [the PGDs] are faced with 36 students, or more, with only one demonstrator and the lecturer. It's not fair and it doesn't work.*

(PGD2): *"It breaks my heart; a student can't streak a plate correctly by the end of first year or third year students that cannot use a microscope correctly. They are graduating without being able to do the basic skills correctly because we [the PGDs and academic staff] cannot give them the time they need to get the skills".*

(PGD8): *"I have noticed that in the last five years, the number of students have increased dramatically, however we [PGDs] have not".*

(PGD9): *"I think the best ratio of PGDs to UGs would be 1:8, which would mean one demonstrator per bench. In Microbiology, you need to be hands on to show the students the different methodologies correctly".*

(PGD10): *"Sometimes students are asked to work in groups and you'll have maybe five students in a group doing an experiment that has been originally designed for two people. Then you will have three students doing nothing, getting bored and not really learning. The experiments need to be designed so that everyone will learn, there are enough pieces of equipment and space so everyone will get something out of it."*

What is the best method of scientific laboratory instruction?

(PGD12): *"Get all the students to do it! Get their hands dirty! Ideally each student do each part of the lab. Sometimes when they are working in twos or groups they don't all get the same experience".*

(PGD9): *"Show them and then get them to do it. If you show me something I will forget how to do it tomorrow, but if I learn how to do it, then do it, then I will remember for a lot longer".*

(PGD7): *"Everything is on Youtube; no matter what you Google you will find a video on it. The students could use this to see what the technique is before they come to the lab".*

(PGD4): *"I find that you could watch a video online and think 'ah, that's easy'; and then struggle in the lab...or the video on YouTube isn't quite right or sometimes the incorrect technique is shown. The [UG] students need to be guided towards the better YouTube videos, especially first year students".*

(PGD4): *"I tend to learn skills better when I watch someone do it correctly, then I do it supervised and repeat it til I get it perfect. Perhaps stations of experiments rather than all students doing the same experiment would mean that we [PGD] would become experts are demonstrating our station as we would be doing it each week, rather than trying to adapt to each task each week. The students would get more hands on experience this way also".*

How do you motivate students to learn?

(PGD3): *"Demonstrators need to be approachable, you are not the lecturer, so you tend to get asked more questions that the students won't ask the lecturer".*

(PGD7): *"You have to be very clear how you explain things to the students as well. You want to be on the same sheet as the lecturers so you don't confuse the students even more! A standard way of delivering things".*

(PGD8): *"Be clear what you expect each student to be able to do by time the lab is finished. Perhaps have some sort of mini oral exam at the end of each lab to ensure the students have achieved these skills. I [as a PGD] would be happy to do this as long I have a manual, something to guide my marking and some assistance in this area".*

(PGD2): *"Some students are shy, afraid to ask for help, so I go them and ask them are they ok. I try to be proactive in the lab".*

(PGD7): *"You have to go talk to the students as they won't come to you!"*

(PGD6): *"Sometimes even when you do go to the students they will say 'yeah, we're fine', but you know they are not. Sometimes they come back to you later and ask for help, sometimes not. I struggle to get the students to open up when I approach them; how to break down the barrier".*

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Theme: TRAINING

What areas should be covered in a PGD training programme (e.g. technical, pedagogical etc.). Can you give examples where this training would be most useful and when it should take place.

(PGD2): *"I think that it is great that we* [the PGDs] *are being offered some training. Any kind of support would be great cos at the moment we don't get any really".*

(PGD6): *"I think it would be good to have a mixture of training (technical and pedagogical). For example, if there is a standardised method then we need to know what it is before we demonstrate. The amount of third year students that cannot put on a pipette correctly is beyond me!"*

(PGD7): *"I think it would be a good idea to have an overview session at the start of the semester, and then as we need things we can have sessions on them during the semester"*

(PGD4): *"I've never assessed, or given feedback to a student, so I would like some assistance with this. Maybe not straight away, but when I need it"*

(PGD1): *"I think that we* [the PGDs] *should have some input into the content and when it* [the training] *takes place. I know I would like some suggestions on how to deal with final year project students, but they don't come into my lab until a few weeks into the semester".*

(PGD5): *"I'm not sure what training I need, as I don't know what I will be demonstrating yet. Perhaps some general information on how to demonstrate better".*

(PDG6): We could only find out the day before the lab what labs we are demonstrating, so specific technical training mightn't suit [this training programme].

