Title: Privileging Tacit Knowledge within a Software Engineering Curriculum: A Living Educational Theory of Practice

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A thesis submitted towards award of Doctor of Philosophy (PhD)

By

Michael P. Russell

To

Maynooth University

Department of Adult and Community Education

Faculty of Social Sciences

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Supervisor: Dr. David McCormack

Head of Department: Dr. Mary Ryan

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Abstract

Through action research I inquired into my pedagogical practice by questioning the nature of knowledge I valued as a lecturer. This questioning led me to develop my 'living educational theory' (Whitehead, 1989, p.41) of privileging tacit knowledge within a Software Engineering curriculum.

My living educational theory is grounded in ideas of professional knowledge, relationships, competence, and expertise. In developing my theory, I explain how I transformed my ontological values of justice, democracy, and care in relation to students through standards of judgement that I developed to direct, test, and evaluate actions I took to improve my pedagogical practice. I describe how I experienced conflict between my existing practice and ontological values that led me to see myself as a 'living contradiction' (Whitehead, 1989, p.41) and to critique the dominant didactic perspectives located within my practice which privileged explicit disciplinary knowledge within a Software Engineering curriculum.

To overcome feeling like a living contradiction, I researched and engaged with dialogical problem-posing pedagogies to encourage and support students to actively participate in their own development of becoming competent software engineering professionals. The dialogical problem-posing pedagogy I developed during this inquiry is constructed on the basis of just, democratic, and caring relationships with students, who are capable of exercising their agency and are constantly remaking their identity as they both create and use professional knowledge to solve Software Engineering problems.

As I engaged with this dialogical problem-posing pedagogy, I re-conceptualised my identity as a pedagogical practitioner. I questioned the traditional and dominant orthodoxies that I subscribed to and which dictated that I positioned myself as the knowledge expert within the classroom. In doing so, I took action to move from being the knowledge expert to being a facilitator within the classroom to help students to realise their capacity to become competent software engineering practitioners.

Acknowledgments

I owe an immense debt of gratitude to Dave McCormack, my supervisor, for his support and belief in me throughout this research journey. His insightful critique raised my awareness of the epistemological concepts that were significant for my research and helped me to focus more clearly on relevant issues. Dave's educative influence on me has given me a different perspective on education and on life.

I wish to acknowledge the teaching staff, my fellow PhD students, and critical friends in the Maynooth University PhD Study Group within the Department of Adult and Community Education who advised, listened, critiqued, and provided strong and sympathetic support when it was needed.

My colleagues Denis McCarthy, Mark Daly, and David Scott, who agreed to be part of my Validation Group, have supported and encouraged me throughout this process. Another member of the Validation Group, Amy Butler, a Senior Software Engineering Researcher with an International Telecommunications Company, brought an industrial perspective to my inquiry and ensured that the actions that I took were relevant in preparing students to become Software Engineering practitioners ready to engage with the challenges of industry. I want to acknowledge publicly their commitment to the Validation Process by simply saying "Thank You…So Much!".

The students who participated in this inquiry deserve a particular mention. Their participation in this inquiry has been a significant contribution to the development of this thesis. I have been their student and they have been my teachers.

Lastly, but definitely not least, my family have supported and helped me through the last six and half years. I would like to acknowledge my daughters Aoibheann and Grace whose love and zest for life has sustained me through this endeavour. My wife, Mary, whose belief in me and love never wavered as I disappeared at all times of the day to "do the PhD".

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Mike Russell,
November 2020.

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List of Abbreviations

Abbreviation	Description
A.C.	Acceptance Criteria
ARC	Action Reflection Cycle
BVA	Boundary Value Analysis
CA	Continuous Assessment
EP	Equivalence Partitioning
HE	Higher Education
M.Ed.	Masters of Education
M.Sc.	Masters of Science
MLO	Module Learning Outcome
NFQ	National Framework of Qualifications
PgDHE	Postgraduate Diploma in Higher Education
RD	Research Diary
U.S.	User Stories
VLE	Virtual Learning Environment

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Section 1 – Background and Context of my Research

Section 1, *Background and Context of My Research*, consists of two chapters.

In chapter 1, *My Journey to Engaging with this Inquiry*, I describe the catalyst that prompted me to start a journey of discovery in relation to my professional practice and my identity as a lecturer. In doing so, I ask and start to inquire into my main research question: *"How can I, as a lecturer, improve my pedagogical practice to value tacit Software Engineering knowledge?"*

In chapter 2, *The Role of Knowledge within my Pedagogical Practice*, in the context of my main research question, I inquire into the nature of the knowledge that should be privileged or valued within a Software Engineering curriculum.

Chapter 1 - My Journey to Engaging with this Inquiry

1.1 Introduction

In this chapter, I present a vignette from my practice which describes the catalyst that prompted me to start a journey of discovery in relation to my professional practice and my identity as a lecturer. This journey has led me to engage in this PhD inquiry. I introduce my main research question which anchors this study. I provide further background by describing my understanding of my practice context, the relevance of my personal experiences to my practice, and how I reconceptualised my practice as a Software Engineering Lecturer before I started to engage with this study.

