The Research-Teaching Nexus as a Curriculum Development Tool in a Graduate Taught Programme*

Deborah Wallace
Olive Lennon
Justin King
Peter Doran

University College Dublin

Abstract

The graduate taught MSc in Clinical and Translational Research is delivered through the School of Medicine at University College Dublin. Our curriculum aims to expose students to research content as well as research process and problems. This has strongly influenced our teaching approach through integration of research in the curriculum by means of a wide-ranging programme of hands-on practical experience complementing classroom-based learning. Here, we investigate the potency of the *Research-Teaching Nexus* in our programme by using the Healey & Jenkins pedagogical model as a curriculum development tool for teachers and a framework for students to develop their research skill set and thereby enhancing their learning. Mapping of our module learning outcomes to this model enables us to examine research-teaching linkages in our curriculum as well as teaching strategies and learning experiences. This approach also allows us to highlight areas of our curriculum for development by means of a curriculum evaluation tool. Furthermore, for students, it offers a structure for expanding awareness of what constitutes research and a framework for research driven continuous professional development.

Keywords; Medicine, Graduate-Taught, Clinical-research, Research-teaching nexus, Curriculum-development

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1. Introduction

Research and teaching are widely perceived as being the primary processes in the higher education sector. Whilst the importance of these activities is not under doubt, the formation of a positive synergy remains open to debate and can often depend on program level and discipline (Hattie & Marsh, 1996, Trowler & Wareham, 2007; Zubrick, Reed and Rossiter, 2001).

Brew (1999, 2003) along with others have favoured a positive synergistic interlinked relationship between research and education (Brew & Jewell, 2012; Halliwell, 2008). Clark (1993) proposed, “The coupling of research with teaching and learning is a basic feature of modern higher education”. However, others consider this link to be both conditional, dependent on the subject area and organizational context (Barnett, 2005), varying from no linkage (Hattie & Marsh, 1996) to only a modest positive relationship (uz Zaman 2004).

One possible explanation, which may help explain the disagreement over the relationship between research and teaching, is the actual definition of “research” that’s used in a particular study. The term “research” is an all- encompassing umbrella term for “Basic”, “Applied” and more “Commercially- driven” research, OECD (2002). Indeed, this is how research is commonly perceived in Medicine where we are involved in so-called “bench to bedside” translational research. However, it also covers many different academic activities such as scientific writing and curriculum development or “knowledge production”. Brew (2006) suggested that this definition was in itself too narrow to cover many of the aspects of the academic driven process of knowledge production. In Medicine, the issue of what actually constitutes “research” is clear: the challenge is to ensure that our students are also aware of this, thereby giving clarity and enabling them to develop the required skill set to contribute effectively to the field. How we deliver our programmes to educate our future researchers is of the utmost importance as they play an integral part in influencing both knowledge and skill set, which in turn may impact patient care (Young et al., 2014). The phrase ‘‘evidence- based medicine’’ (EBM) was first coined by Guyatt in 1991, and was proposed as “an ability to assess the validity and importance of evidence before applying it to day-to-day clinical problems”, this was later broadened to introduce the concept, “evidence-based practice” (EBP), (Dawes 2005). The recent Research on Teaching of Evidence Based Practice in Ireland-to Healthcare Professionals and Healthcare Students report (2017) indicates that at an academic level the first three steps (Ask, Acquire, Appraise) are most frequently taught,

whereas Assess and Apply, steps four and five are less common in curricula.

Studies that take a positive view on the relationship of research and teaching call it a “nexus” (Elsen, Visser-wijnveen, 2009; Henkel, 2004; Neumann, 1994). Some propose a synergistic link between the two, termed “scholarship”, i.e that research and teaching are two-sides of the same phenomenon, namely, learning (Brew, 1999, 2003). This model is highly relevant to our current curriculum based on the classroom-based learning of the theory of research and the students’ ability to transfer this into solving real-life research questions and applying into practice (such as EBP). Indeed, as part of our curriculum, students research real-life problems and at the same time become more research literate through developing their skill set. Brew (1999, 2003) described a symbiotic relationship between research and teaching where it can be research-led teaching or research-based teaching. This idea is descriptive of our approach to embedding research in the teaching of our programme where initially students are thought “how to” perform research through to where the students themselves actually actively learn by performing research. This approach also fits with the model proposed by Hensley (2015) of a “continuum of undergraduate research” where the student moves from being a “consumer” of research to a “producer” of research.