(PGD2): *"I mark student reports; I'm happy with that as I have the grade sheet...but I wouldn't be confident in giving feedback to students".*

Theme: PERSONAL DEVELOPMENT

(PGD3): *"Demonstrating is like a PhD really, you have to learn new skills and put them into practice".*

Do you get feedback on your demonstrating from the lecturer or the UG students?

(PGD6): *"If it means that we* [the PGDs] *could improve then I would like to get feedback from the* [UG] *students and the lecturer, however, I don't get any at the moment".*

(PGD2): *"At the moment we get no feedback, so any feedback would be welcome!"*

(PGD6): *"Feedback works both ways. We* [the PGD] *could provide feedback on how the lab is working in real life and if there is something that can be done to improve the lab for next time. The lecturers need to be willing to take these comments on board also".*

Do you have a chance to influence the curriculum:

(PGD3): *"I think every lab module should be reviewed each year with the PGDs that demonstrate it, the academic and even the technical staff. I know that I developed resources for my students that I demonstrated to because I found the manual difficult to understand and these resources helped the students. These could then go into the next revision of the lab manual".*

(INT): Would you like to have more input into the development and creation of labs (or resources)...to have your say in alternative approaches to achieve a learning outcome, for example to be able to gram stain?
All: Yes.
(PGD6): It comes back to demonstrating labs that you are comfortable doing. You are then more likely to feel comfortable with the content and willing to contribute".

(PGD5): *"I have had to adapt the lab when, for example, a chemical is not available in the lab. I enjoyed this as I had to think about the reaction and problem solve...this is what I do each day in my research lab and it was good to be able to bring these skills to the teaching lab".*
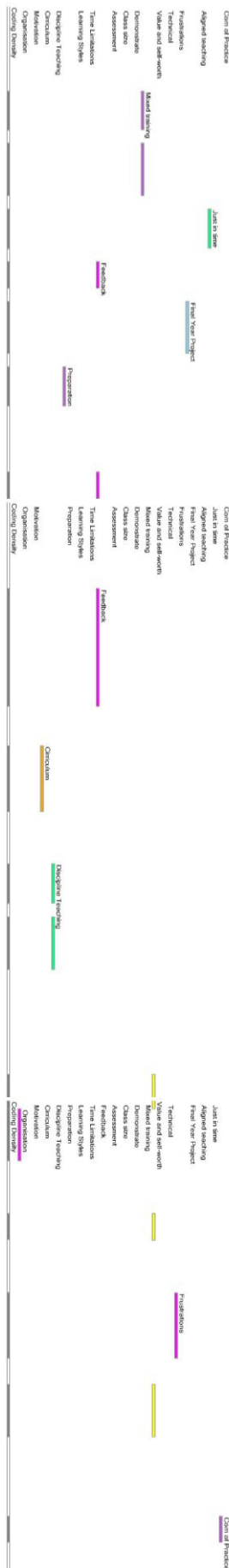
Are you given autonomy in the teaching lab?

(All): Sometimes.

(Int): Would you like more?

(PGD8): *"Provided the manual is there and we have received sufficient training in teaching, the outcomes of the lab and safety"*

(PGD6): *"If we were supported the correct way, then I think I would enjoy it.*

(PGD2): Sometimes the lecturer is sick and we have to take on the role of lead in the lab; however, this raise concerns about insurance etc. Are we [the PGDs] taking responsibility for the students if something happens?"

(PGD3): We do have autonomy at each bench we demonstrate at. We demonstrate, or teach, in a way that we fell comfortable. Maybe it's not the best way, but it's a way the works for me".

(PGD7): *"If you have more ownership over a module or a lab, then you tend to enjoy it more".*

Do you feel stimulated in you teaching labs?

(PGD2): *"I feel frustrated!"*

(PG10): *"I feel frustrated with the system and the* [lack of] *organisation and the poor communication from management and lecturers".*

(PGD3): *"Poor communication* [in general] *really frustrates me, it's really a big thing. I would prefer to be copied on all emails than not, I don't see it as a burden"*

(PGD5): *"I feel motivated as the UG students have great energy and it lifts me!"*

(PGD3): *"If you think that teaching might be a career, then this is a valuable experience, but I don't feel I am getting the most out of the labs, and the labs aren't getting the most out of me".*

Do you feel like you are part of the teaching community?

(PGD3): *"Depending on the lecturer, but I would have no problem sitting with the lecturer of the lab I was demonstrating for a casual coffee in* [the staff coffee room]".