1.2 Vignette From my Practice

Throughout 2007 I became discontented and restless with my pedagogical practice within Higher Education as a Software Engineering lecturer. I began to question myself about my practice and in particular did I believe in what I was doing or was I happy or was I fully engaged with my work. In late 2007, this questioning came to a head one sunny morning. I found myself in a classroom looking out at a beautiful winter's morning reciting content that I had placed on the overhead projector. I turned around as I continued to recite. What I observed summed up the discontent I had with my practice. None of the students were looking at me, I even doubt if they were listening to me. Each of them was writing furiously, looking up at the overhead, and then writing again. The only time they spoke or interacted with me was if I removed the current content slide from the overhead. This interaction normally was a request to leave the slide on the projector as they had not yet finished writing down the content. I felt no sense of achievement in my role as a lecturer resulting in no sense of a connection with the students. I was bored extracting, summarizing, presenting, and assessing explicit discipline-specific or subject knowledge. I also felt the students were bored in their learning and assessment of this knowledge. I recognised that I was like one of the many educators that I knew who gave 'out directions, busywork, and fact-fact-fact lectures in ways that keep students intellectually passive' (The Holmes Group cited in Shor, 1987, p7). I didn't know what I could do to change! I didn't know how I

could go about changing! It was at that point I concluded that I was at a cross-roads in my career and was considering returning to the software engineering industry.

I started to think again about the experiences I had in industry as a software engineer and project manager. Thinking about this industrial experience, I came to realise that the knowledge valued in the curriculum (explicit discipline-specific knowledge) I taught constituted only part of the knowledge that I engaged with and experienced in industry. For example, I felt that knowledge concerning group-work, problem-solving, and/or leadership is vital within the software industry but was not being addressed in the curriculum.

As I continued to think about the situation I realised I had been a lecturer since 1996. When I started teaching I had no formal training in teaching and learning or formal educational theories. In the intervening 11 years I did not engage with any of these theories. As far as I was concerned I was hired to teach software engineering. I assumed that my role was that of a Software Engineer teaching the software engineering discipline. However, on reflecting further on my assumption, I determined that I had not fully appreciated my role as a lecturer. It occurred to me that the role is, and in fact can be better described as, that of an educator teaching the software engineering discipline. For me, this description of the role highlighted what I thought was a deficit within my practice – I am a trained and experienced software engineer possessing the discipline's knowledge but lacked formal training within the educational discipline. In highlighting this deficit to myself, I did acknowledge that I had spent the previous 11 years as a lecturer (not an educator) and that that experience must count for something. At this point, in late 2007, these experiences as a lecturer and the past experiences as a software engineering professional were telling me that I needed to change something within my practice or else change career.

Do I stay in or leave education? This question roamed throughout my mind during Christmas 2007 and early 2008. In the end, I decided I needed to engage in formal Teaching and Learning training. I enrolled in 2008 for a Postgraduate Diploma in Higher Education qualification. I then followed this training by studying for a Masters of Education degree, which I completed in 2013. At this stage in my career I felt I had

acquired sufficient theoretical knowledge in the discipline of education, particularly in relation to concepts such as knowledge, learning, curriculum, and pedagogy.

However, the remnants of the 'disorienting dilemma' (Mezirow cited in Laros, 2017, p.85) that occurred on that winter's morning in 2007 still stayed with me. Although the disorienting dilemma had triggered me to identify that part of my dissatisfaction with my practice lay in my lack of knowledge of formal educational theories and practice, thus prompting me to complete both the Postgraduate Diploma in Higher Education (2008-9) and Masters of Education (2011-13), I still had the feeling that I could do better. This feeling that I could "do better" morphed into my decision to engage with this action research inquiry into my practice.

I identified that I had positioned myself as a knowledge expert, or a 'giver of information' (Murphy *et al.*, 2008, p.149), within my pedagogical practice as I taught Software Engineering to third-level students. I had not enabled students to learn how to both create Software Engineering knowledge and use that knowledge. Instead I had filled their minds 'with the contents of [my] narration - contents that are detached from reality, disconnected from the totality that engendered them and could give them significance' (Freire, 1970, p.44).

Freire (1970) is critical of educational institutions and educators who deposit content (as a form of knowledge) in a manner that considers students as passive consumers of knowledge. 'This is the "banking" concept of education, in which the scope of action allowed to the students extends only as far as receiving, filing, and storing the deposits' (Freire, 1970, p.45). In 2013, I acknowledged to myself that I still subscribed to this traditional view of education which 'orients students to conform, to accept inequality and their places in the status quo, to follow authority' (Shor, 1993, p.28).

1.2.1 My Visit to Aalborg University

On completing my *Masters of Education* programme in 2013 I had the opportunity to visit Aalborg University in Denmark. The university has pioneered a pedagogical approach, called The Aalborg Model (Askehave *et al.*, 2015), based on problem-centred and authentic real-world projects of educational and research relevance.

There were many aspects that attracted me to this model. In particular, based on my own experiences as a software engineer, I was intrigued to see that Aalborg University students are required to engage in 'project work based on authentic problems, self-governed group work and collaboration' (Askehave *et al.*, 2015, p.3). I immediately identified that such an approach required students to be able to develop their communication and cooperation competencies as they apply both theory and research knowledge as they work on an authentic real-world problem. To promote this student learning, the model supports students in independently acquiring and developing knowledge, skills, and competencies at various academic levels.