Numerous models describe the relationship between research, teaching and learning (Griffiths, 2004; Healey, 2005; Trowler & Wareham, 2007). Jenkins et al., (2007) proposed that a linkage between research and education occurs when the students learn how research within their disciplines leads to knowledge creation. In the Healey model (2005 and Healey & Jenkins, 2009), which is one of the most prominent models and builds on the work by Griffiths (2004) it is proposed that there are four different types of relations between research and education (Figure 1), research-tutored, research-based, research-led and research-orientated education. Taking this model further, it can be thought of as existing in two parts, the first distinguishing between student-focused education where students are participants (“participants/producers”), to teacher focused education where students are an audience or passive recipients (“audience/consumers”) of learning content. This model is one of the most highly cited models concerning the relationship between research a and teaching.

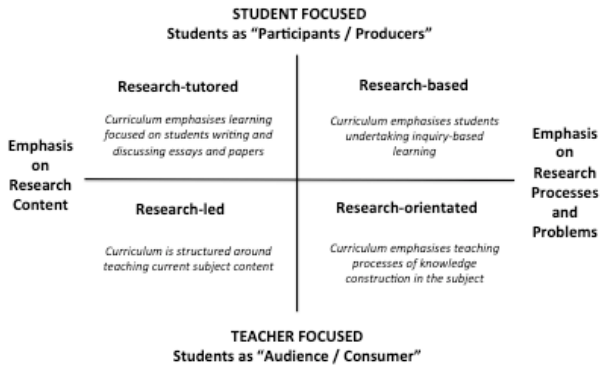


Figure 1. Healey and Jenkins Model (2009)

Ozay (2012) proposed a "research informed" model that encompasses systematic inquiry into teaching and learning processes as a central element of the Healey model. This idea builds on the notion of implementing a research-based curriculum. Following on from this, Hensley et al., (2015) viewed students interaction with knowledge as a continuum where initially students exist as consumers of existing knowledge and move towards existing as producers of new knowledge.

The aim of our MSc in Clinical and Translational Research is to produce the highest calibre of future clinical researchers which is especially relevant from a medical / healthcare point of view. Integration of research into the curriculum is of significant importance as studies have shown that patients treated in "research active" hospital are more likely to have a more positive outcome and / or decreased mortality rates (Baris et al., 2015; Hanney et al., 2013). Teaching approaches incorporating EBP have proved to be highly attractive and received a lot of attention as they address the need to accomplish: (1) improved patient experience of care (including quality and satisfaction), (2) improved health of populations and (3) reduced per capita cost of healthcare (Berwick et al., 2008; Melnyk, 2012; Gilliam and Siriwardena, 2014). It is crucial to have robust and wide-ranging links between research and teaching to advance student research and inquiry by designing modules, which promote student engagement, deep learning and research skills.

To be awarded the MSc in Clinical and Translational Research, students complete seven modules, earning 90 credits (European Credit Transfer System) over three semesters. Upon successful completion students will be able to:

- Apply their knowledge at the leading edge of patient focused clinical research
- Design methodologically robust and statistically valid clinical research protocols
- Lead programmes of clinical research that comply with the highest national and international legal, regulatory and scientific standards.
- Appraise, evaluate and enhance clinical research protocols, ensuring the highest quality research outputs
- Understand clinical trial regulations and appreciate the importance, practical use and evolution of these regulations.
- Possess excellent communication and presentation skills, appropriate to the multidisciplinary clinical research environment
- Collaborate with patients, academic partners and industry to complete clinical research programmes
- Commit to continuous lifelong learning and further diffusion of their clinical research expertise

All these outcomes are met through the combination of the individual seven module learning outcomes. As the programme outcomes are heavily research focused, the objective of this study was to map our module learning outcomes to the Healey & Jenkins (2009) pedagogical model. In the study presented here, the seven module learning outcomes were mapped to the four quadrants of the Healey & Jenkins pedagogical model in order to objectively review how all research themes have been incorporated into our curriculum. This evaluation will ideally provide a framework for curriculum development for staff, especially from positions of both delivery and assessment. For students, it will challenge their perception of what constitutes research and provide a roadmap whereby they can visualise their research skill set and identify continuous professional development (CPD) by facilitating the students' visualization of their research skill set. The advantage of using this model is that it is straightforward and can be easily transferred into a means of critical reflection for curriculum development and students' CPD.