(INT): *"Do you discuss, with your PGD colleagues, experiences from the teaching labs: (All): Yes, too often!*

Responsibilities

- Demo not in discipline
- Technical Demo Assist UGs
- Preparation
  - Under prep = frustration
- Time Limits
  - Research vs Demo
- Assess?
  - Support?
  - Discipline?

Learning

- Discipline Teaching
- Technical skils Link theory to practice
- Key influences
  - Alignment* Availability Preparedness Time Organisation*
- Motivation
  - Approachabilty Communication Proactive Contextualisation
- Physical
  - Space
  - Environment
- Lab Learning Theory
  - Kinaesthetic Behaviour Mix (K/B) Cognitive Loading
- Ratio UG:PGD

Training

- Areas to Develop
  - Feedback FYP demo Overview Tech/Ped Mix

Personal Dev.

- Feedback Willing to engage
- Utilising Skill Set
  - Discipline Teaching
- Frustrations
  - Undervalued Underutilised Disorganised Communication
- Autonomy
  - Enablers
    - Micro teaching Enjoyment
  - Barriers
    - Red tape Skill shortage Support

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Appendix 17

An online survey completed anonymously by PGDs within the School of Food Science and Environmental Health provided examples of PGD responsibility in undergraduate teaching labs. The responding PGDs (n=10) provided forty-three examples of PGD responsibility and these were coded under five emergent themes as outlined below.

Coded Name	Example of Responsibility	Coded Theme
1	Be familiar with the equipment	Procedural
1	Be familiar with the lab outcomes	Pedagogical
1	Communicate with the students	Engage
1	Ensure lab is completed in a timely fashion	Procedural
1	Ensure H+S procedures	Safety
2	Health and Safety	Safety
2	Provide tutorial in accordance with the instructions provided	Procedural
2	Supervise students	Procedural
2	Provide support in carrying out assessments and practicals	Grading
2	Assist students to understand the principles of practical work	Procedural
3	Identify potential risks	Safety
3	Identify students which may need help	Engage
3	Assist lecturer if needed	Procedural
3	Ensure students understands theory behind experiment	Pedagogical
3	Encourage students in Science	Engage
4	Be prepared (read over lab manual before)	Procedural
4	Ensure safety regulations are being followed	Safety
4	Assist lecturer when required	Procedural
4	Ensure all materials are in place for lab	Procedural
4	Monitor students	Safety
5	Training	Procedural
5	Supporting student practical labs	Procedural
5	Health and Safety	Safety
5	Lab procedure	Procedural
5	Emergency procedures	Safety
6	Reaserching	Pedagogical
6	Supervising undergraduate students	Procedural
6	Learning	Pedagogical
6	Teaching	Pedagogical
6	Developing projects	Pedagogical
7	Help the students	Procedural
7	Commitment to the students	Engage
7	Lab safety	Safety
7	Motivate the students	Engage

Coded Name	Example of Responsibility	Coded Theme
7	Make all students participate	Engage
8	Ensure students safety in lab	Safety
8	Solve problems associated with experiments from students	Procedural
8	Demonstrate correct experimental technique	Procedural
8	Invigilate post-lab cleaning	Procedural
8	Help lecturer to prepare the class	Procedural
9	Make sure health and safety is followed	Safety
9	Assist lecturer	Procedural
9	Help students	Procedural
9	Demonstrate practical work	Procedural
9	Help students understand the lab	Pedagogical
10	Preparation	Procedural
10	Safety	Safety
10	Guidance	Safety
10	Interaction	Engage
10	Planning	Pedagogical

Appendix 18

An online survey completed anonymously by PGDs within the School of Food Science and Environmental Health provided adjectives to describe the PGD responsibilities in undergraduate teaching labs. The responding PGDs (n=10) provided forty-three adjectives of PGD responsibility and these were coded under six emergent themes as outlined below.