At that point in time, I had a sense that Aalborg University was preparing its students better than I was preparing students in Ireland. I felt the group work, engaging with authentic real-world problems, provided an environment for the Danish students to more effectively learn communication, cooperation, and independent learning competencies. Additionally, I also felt that students in Ireland were potentially missing learning opportunities as I realised that the curriculum I taught did not fully value Software Engineering as a profession grounded in solving unique problems, communication and cooperation within teams, and the ability to adapt to new problem types, technologies, and tools (Schön, 1983).

Reflecting on that week many questions started to fill my mind: *What types of knowledge, skill, or competence should the Irish curriculum value? How should such knowledge, skill, or competence be incorporated within the curriculum's Learning Outcomes? Which teaching and assessment strategies best support students' learning as they engage with the curriculum? How can I transform my pedagogy? Are there alternatives to the banking model of education? What are the differences between teacher-centred and student-centred pedagogies?*

Following on from my visit to Aalborg University, I undertook this doctoral research to inquire into these questions. In doing so, I recognised that this research would also advance my own 'professional development' (National Forum, 2016, p.1). The *National Forum for the Enhancement of Teaching and Learning in Higher Education* identifies a multitude of professional development activities, ranging from informal conversations with peers to non-formal attendance at seminars to formal accredited

PhD programmes, that staff who teach within Higher Education in Ireland can choose from (National Forum, 2016). I decided to undertake this PhD study to continue to advance my professional development as I took action to both improve practice and become more competent as a lecturer.

The *National Forum for the Enhancement of Teaching and Learning in Higher Education* influenced both my choice of methodology (Chapter 3) and my implementation of the action-reflection cycles (Chapter 4) that I engaged with in this inquiry as the framework itself places the 'self' (National Forum, 2016, p.4) at the centre of professional development activities. Similar to the Living Educational Theory (Whitehead, 1989) methodology that I adopted, the national framework

> emphasises the personal values, perspectives and emotions that individuals bring to their teaching, including self-awareness, confidence, life experience and the affective aspects associated with teaching. It makes transparent the importance of the personal values that underpin any human interaction, especially those needed for authentic, engaged teaching and how these values are impacted by the work context. (National Forum, 2016, p4)

1.3 My Main Research Question

I registered in 2014 to begin my PhD studies in Maynooth University. During the first PhD Postgraduate Workshop that I attended at Maynooth University I was asked to think about my own individual interests with respect to both education and my professional practice. After that workshop, I wrote that:

> I am interested in curriculum development that moves away from…the written exam as the main mode of assessment. This approach would also require that I examine "what type of knowledge" is to be valued [within pedagogical practice]. I would be arguing we need to value tacit knowledge (not currently valued in the main mode of assessment) while still valuing explicit knowledge. This would require a re-examination of Learning Outcomes to incorporate both explicit and tacit knowledge as well as reconsidering teaching, learning and assessment strategies /approaches. (Research Diary, 11/02/2014)

Up to this point in my career I realised that the curriculum that I had developed and taught focused primarily on explicit software engineering knowledge - knowledge that

is readily articulated, codified, stored, accessed, and not dependent on context (Murphy *et al.*, 2008; Gascoigne and Thornton, 2013). On further reflection, I began to consider how 'the "banking" concept of education' (Freire, 1970, p.45) and my position as the knowledge expert, where I dispensed explicit discipline-specific knowledge within the classroom, contributed to the disorienting dilemma that I continued to have with my practice. I identified that I was not preparing students adequately for the rigours of engagement as 'competent' (Schön, 1983, p.49) software engineering professionals within society after they graduate as my curriculum did not address 'the demands of real-world [software engineering] practice' (Schön, 1983, p.45). I reflected that this lack of preparation occurred because I did not recognise the students' capacity to learn and think for themselves. Instead, my teacher-centred pedagogy discouraged the students from improving their learning by not allowing them to actively engage and take ownership of knowledge within the context of real-world practice. I had not embraced student-centred pedagogies which require 'a shift from teacher-centred forms of teaching to more learning-oriented forms in which the teacher's role is to be a facilitator of learning' (Harju and Åkerblom, 2017, p.1532).

I started to think more about the nature of knowledge that I valued within my practice. I identified within my practice that I had focused on teaching explicit or 'propositional knowledge [representing the] discipline-based theories and concepts' (Eraut, 1994, p.103) relevant to Software Engineering practice.

My past experiences of being a software engineering practitioner in industry told me that to be successful, requires not only explicit software engineering knowledge, but also the knowledge needed to navigate 'the changing character of the situations of [software engineering] practice - the complexity, uncertainty, instability, uniqueness, and value conflicts which are increasingly perceived as central to the world of [software engineering] professional practice' (Schön, 1983, p.13). At this early stage within my inquiry I labelled this knowledge as tacit because it embodies the key skills and attributes that live in a person's mind or memory and, in my experience, is necessary for the production of software products (Markus, 2001).

I decided to ask the following research question as a means to anchor and focus this inquiry:

- How can I, as a lecturer, improve my pedagogical practice to value tacit Software Engineering knowledge?