2. Curriculum Mapping (Methodology, Analysis & Results)

2.1. Methodology: Mapping of MSc Module Learning Outcomes

The previously defined Learning outcomes from the seven modules of the MSc in Clinical and Translational Research were mapped to the four quadrants of the Healey & Jenkins model, Research–tutored (RT), -based (RB), -led (RL) and –orientated (RO). Learning outcomes were mapped based upon how each outcome was achieved. The teaching approaches employed in each module were listed and incorporated into the mapping process, these included didactic (RL/RO), Problem Based Learning (PBL) (RB), EBP (RB) and peer-review (both teacher-student and student to student), use of Virtual learning environments (VLE) such as Blackboard and experiential learning such as clinical placements (RL/RO). Methods of assessment used were mapped in a similar fashion, these included, written exam (RL/RO), multiple choice questions (MCQ) (RL), reflective diaries (RT/RB), critical appraisal of clinical protocols (RT/RB/RO), oral presentation (RT/RB) and successful completion of a Minor Taught Thesis (RB/RT).

What is evident (Table 1) is that for most module learning outcomes there is a blended approach for integrating research into teaching. The use of both a written and oral assessment components also incorporate the principles of diversity / equality by promoting inclusive teaching, learning and assessment strategies. This, of course, could be accounted for by the practical experience, PBL and EPB, which are incorporated into many of our modules complementing classroom-based didactic learning. For example, in Clinical Trial Management, the learning outcome of “Understanding clinical trial management” falls under research-led, -based and –orientated integration of research into teaching by means of lecture content, clinical placements in the Clinical Research Centre and “authentic” assessments in the form of clinical protocol critique and presentation.

Principles and Practices of Clinical & Translational Research (MDCS41630) Semester 1 (10 ECTS)	RT	RB	RL	RO
Understand clinical & translational research principles, including study design			✔	✔
Understand core methodologies used in the conduct of clinical & translational research			✔	
Analyse the design of clinical & translational research projects			✔	
Use project management techniques to optimize project outcomes		✔		
Gain practical knowledge of the conduct of clinical trials		✔		
Understand the linkages between clinical and basic research		✔		
Biostatistics & Data Management (MCDS41950) Semester 1 (10 ECTS)	RT	RB	RL	RO
Understand the importance of data management and biostatistics			✔	✔
Understand core considerations of data management, including data security, source data, etc.;			✔	
Understand core principles of experimental design			✔	
Understand common statistical methodologies applied to data generated from clinical trials		✔		
Be able to carry out basic statistical analysis of clinical trial datasets		✔		
Create a data management plan for a clinical research project		✔		
Clinical Trials (MDCS41640) Semester 1 (10 ECTS)	RT	RB	RL	RO
Understand clinical trial principles, including study design			✔	✔
Understand regulatory and legal environment in which clinical trials are completed			✔	✔
Analyse the design of clinical trials		✔		
Understand how emerging technologies are directly enhancing clinical trials			✔	✔
Appreciate how Good Clinical Practice guides trial design, development and implementation			✔	✔
Principles of Laboratory Medicine (MDCS41890) Semester 2 (10 ECTS)	RT	RB	RL	RO
Understand the relevance and importance of biomarkers as endpoints in clinical research			✔	