Coded Name	Example of Responsibility	Coded Theme	Coded Name	Example of Responsibility	Coded Theme
1	Assistant	Technical	6	Teaching	Pedagogical
1	Helper	Technical	6	Learning	Pedagogical
1	Demonstrator	Technical	6	Trying	Engagement
1	Facilitor	Pedagogical	6	Assessing	Pedagogical
1	Teacher	Pedagogical	6	Improving	Engagement
2	Health	Safety	7	Assistance	Engagement
2	Safety	Safety	7	Teaching	Pedagogical
2	Assistance	Technical	7	Learning	Pedagogical
2	Teaching	Pedagogical	7	Confidence	Engagement
2	Supervise	Pedagogical	7	Communication	Communication
3	Confidence	Engagement	8	Assistance	Technical
3	Assistance	Technical	8	Helpful	Engagement
3	Subject Knowledge	Knowledge	8	Problem solver	Pedagogical
3	Attention	Engagement	8	timetable	Logistical
3	Active	Pedagogical	8	Manual	Logistical
4	Assistance	Technical	9	Help	Technical
4	Demonstrate	Technical	9	Teach	Pedagogical
4	Safety	Safety	9	Listen	Communication
4	Monitor	Engagement	9	Demostrate	Technical
4	Learning	Pedagogical	9	Assist	Technical
5	Teaching	Pedagogical	10	Patience	Engagement
5	Supporting	Communication	10	Environment	Logistical
5	Training	Technical	10	Students	Pedagogical
5	Supervisor	Pedagogical	10	Material	Technical
5	Motivation	Engagement			

Appendix 19

After the completion of the PGD training course and a semesters teaching; academic, management and technical staff (n=16) were asked to provide feedback, via email, on their experience with PGDs who participated in the training course. The respondents (n=2) provided written descriptions of their experience of the PGD in their teaching lab under the headings noted as 1, 2, 3 and 4 below.

Hi XXX,
I am currently investigating the role of the postgraduate demonstrator in undergraduate science lab learning as part of an MA in Higher Education. As part of my research some demonstrators volunteered to take part in a bespoke training course I designed during Semester One of the current Academic Year. This course was designed based on a needs-analysis carried out within the School of Food Science and Environmental Health.

As the Semester is coming to a close, I would like to evaluate the effects of this training course, both from an academic and demonstrator viewpoint. I would appreciate it if you could spend a few minutes answering the questions (1-4) listed below based on the postgraduate demonstrators that worked with you and took some/all of the training course.

I would also appreciate it if you could complete the attached consent form to allow me to use your responses as part of my MA thesis (and potential publications). The attached information sheet outlines all the ethical considerations in place for this study and confirms to best practice within the Institute.

Theme: Pedagogical skills development
1. *Did you notice any changes in pedagogy in your postgraduate demonstrators?*
2. *If so, describe these changes and were they positive/negative?*
3. *What PGD skills do you still think require enhancement in the PGDs that you have worked with?*
4. *Do you think these skills be improved through training?*

Many thanks for your time on this and if you are interested in the findings of this study, please let me know and I will keep you updated.

Best regards,
Barry

Appendix 20

Screen shots taken from the online community of practice page developed during the study.

Appendix 21

A partially transcribed, and fully coded, transcript from the semi-structured discussion forum involving PGDs (n=4) from within the School hosting the intrinsic case study after the completion of the training course. Coding was carried out manually, influenced by Braun and Clarke's (2006) six-step approach to data analysis. *Nvivo* (V.10, QSR software) was used to visualise the codes aligned to the text and *SimpleMind* (V.1, ModelMaker Tools) was used to concept map the emergent themes.

11th Dec 2014
Room 5 Sackville Place.
Postgraduate Demonstrator Evaluation Forum.
Facilitator: Dr. Christine O'Connor.
4 PGDS in Attendance

Theme: Bespoke training module

1. Did the training module meet your expectations?

    (PGD1): *Exceeded them, was more complex than I thought it would be... in a good way.*

    (PGD3): *It gave a good introduction to how to start demonstrating and what are the problems faced by demonstrators and we worked on how we could improve it.*

    (PGD2): *For me, as an experienced demonstrator, it gave me a different perspective on area I had never thought of. Scenarios I had come across, but different approaches to them.*

2. What areas exceeded your expectations?

    (PGD1): *From my experience as an undergrad, the role of the demonstrator seemed to be health and safety or helping me find the chemicals I needed for example. When I first started the class [training workshop] I felt scared and a bit overwhelmed as I didn't have a clue about things such as 'how would I deal with running a lab or assessing assignments'... but the class brought me through these, and other areas, in a good way.*

    (PGD3): *It gave me ways to connect with students; how to start off demonstrating something.*

    (PGD2): *It highlighted to my role in the lab wasn't just health and safety, but I could be more approachable to both the academic and the students. I tried to be more like this in labs after the class [training workshop].*

3. What areas did not reach your expectations?

    (PGD1): *None, I think it was really comprehensive, for me anyway.*
    (PGD2): *The four sessions covered a lot more than what I was expecting, so it was good. How you could implement this with the lecturer [running the lab] would also be important in the future. This needs*

    a change in lecturers' attitudes to PGD also, as some lecturers are very open to change; however, some are not. Aside from this, it is important the demonstrators demonstrate in areas that they are familiar with... in this way they could add to the lecturer in the lab.