In stating the Research Question, I had identified that both the concept of "*tacit knowledge*" and the nature of pedagogical practice within the context of the Software Engineering discipline are central to this inquiry. However, at the start of this study, I had a limited perspective on both of these entities. In particular, I loosely used the term *"tacit"* 'as a catch-all label' (Eraut, 2000, p.114) to refer to all representations of knowledge other than 'explicit knowledge… such as facts, formulae and principles' (Murphy *et al.*, 2008, p.210).

1.4 Practice Context

The context to my research into my professional practice as an educational practitioner is that I am a Software Engineering lecturer within Athlone Institute of Technology. I teach a variety of Software Engineering subjects at both undergraduate and postgraduate level. The purpose of such pedagogical practice is to educate students to learn to become 'competent practitioner[s]' (Schön, 1983, p.49) as Software Engineering professionals.

I have determined that there are many constituent parts to my 'standards' (QQI, 2016, p.19) based educational practice, within the context of Higher Education, which inform what I do as a lecturer. Engaging with the *Framework for Analysing Educational Practice*, see Figure 1.1 on the next page, I have identified that my practice or

> [m]y reality [can be] explicitly divided into a Social Order and Experienced World perspectives. The idea that the curriculum could be divided and critiqued from many different levels was new to me but as I studied this more I realised that the different levels of curriculum, if applied as a lens to one's practice, emphasises and pays attention to different parts of one's practice [at particular times]. I was intrigued on the

> equal emphasis put on the relationship between Learning, Knowledge, and Pedagogy. … The framework also suggested to me that I needed to investigate more my own views of knowledge, learning, and pedagogy. (Research Diary, 2/5/2017)

Analysing the framework in more detail provided me with the means to describe and understand the social reality that is my practice. In particular, I have discovered that there are 'forces present in wider society' (Brookfield, 1995, p.9) which intrude into and influence what I do as a lecturer. I have identified that my standards-based practice is built and structured upon three related structures or entities: society, educational institutions, and ongoing (classroom) activity. Central to this perspective is a Policy-Practice duality, where social policy informs practice and practice fulfils social policy.
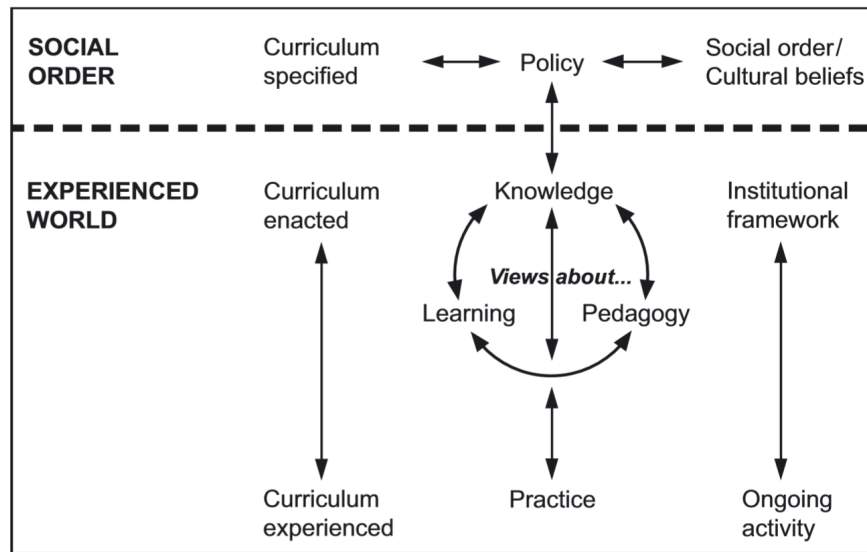
Figure 1.1
Framework for Analysing Educational Practice (Murphy et al., 2008, p.50)

From a policy perspective, my professional practice is first and foremost governed by Irish society through laws and policies put in place by government as well as the corresponding structures, standards, and procedures defined by the Higher Education Institute that I work for. The basis for this standards-based approach within Athlone Institute of Technology is to be found within the Qualifications (Education and Training) Act 1999 and the Qualifications and Quality Assurance (Education and Training) Act 2012. My professional role is given legitimacy by these Educational Acts enacted by the government.

In particular, the *National Framework of Qualifications* (QQI, 2016) defines the actual standards that must be met in the awarding of formal educational qualifications within Ireland in terms of curriculum design, assessment practice, and the relationship between knowledge and learning in terms of programme and module learning outcomes. Within Higher Education, programmes are the vehicles that provide learners with the opportunity to attain and develop knowledge, know-how and skill, and competence as a means to earn a third-level qualification. Programmes are comprised of individual modules or subjects (O' Neill, 2015; QQI, 2016). 'Learning [o]utcomes' (Jordan, Carlile and Stack, 2009, p. 209) state what a student should know and be able to demonstrate on the completion of each module and/or programme. Within the curriculum, the relationship between knowledge, assessment, and learning is captured through constructive alignment of module learning outcomes to assessment practices and methods employed (Biggs and Tang, 2011). The use of

> [c]onstructive alignment reflects the shift of the paradigm from a teacher-centred teaching and learning to a student-centred one, which emphasises encouraging and supporting students' construction of their own knowledge inside and outside the classroom instead of teachers' transmission of the knowledge in class. (Wang et al, 2013, p.477)

Additionally, the *National Strategy for Higher Education* (Hunt, 2011), covering the years 2011 to 2030, is particularly relevant to pedagogical practice within Higher Education as it identifies the teaching and learning changes and challenges that I, Athlone Institute of Technology, and Irish society face as we transition to the knowledge economy. Higher Education is seen as 'central to future economic development in Ireland' (Hunt, 2011, p.3), an Ireland of cultural diversity in which the workforce must engage with lifelong learning and training to ensure continued participation within an ever-changing economy and evolving society facing both social and cultural challenges.