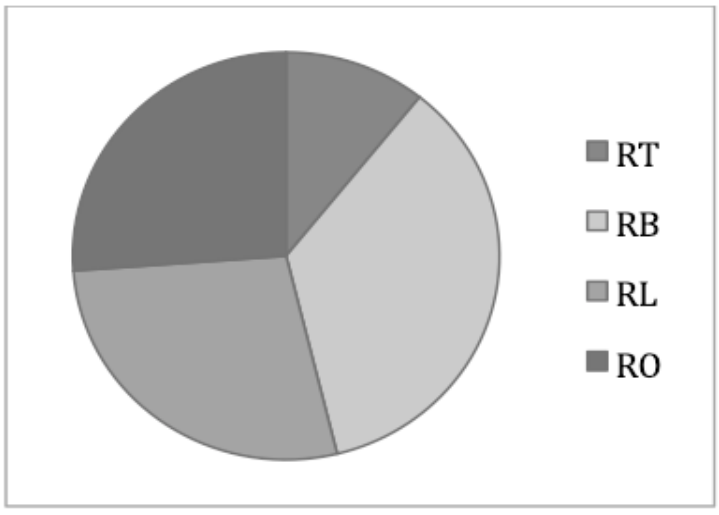
Develop a full understanding of the methodologies of biomarker development and validation		✔	✔	
Understand the technologies used in biomarker analysis, in both clinical research and normal clinical practice			✔	
Gain an appreciation and understanding of sample management in the clinical research context			✔	✔
Understand the infrastructure and systems needed to develop a biorepository			✔	✔
Be able to develop sample management and analysis plans	✔	✔		
Gain practical experience in sample handing, processing, and analysis		✔	✔	
Clinical Protocol Development (MDCS41900) Semester 2 (10 ECTS)	RT	RB	RL	RO
Design a study to be carried out in a clinical, occupational or scientific setting		✔		✔
Develop a Research Protocol to a specified framework	✔	✔		
Choose the design most appropriate to the research question, and appropriate sample size		✔		
Understand most appropriate control and intervention groups		✔		✔
Present protocol	✔			
Clinical Trial Management (MDCS41940) Semester 2 (10 ECTS)	RT	RB	RL	RO
Understand clinical trial management		✔	✔	✔
Understand study start up and monitoring		✔	✔	✔
Understand Regulatory and Quality Systems		✔	✔	✔
Understand core principles of project and time management		✔		✔
Clinical Research Project (MDCS41880) Semester 3 (30 ECTS)	RT	RB	RL	RO
Complete a systematic review of the literature	✔			
Create clinically and scientifically validated data collection forms	✔	✔		
Write a data management and statistical analysis plan for a clinical trial	✔	✔		
Obtain regulatory approvals for clinical study		✔		
In addition students will prepare a thesis and present their study in an oral presentation	✔			

Table 1. Curriculum Mapping to the Research-Teaching Nexus

2.2. Mapping of module learning outcomes to the Healey and Jenkins model and by semester

Figure 2a illustrates the percentage of each of the four approaches for integrating research into teaching undertaken in our programme: Research-tutored 11%, Research-based 35%, Research-led 28%, Research-orientated 26%. Results show that there is a large proportion (54%) of module learning outcomes mapped to Research-based and Research-tutored approaches, indicating that students are actively participating in research within our taught programme, thereby ensuring their teaching is highly research relevant. Figure 2b further explores this data by examining the distribution of teaching approaches adopted by semester. Perhaps the most noteworthy aspect is the move from a Research-orientated and Research-led focus in semester 1 (58%, 50%) & semester 2 (42%, 50%) in modules such as Principles and Practices of Clinical and Translational research, towards a Research-tutored approach in semester 3 (86%). This is where students are undertake their clinical research project (thesis) and reflects how research is considered as a continuum, increasing in complexity as the programme develops.

(2a)



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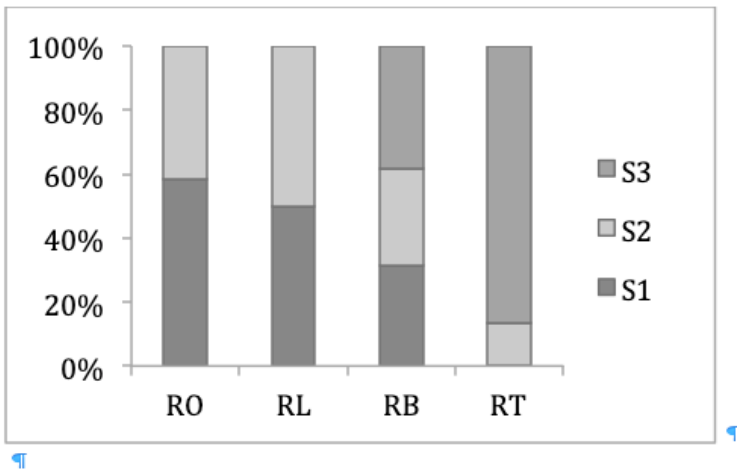

Figure 2. Mapping of module learning outcomes to the 4 quadrants of the Healey and Jenkins model and by semester. (A) mapping to quadrants, (B) mapping by semester. Research-orientated (RO), Research-led (RL), Research-based (RB), Research-tutored (RT), Semester 1 (S1), Semester 2 (S2), Semester 3 (S3).