4. What influenced your engagement with the PGD training?

    (PGD1): *I just thought that it was a great idea. I was nervous about starting off demonstrating, this was great...I was starting off from zero and an needed to learn how to do it right...this really helped me with that.*

    (PGD3) *Me too, I didn't know how to start demonstrating and this was really a help to get me going.*

    (PGD2): *I really got a lot from the first session that I could apply straight away. This encouraged me to come back and every class I tried to improve my demonstrating using the things we covered in class [training workshop]. I could see myself in more of a academic role in the future now.*

    (PGD4): *I wanted to improve my teaching skills and I also wanted to meet my demonstrating colleagues.*

5. Should time be allocated to allow attendance/engagement?

    All: Yes.
    (PGD1): You have to do the manual handling courses and first aid, so this should be included there. At first you may say 'I'm too busy', but in reality it is really worth doing it. I don't think any PGD would object to doing 4 sessions over three months.

6. Should it be paid or unpaid?

    (PGD1): I wouldn't expect to be paid.
    (PGD2): I wasn't expecting to get paid for attending this training; I am developing myself. I would like to further investigate certification in this area. Perhaps, if no payment is available, then some sort of certification should be awarded upon completion.
    (PGD2): It depends really on the interest of the PGDs if they attend or not.

    (PGD4): Without payment, actually we should pay to attend as we are the ones that are gaining so much from it. We should pay for this privilege!
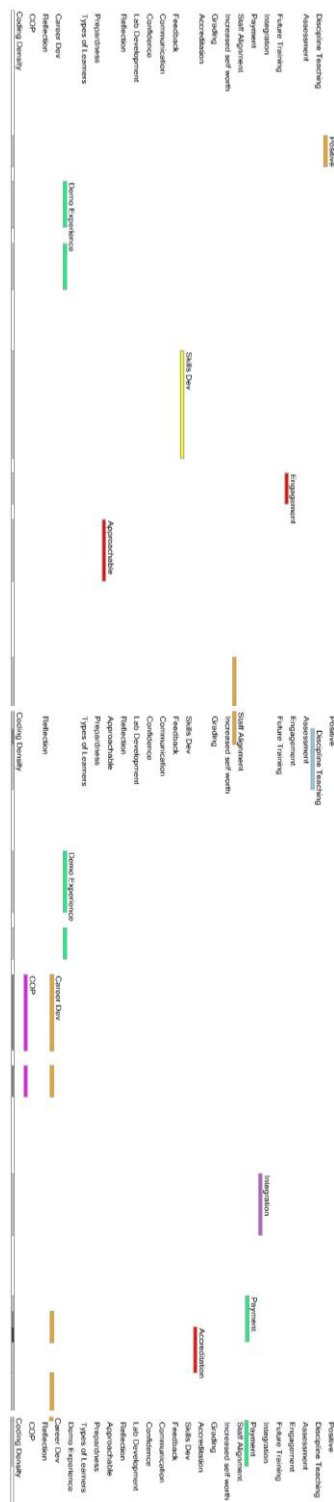
Theme: Pedagogical skills development

1. Do you feel more prepared and supported in your PGD duties after completing the PGD module?

(PGD1): *I do, definitely. It made me look at different ways of approaching my demonstrating. It also gave me the skills to deal with these different approaches. I learnt a lot about the different types of learners. I remembered a lot about how I was demonstrated to when I was an undergrad and how I would have learnt a lot more if I was demonstrated to in a way that was suitable for my style of learning.*

(PGD3): *Following these classes allowed me to talk to other demonstrators about better ways of demonstrating, problems I was having and how they over came similar.*

(PGD2): [The Researcher] *asked questions during the training, and I had never thought about them before. I tried to think about them more and apply them in my demonstrating. It was very useful, I became more approachable and I became more engaged with my students.*

(PGD4): *For sure; I feel much more confident. For example, I try to answer a students question without giving the answer. I try to help the student to work out the solution themselves with my help. I felt much more confident in helping students this way and the students followed this structure very well.*

(PGD1): *The first two classes there were lots of us there, it was really interesting to talk with those that were more experienced than you; or even speaking with people from different backgrounds to get their perspective on demonstrating. It's good to share problems and solutions.*

2. Describe any new skills you developed or any existing skills you enhanced after completing the PGD training module?
3. Can you give examples?