Within Athlone Institute of Technology these standards and policies both inform and regulate how my colleagues and I design a formal programme of study.

From a practice perspective, depending on context, the term "curriculum" is used interchangeably to refer to either '[t]he structure and content of a programme of study

[or] a unit (subject)' (O' Neill, 2015, p.8). The notion that the concept of curriculum can be viewed through the lenses of the specified, enacted, or experienced curriculum (Murphy *et al.*, 2008; McCormick and Murphy, 2008) has been central to my analysis and understanding of my practice within this inquiry. Each lens has a distinct but related purpose in how I can view and think about what I do as a lecturer in terms of knowledge, learning, and pedagogy: 'what [knowledge] is selected for inclusion [specified curriculum]; how it is taught [enacted curriculum] …; and the nature of the teacher's role and relationship with learners [experienced curriculum]' (McCormick and Murphy, 2008, p.4).

In particular, as part of the curriculum design process for individual modules, I am required to capture student learning outcomes as written descriptions within the *specified curriculum* which I then enact through my chosen pedagogical approach. It is the *enacted curriculum* that links the learning outcomes to the knowledge experienced by students as I teach and assess.

1.4.1 My Role within Higher Education

There are two aspects to my role as a Software Engineering lecturer within the Higher Education institute that employs me. Firstly, I am required to work alongside my fellow lecturing colleagues in the development of Software Engineering programmes. Secondly, I work with students as I enact the specified curriculum for the Software Engineering modules that I teach and assess.

The opportunity to work with my fellow lecturing colleagues happens once every five years during programmatic review which 'involves the campus community and other constituencies (internal and then external) peer review of the programmes in a particular faculty/department, and also takes into account new programmes currently being proposed/processed for approval' (AIT, 2016, p.6). Collectively as a team, as my colleagues and I review existing and develop new programmes, we are required to

> (i) Analyse the effectiveness and the efficiency of each of the programmes approved.

(ii) Review the development of the suite of programmes having regard to the views of education interests, employers, professional bodies, etc.

(iii) Evaluate the physical facilities provided by the institute for the provision of the programmes.

(iv) Review the institute's research activities and projections in the area of study under review.

(v) Evaluate the school/department flexibility in responding to market requirements and educational developments.

(vi) Evaluate the formal links the institute has established with industry/business and the wider community in order to maintain the relevance of its programmes.

(vii) Evaluate the institute's projections for the succeeding five years in specific areas.

(AIT, 2016, p.6)

In the context of new programme development, the team agree the Programme Learning Outcomes before delegating the specification of individual modules to individual lecturers, who are typically considered subject experts. It is then the responsibility of each subject expert to develop the Module Learning Outcomes for each module that has been allocated to them for specification. I have reflected that this approach to the design of programmes has led to the creation of 'silos in education … a simple structure that keeps things compartmentalized, organised, and safe' (Zahradnik, 2018). In developing both the Programme and Module Learning Outcomes, the programme team and subject experts must take into consideration the perspectives of the various stakeholders identified in the preceding paragraph.

After each module has been specified by the subject expert, the team reviews the Module Learning Outcomes for each module to ensure their consistency with the Programme Learning Outcomes. The newly specified programme is then submitted to the institute's Academic Standards and Quality Group for approval.

In contrast, I work with students every day of every week during the academic year. It is my responsibility to enact the modules that I teach. In this role, I am an independent agent with the freedom to determine and implement the pedagogical approach that I chose for each module I teach. The teaching, learning, and assessment activities that I implement are not reviewed or questioned by my fellow lecturing colleagues due to our implicit acceptance of maintaining silos in education where everyday activities within the classroom conform to the following principles: 'one

teacher per room, every subject its own class or time frame, and every child his or her own desk!' (Zahradnik, 2018). In my practice prior to this inquiry, I have reflected that I accepted this silo approach to education. I now see that this approach contributed to my sense of frustration with my practice, particularly as colleagues and I typically did not discuss or share pedagogical practices with each other.

1.4.2 What Constitutes a Software Engineering Curriculum?

Software Engineering is concerned with the development and integration of large complex software systems comprised of many components where no one engineer understands the whole system (Sommerville, 2016). Higher educational institutes must be 'aware of industry requirements for software engineering graduates and to tailor the curriculum and teaching and learning practice to better fulfill these' (O' Leary et al., 2006, p.1) needs by bringing students through a curriculum to graduate as competent software engineering practitioners. Industry expects that these software engineering graduates must be able to do the following:

> 1. Show mastery of the software engineering knowledge and skills necessary to begin practice.
> 2. Work individually or in a team to develop quality software.
> 3. Make appropriate trade-offs within the limitations imposed by "cost, time, knowledge, existing systems, and organizations."
> 4. Perform design in one or more domains using software engineering approaches integrating "ethical, social, legal, and economic concerns."
> 5. Demonstrate understanding of and apply current theories, models, and techniques necessary for software engineering.
> 6. Demonstrate skills such as interpersonal negotiation, effective work habits, leadership, and communication.
> 7. Learn new models, techniques, and technologies as they emerge [Lifelong Learning].
>
> (Lethbridge et al., 2006, p. 20)

As part of my practice, I have come to recognise 'the need for educational institutes to be more aware of industry requirements for software engineering graduates and to tailor the curriculum and teaching and learning practice to better fulfill these' (O'Leary et al., 2006, p.1) demands within the context of the 'rapid development of [the] software industry' (Guo, Yan, and Xu, 2011, p.442) occurring at the start of the twenty-first century.