2.3. Engaging Student Learning through provision of relevant skill sets

Next we examined the percentage of the curriculum mapped under Research Content (Research-tutored / Research-led) and Research Processes and Problems (Research-based / Research-orientated) (38%, 62%) (Figure 3a). Again data suggests that students are actively participating in research-integrated learning. When analysed by semester (Figure 3b), an increase in Research Content in semester 3 (57%), when compared to semester 1 (31%) and semester 2 (41%) is noted. This may be largely accounted for by the students participation in the Clinical Research Project module, however, they continue to learn about current research (Research-led) in their discipline, complemented by concurrent research discussion (Research-tutored).

Figure 3(a)

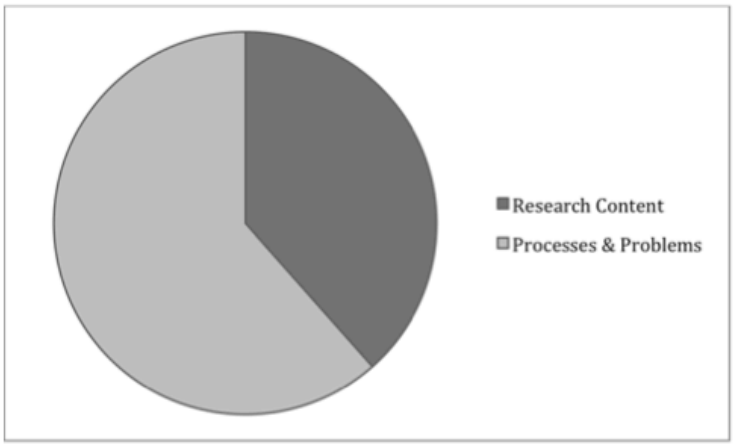

Figure 3(b)

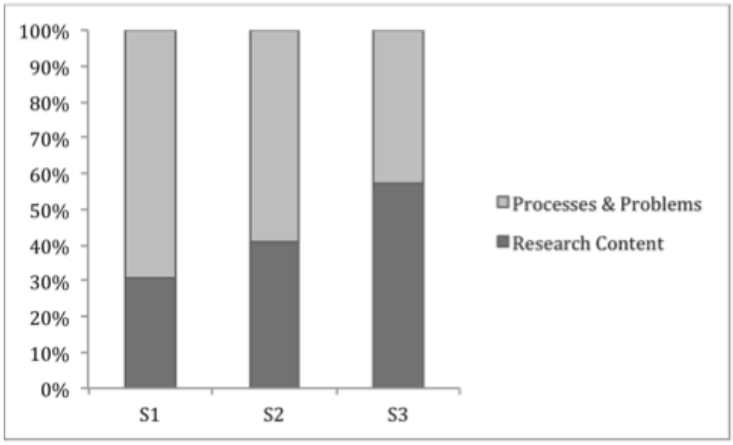

Figure 3. Mapping of module learning outcomes to Research Content and Research Processes and Problems. (A) mapping to Research Content and Research Process and Problems , (B) mapping by semester.

2.4. Student Focused Learning

Finally, we examined our curriculum from the perspective of students acting as an “Audience” (Research-led / Research-orientated) or “Participants” (Research-tutored / Research-based). Overall (Figure 4a), we found that there was a relatively even distribution of both students roles (46%, 54%) in teaching and learning. When, examined by semester (Figure 4b), a shift towards students acting solely as “Participants” in semester 3 (100%) is evident, whereas semester 1 & 2 are more weighed with students acting as an “Audience” (65%, 56%). This is indicative of the activities undertaken by the students in each semester, where initially they acquire the knowledge and basic research skill set and then they shift towards a PBL/project/dissemination-based approach to their learning.