(PGD4): *For me it was the idea of a grading rubric. The real life examples use in class really showed me how to use rubrics in grading student reports.*

(PGD1): *I just felt more confident, as I felt that I had prepared myself. Something I started doing after the first class with [the Researcher] was to give my students a quick oral quiz before they started, so I*

knew they where they stood in terms of understanding. It actually speeded-up the subsequent lab-work as I could spend more time with those that were struggling and those that were fine continued on with their lab-work...and this built the students confidence also. Barry emphasised the real-life applicability of questions. This also made me better at explaining things, as I had to think about the different ways each of my students could learn.

(PGD3): *I felt the skills of being more confident and more approachable are the skills that I developed most during these sessions. It helped me to help the students. Sometimes there is a gap between lecturers and students and the demonstrators can fill that gap.*

(PGD2): *I found more confidence in myself; I took on more responsibilities, such as marking, because I felt confident in myself. I became more engaged; more in touch with the lecturer...I tried to prepare more for labs than I ever did before. I felt I was more valuable in the lab than before.*
I had not noticed in my contract before that I could do these things [such as marking]; [the Researcher] pointed it out in class and also gave us the skills to apply ourselves here also. I feel I became more useful in the lab.

(PGD4): *This is a great opportunity that the SFSEH provided for us; not every School has this programme.*

4. Do you feel more confident in your abilities as a PGD after completing the PGD training module? Why?

(PGD1): *I felt better equipped, rather than just winging it. I feel more organised and prepared in my mind. I felt I became more structured after seeing example approaches and speaking to other PGDs in class [training workshop]. I thought the students became more organised once they noticed that I was organised and wanting to help them.*

(PGD3) *I tried to contact the staff member giving the lab so I could get the manual and think about what questions the students might ask so I could prepare myself more.*

(PGD2): *Yes, preparation is key for demonstrating. You always have to be prepared for the lab. I now try to be more prepared now and also more in touch with the students and lab technicians.*
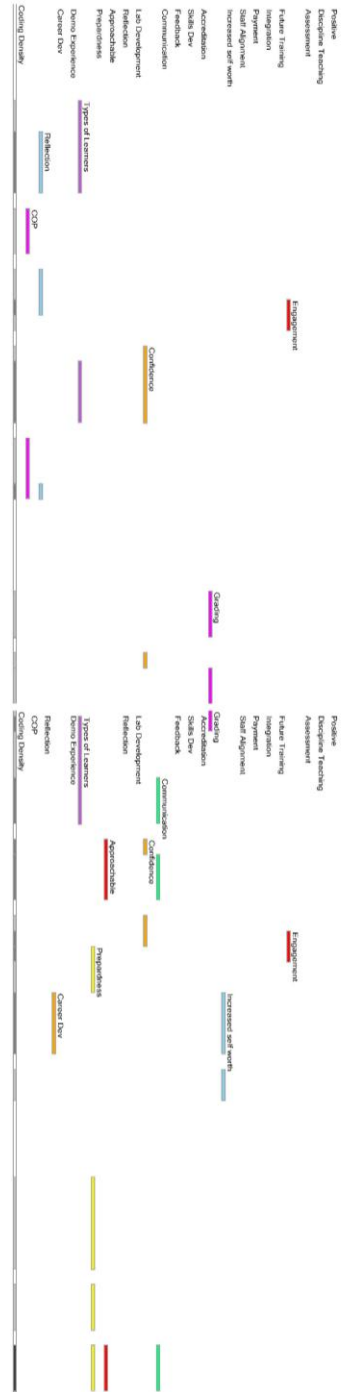
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(PGD4): *I really enhanced my communication skills and helped me to connect with my students. I am also more structured and organised. I developed my own pedagogical ideas. It is useful to study the different pedagogical ideas.*

5. What skills do you still think require enhancement?

(PGD4): *We need to write more reflections and do them more actively, even if we are busy we need to write and think about our demonstrating. If we don't write reflections our memories and emotions become faded and we lose our learning and experiences.*