1.4.3 Software Engineering Education and Pedagogical Research

To remain relevant to the ever-changing demands of the software engineering industry, there has been a shift within the research of Software Engineering education and pedagogy to integrate

> theory and practice, so that the learner develops both a deep understanding of the academic discipline and the skills to solve real-world software engineering problems, in all their facets and complexity. In the last decade, value has been found in pedagogical approaches which try and meet this challenge by presenting learners with real-world open-ended situations, rather than toy examples and fictitious software problems: learning through tackling real-world open-ended problems narrows the gap between what students do as part of their study and what they encounter when working in the industry and, as such, is a welcome advancement in the way our discipline is taught. (Hall and Rapanotti, 2015, p.311)

This shift moves away from the notion that the structure of Software Engineering coursework should rely 'heavily on theoretical classroom teaching' (Gondhalekar and Bojewar, 2013, p.27) as research has demonstrated that that the success of students in learning 'depends greatly in their ability to develop competence, and perhaps more importantly, a sense of confidence in their software development skills' (Johnson, Port and Hill, 2016, p.8) that enables them 'to deliver high-quality, robust, secure code when working with team members' (Beecham et al., 2017, p.9).

In 2012, at the *First International Workshop on Software Engineering Education Based on Real-World Experiences*, in thinking about how to integrate theory and practice, software engineering researchers and educators presented their research and experiences in

- '[t]eaching requirements engineering with authentic stakeholders' (Gabrysiak et al., 2012, p.1) or real clients,
- '[t]eaching software engineering with projects' (Ludewig, J. and Bogicevic, 2012, p.25), and
- facilitating students to learn the important skills of '[t]eamwork, coordination and customer relationship management skills [by] employing

Agile Methodologies [within a] Global Software Development' (Damian and Borici, 2012, p.37) environment.

In addition, Damian and Borici (2012) encouraged and facilitated students to reflect about how 'to enhance their skills and add to their repertoire of experiences from which they can draw' (O' Leary et al., 2006, p.5) by interrogating their metacognition as they make decisions and solve problems within the context of working as part of a Software Engineering team. This idea that students learning to become software engineers can draw on their prior experiences as they analyse different potential solutions until the presented problem is solved is seen as an essential skill within a person's professional practice (Schön, 1983). Such reflective practice is seen as a means to nurture students' 'ability to *learn how to learn*' (O' Leary *et al.*, 2006, p.7, original italics).

As industry requires that Software Engineering students learn to incorporate both technical and soft skills into their practice and decision-making, the use of real world projects within Software Engineering education is seen as an effective approach to improve both the technical and 'soft skills of the graduate students to meet the needs of employers, and thus increase their employment prospects' (Khakurel and Porras, 2020, p. 1). Past studies have demonstrated that projects can be an efficient method through which to teach students the required technical and soft skills required by industry (Karunasekera and Bedse, 2007; Mohan *et al.*, 2010; Kauffmann and Dixon, 2011; Bastarrica, Perovich, and Samary, 2017).

Of particular interest to this research inquiry is the state of educational research into the teaching of '[a]gile software development' (Ashmore and Runyan, 2015, p.1) approaches employed within the Software Engineering industry. In thinking about researching and transforming my practice, I found that the work of Mahnic (2012, p.99), who researched and implemented a course on 'Agile Software Development Using Scrum', resonated with my experiences of the group project work that I had engaged with in my past practice as a Software Engineer.

Mahnic (2012, p.100) designed a course which required students to work as part of a scrum team 'in a near-world environment, augmenting the scrum method with user

stories, release planning, and velocity tracking'. The first three weeks of the course focused on formal lectures teaching the theory of scrum and user stories, while the majority of course followed the structure of a typical scrum project implemented in industry, where the remainder of the semester was divided into three sprints with the duration of each sprint being three weeks. He observed, surveyed and analysed student behaviour as they engaged with the scrum process for the first time to understand students' learning with respect to estimation and planning skills by asking the following questions: '1) How does the ability [of students] to plan improve through iterations? 2) How does the velocity change from iteration to iteration? 3) How accurate are initial estimates?' (Mahic, 2012, p.102).

Mahnic's research resonated with me as a lecturer and provided me with the belief that I too can and must research my pedagogical practice as part of my everyday practice. I concluded that I must integrate and continuously engage with research activities and transformative actions within my professional practice to remain relevant to the needs of both the software industry and the students learning to become software engineers.