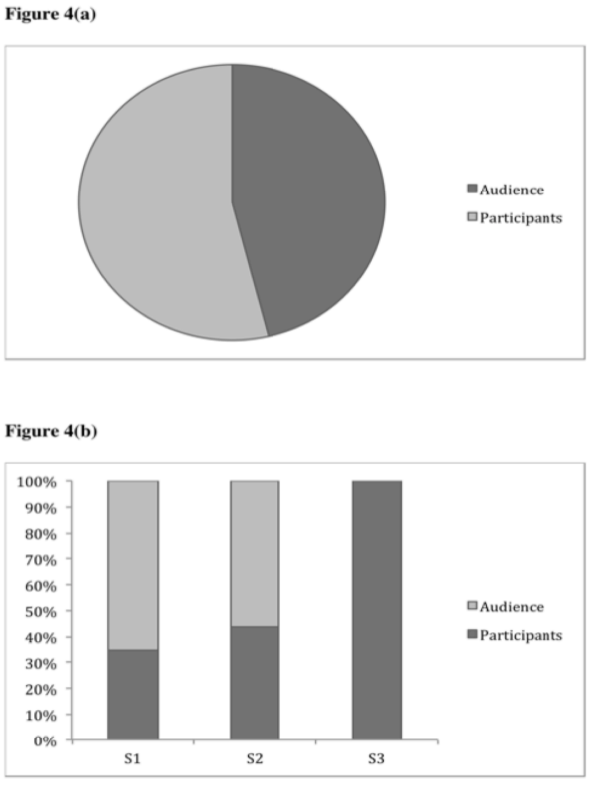

Figure 4.

Mapping of module learning outcomes under Audience and Participants. (A) mapping under Audience and Participants, (B) mapping by semester.

3. Discussion

The majority of the pedagogical literature focuses on the undergraduate student and their experience of the research-teaching nexus. However, the degree and complexity of research engagement likely increases as students' progress to graduate studies. This is critical as there is an increasingly need for students to engage in research and new demands from employers for a shift away from didactic to enquiry-based learning reflecting real world learning. Indeed, from the students' perspective, research has been positively linked to career choices and skills development (Adedokun & Burgess, 2011, Cuthbert; Arunachalam & Lucina, 2012). The overall aim of this study was to investigate if indeed all aspects of research were integrated in our post-graduate curriculum while at the same time identifying areas that may require improvement in terms of accessibility and diversity in teaching and learning offerings for the student. The outcomes of this study are illustrated in Figure 5, each of which will be discussed here.