(PGD2): *How could we optimise a lab manual? PGDs could be the common link between different classes taking the same module with different academic staff. PGDs could be used in the development or enhancement of a manual. PGDs could form a teaching team and the team could work together to develop the manual and lab.*

(PGD2): *Language of feedback; how to be encouraging but still to give constructive feedback. Some more examples from real life, perhaps we could bring some samples from our demonstrating to practice on and we receive feedback on our feedback.*

(PGD1): *I would like to be able to bring ideas to an academic or the teaching team. Perhaps some time to think and develop some of these ideas would be good and have group work and [the Researcher] to help with developing our ideas.*

(PGD1): *Perhaps looking alternative ways to assess students might be good. You can still assess for skills that are required, but using alternative approaches. We could design one perhaps as part of the class [training workshop]?*

6. Can these skills be improved through training?

(PGD2): *In the future this module would be really good as part of a structured PhD. For 5 or 10 credits, that would give worth to the effort and work put into the module. Like I said before, certification for the module.*

(PGD1): *Refresher every year would be good; if you knew what you were demonstrating; then you could approach the scenarios in class with a different perspective to prepare for the new year ahead.*

Theme: Community of practice engagement
1. Do you post your reflections to the CoP site?
2. Why, or why not?

(PGD4): *I posted for the first three sessions; I didn't do the last one as I did not attend the final session. I would like to do this type of writing more regularly. When you write things down they are concrete... just thinking about things can be too broad sometimes. Writing it down makes it real; you can see if there are gaps easier. Also, we are asking students to do a lot of writing, so why do we not write also?*

(PGD2): *I prepared some reflections, but I have not posted them yet. I did share my experiences in class with the other PGDs and I found this very useful.*

(PGD1): *I felt embarrassed to post, I felt like I had nothing to say. I am only new to demonstrating and I felt I had nothing to add to the site. It's emotional writing, something I am not familiar with.*

(PGD3): *I felt my experiences weren't good enough a I am only new to demonstrating. Also, I had never written this way [reflectively] before, so I was unsure what to do. However, I did note things down in my diary; things to improve for next year.*

3. Do you think you can learn from CoPs?
4. Why or why not?
All: *Yes!*
Facilitator: *Did you read others blogs, even if you didn't post your own?*
All: *Yes!*

(PGD3): *I found it very useful to read other blogs to give me ideas on how to approach challenges in my demonstrating. I was good to read others work.*

(PGD1): *I found it good to read PGDs from other Schools within the College. They gave me a different perspective also. They were very good. I read with great interest all the postings on the site; but I still couldn't bring myself to post to it! I certainly learnt from the other postings. I learnt that we are all in the same boat; the experiences are quite universal, even if you are only new to demonstrating.*

5. If you engaged with the CoP page did it encourage any further reflection, change mind etc.?
(PGD4): *I am also currently doing the Diploma in Third Level Teaching and Learning, and the two courses do not overlap each other. This class is very applied and focussed on the lab.*

(PGD1): *Its great to meet and get to know this community in real life. I now can say hello and chat to all these guys. Even just chatting to the other demonstrators over coffee can give you ideas.*

(PGD4): *Yes, I find it is good to chat with the new demonstrators as they have new ideas on how to teach certain labs. They have great energy. We can also share resources with each other, for example, XXX [another PGD] gave me some examples of reports from her class and I asked my students to see what they thought of them. My students soon realised the standard they had to write to once they saw their peers work.*

Training

- Positives
  - Required skills
  - Engagement
  - Approachable
- Negatives
  - Staff engagement
  - Discipline specific teaching
- Why?
  - Value
  - Self & Career Development
  - Inexperience
  - COP
- Expectations
  - Experienced
  - Novice
- Sustainability
  - Payment = No
  - Induction = Yes
  - Accreditation and CPD

Skills

- Positives
  - Alternative approaches
  - Reflection
  - Confidence
  - Engagement
  - COP
- Developed
  - Grading
  - Confidence
  - Non graded assessment
  - Prioritisation
  - Contextualisation
  - Learning styles
  - Value added
  - Self esteem
- Accreditation
- Why confident?
  - Prepared!
  - Communication
  - Dev. Pedagogy
- To develop
  - Reflective writing
  - Development of labs
  - Development of feedback
  - Development of ideas
  - Development of assessment
  - Refresher courses

COP

- Benfits
  - Reflection
  - Support
  - Sharing resources
- Personal Network
- Social
- Sharing
  - Resources
  - Best practice