1.4.3.1 Researching my Pedagogical Practice

Much of the Software Engineering education literature that I reviewed in the previous section focuses on the change in student behaviour as a result of the newly implemented pedagogical practices rather than the change of behaviour that occurs within the teacher themselves due to their lived experiences as they enacted those practices. In taking such a stance, these authors' research methodologies differ from the Living Educational Theory (Whitehead, 1989) approach that I adopted within this inquiry. I choose this methodology because I identified that a Living Educational Theory approach provides an unique perspective through which to understand how to best integrate the theory and practice of software engineering where I, as an educator, would develop pedagogical practices to meet this goal. This approach to research allows me to focus on and develop personal knowledge about the transformative pedagogical practices that I develop through my direct and first-hand experiences as I enact the curriculum on behalf of students.

In my mind this utilisation of the Living Educational Theory approach shifts the focus in software engineering educational research onto the educator as a means to understand and develop pedagogical practices that provide the best possible way to teach, learn, and assess activities that integrate the theory and practice of software engineering in a meaningful and relevant way that both meets the demands of the software industry and the learning of students becoming competent software engineering professionals. In taking this approach I do employ 'student feedback to inform and improve my practice' (Griffin, 2013, p.62).

A Living Educational Theory approach has been employed to research and transform a variety of pedagogical situations and practices ranging from improving the teaching and learning activities of Higher Education practitioners (Hartog, 2004; Farren, 2005) to the use of 'Irish language e-portfolios [in a] primary classroom' (Clerkin, 2009, p.32) to supporting 'primary education students' creativity in design and technology' (Jackson, 2009, p.257) to enhancing 'the teaching of literacy' (Lothian, 2010, p.iii) and to encouraging 'higher order thinking among… students of mathematics' (Rooney, 2012, p.99). However, I did not discover any publications linking the use of a Living Educational Theory approach as a means to inquire into software engineering educational and pedagogical practices. It is from this perspective that I believe I have discerned a gap within the literature and identified an opportunity to research in the domain of Software Engineering education and pedagogy. This thesis is my contribution to the development of a Living Educational Theory within this domain.

1.5 Personal Experiences

In this section, I have identified different sets of experiences that I feel helped me to make sense of the nature of my practice (described in the vignette) and to decide to pursue this inquiry. How I conducted my pedagogical practice prior to this inquiry has its' origins in the experiences that I had while growing up, being educated, and working as a Software Engineer.

1.5.1 Growing Up and Becoming Educated

My parents placed a high value on the importance of family, church, education, and employment. On the one hand, the society that I was born into was considered 'rational, industrial, urban, and… capitalist' (Share, Corcoran and Conway, 2012, p.12, p.38) but on the other also guided by a strong religious ethos. My upbringing was influenced by the values deemed important by a society instructed by religion and informed by my gender, sexuality, class, and race (Giddens and Sutton, 2013). I learned to know my place in the world, which valued 'rational action… involving the application of knowledge, calculation and rules' (Share, Corcoran and Conway, 2012, p.12), to ensure that society functioned without any challenges to the status quo (Roche, 2007). My parents taught me to accept things as they were – the concept of the modern nation state, compartmentalisation of social life, education as a commodity, and the economy incorporating the concept of an economic individual as the central bias within society (Spretnak, 1999) - partly due to their religious beliefs where the Catholic Church 'lay down standards of acceptable behaviour, of good and evil [which operated] to govern the behaviour of populations' (Share, Corcoran and Conway, 2012, p.326).

I did not actively question what they passed on to me. In hindsight, I now acknowledge that these values instilled in me made me not question the authority, operation, or workings of the influential structures of society, for example the church, the professional classes (such as medicine or law), or educational institutions. It was a culture dominated by a positivistic view of reality in which the notion that an individual had 'agency' (Giddens and Sutton, 2013, p.87) to challenge and change a situation for themselves or others was neither discussed or encouraged. It is only in later life that I have acknowledged to myself that it is within my own capabilities to question and make changes to my life (Sen, 1999) and that knowledge of reality must incorporate both personal knowledge (Polanyi, 1962), a way of knowing that recognises a person's experience, as well as the *know-that* knowledge (Ryle, 1949) privileged by the society that I grew up in.

Still, within this environment, my parents explained the importance of cherishing values of respect, fairness, trust, caring for the less well-off in society, and a good

work ethic built on a determination to succeed. In particular, these values and education were viewed by them as the means to become a productive and economic member of society. My parents recognised that the economic needs of society were served by Higher Education institutions. They believed that Higher Education institutions were an integral part of society, and provided the basis for society's economy with their 'intellectual, educational, scientific, cultural' (Collini, 2012, Introduction) and monetary focus.

A key message for me from my parents as I grew up was to value education to ensure I got pensionable employment. They realised that society was 'meritocratic as jobs need to be assigned to people on the basis of their skills, rather than any inherited social position' (Share, Corcoran and Conway, 2012, p.41). They perceived education as a means for me to maximise my salary. In doing so, I was encouraged not to question educational policies and practices as they were applied to me and my siblings. As an example, I remember that I never questioned why memorised facts, rather than intellectual curiosity, enquiry, and creativity, were valued in school and college. These values, prioritising the economic individual with a formal Higher Education qualification, were seen by my parents as providing the foundation for a good life. This was their (and my) worldview in which the 'human is considered essentially an economic being' (Spretnak, 1999, p.40) with 'humankind in a glass box on top of nature' (Spretnak, 1999, p.66).