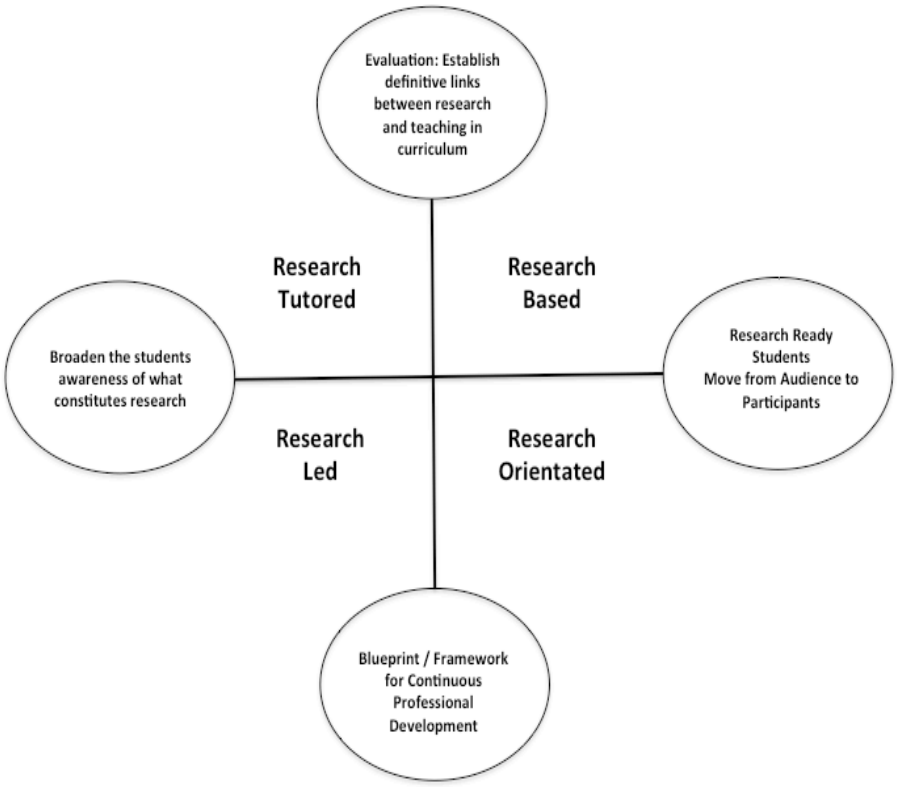

Figure 5. Study Outcomes

When considered this in terms of Biggs' model for constructive alignment (1999 & 2003), the intended learning outcomes are written to include an activity, not just a topic. Therefore, it is imperative to align intended learning outcomes with teaching, learning and assessment tasks. For assessment, students research real-life problems through enquiry or Problem based learning (PBL) initiatives and EBP as discussed previously. PBL has long been thought of as a highly productive means to create a link between research and teaching (Spronken-Smith & Walker, 2010), of course the actual process of PBL is closely related if not even identical to actual "real-life" research. Importantly from a research perspective, in PBL, alternative hypotheses are encouraged and explored in contrast to an emphasis on right answers in classroom teaching methods. Studies have shown that when the student is actively engaged in this manner a more positive link is perceived (Horta et al., 2012; Blomster et al., 2014). The students' motivation to learn can be influenced heavily by the desire to attain the necessary skills and proficiencies to perform in the workplace, which can be achieved by use of the research-orientated approach. Here students will focus on research processes, and problems and these strategic approaches by students offers us, as teachers, a challenge to implement relevant and motivating assessments. Completion of this study has helped us identify areas for curriculum development, such as in Laboratory Medicine, where essay-type assessments have now been replaced with assignments linked to practical sessions to make them more "authentic" and research relevant. Additionally, we have redesigned some modules to include peer-review with the aim of improving the students' educational experience via engagement and self-reflection.

Students often think of research as only being concerned with the research-led, –orientated and -based quadrants of the model and to a large extent, ignore the research-tutored quadrant. In our programme this can now be addressed through the provision of the research blueprint for their MSc, a useful tool for them to identify areas in their own expertise that they may need to develop. It is widely accepted that it is of the utmost importance that this cohort of students can appraise, evaluate and disseminate research effectively. In Medicine, it is perhaps one of the most vital "skill sets" students can possess, as it plays a large role in every aspect of professional practice from clinical decision making to interaction with patients. Findings show that while research-orientated and –led approaches feature in semester 1 & 2, there is a shift towards a more research-tutored means of integrating research into teaching in semester 3 where also students have moved to acting as producers of research. Buckley (2011) described, by means of a case study, how students and staff have varied interpretations of both the nature of learning and research and indeed the association

between the two: this again reinforces the advantage of using one research-teaching model for both teachers and students.

4. Conclusions and Future Work

The work presented here can now be used as a tool for both faculty and students. By integrating teaching and research we are ensuring that our graduates have the knowledge and skills to be the future leaders in clinical and translational research. This analysis provides a blueprint on how research is coupled to teaching in the curriculum, through outlining the underpinning linkages, and it is envisaged that this work will also aim to broaden the students' awareness of what constitutes research. Implementing the learnings from this process should encourage students to develop from consumers to producers of research and for us as teachers, will support the delivery of a connected curriculum in terms of content and assessment.

These analyses presented as part of the mapping process, clearly illustrate the importance of research in our curriculum and how the research-teaching nexus is at the core of our programme design. It has however, also identified areas for improvement in terms of teaching and assessment, and also offers the possibility of increasing diversity in terms of learning and assessment. Future directions for this body of work include conducting surveys / workshops with our students and module coordinators to understand their perceptions of research and whether or not they find these data generated here as useful tool for their learning and expanding their clinical research skill set. This next step in the process could align with the methodology previously described by Healy et al., (2010).

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