In particular, for my mother, this was a bitter-sweet position that she advocated. In a society, where social identities were constructed from categories such as social class, profession, occupation, and gender (Giddens and Sutton, 2013) she was denied the opportunity to continue working professionally outside of the home after she married. Although, she 'suffered from legal discrimination in [the area of] employment' (Share, Corcoran and Conway, 2012, p.106) she conformed with societal expectations while still instilling the same expectations and values in her children. It is only in recent years that she has confided in me how difficult she found it to lose her professional identity. However, she never displayed this emotion to me or my siblings as she encouraged us to become educated. The fact that she lost her professional identity pushed my mother to constantly remind and emphasise to me and my siblings the value of education and employment in one's life.

On reflection, I now have to admit I conformed to this notion of prioritising the economic individual unquestionably as I progressed through primary, secondary, and tertiary education, where the knowledge valued was explicit discipline-specific knowledge and easily objectively assessed. Society required that I paid for Higher Education as a precursor to my search for the highest paid employment possible. I now see that my search for employment was regulated by the educational and economic structures of society but that society also taught me to regulate myself within the context of its educational and economic needs (Giddens and Sutton, 2013). I now recognise that my behaviour as a student (and professional software engineer) was influenced by my perceived obligation 'to meet the needs of the market'(Busch, 2017, loc. 141) and society in general.

I have also recognised that these personal experiences influenced the pedagogical approach that I enacted when I started to teach Software Engineering in 1996. I was educated as a student and trained as a software engineer to rely on explicit propositional discipline-specific knowledge. As a result, as a lecturer, I taught students as I myself was traditionally taught - to accept the status quo and not 'to question the system [I] live in and the knowledge being offered' (Shor, 1993, p.28) to me. I deliberately positioned myself and behaved as the knowledge expert within the classroom. I had automatically and unquestionably adopted a pedagogy characterised by the one-dimensional transmission of explicit knowledge to passive students (Freire, 1970). I had yet to encounter the concept of '[s]tudent-centred learning …an umbrella term to describe efforts for students to become actively engaged in their learning and for teachers to design and facilitate the learning process' (Trinidad, 2020, p.1013).

1.5.2 Working as a Software Engineer

By subscribing to society's values and becoming an 'educated person' (Murphy *et al.*, 2008, p.43) in the sense of acquiring higher-level qualifications, I reaped the rewards promised by my parents and society. After graduation, I focused on working hard in pursuit of making money. On graduating from college I immediately found pensionable employment with a large US multinational. This employment was obtained on the basis of my research M.Sc. in Computer Science. In this role I travelled internationally and had excellent performance reviews which resulted in higher pay

and faster promotion than my peers. In hindsight I now know I bought into this culture, with its focus on the company's shareholders, which resulted in greater rewards for the employees who could increase company and shareholder value.

For nearly 10 years I embraced this culture as I changed employment every 18 to 24 months in order to move up the corporate ladder in terms of position and salary. As I did so, I was accepting of the bureaucratic nature of the organisation I worked for. As a new graduate Software Engineer I had a rationalist view of knowledge as my Bachelors and Masters of Science degrees in Computer Science 'revolve[d] around formal aspects of knowledge…primarily on cutting edge technology… to reproduce knowledge or to model human functions' (Lejeune, 2011, p.92). One such project, where I managed a team of thirty software engineers, involved the specification, design, development, and testing of a software system to manage the operation of an Intensive Care Unit Ventilator which had the capability to reproduce paediatric, adult, and geriatric breathing patterns.

As a more experienced Project Manager I thought 'the only knowledge worth pursuing is that which has more or less immediate market value' (Busch, 2017, loc. 133) in terms of the cost of development and the price of the software products that the company produced. But my success as an employee was due to skills or knowledge I did not overtly acknowledge – 'analytic reasoning, critical thinking, ability to generate fresh ideas, the practical application of theory, ease in written communication, leadership ability, and the ability to work in a group' (Hunt, 2011, p.57). These skills and knowledge of applying these skills, which I constantly developed over time as I continued to become a competent software engineer, provided me with knowledge to engage and problem-solve in different, unique, and complex situations with various individuals and groups. On reflection, in some instances my use of such 'knowledge is indescribable' (Schön, 1983, p.ii) as it reflects an intuitive feel that I developed to solve problems over time as I progressed from one project to the next. Such indescribable knowledge, developed and learned through experience, is difficult to place a market value on. I now realise that this type of knowledge, tacit and intuitive in nature (Gascoigne and Thornton, 2013), is crucial to the successful delivery of unique software products and what it means to be a competent Software Engineering professional.

I finally began to question this view of the world on the death of my father. My father was self-employed, fulfilled '[t]he traditional image of the male breadwinner' (Share, Corcoran and Conway, 2012, p.198) within the family, had to work long hours at the expense of spending time with his family, and died well before retirement age. At the time of his death I had been married less than 2 years but was working in excess of 60 hours per week for my American masters. As a 31 year old, in society's eyes, I was a successful (economic) human being. Reflecting now, I see I had reached this point in my life by playing the rules of the economic game as espoused by my parents and society. Unlike now, along the way I never questioned my reality or how my identity as a person or practitioner had evolved over time (Wenger, 1998) as I chased the economic dream. For reasons that I was unable to articulate then, I left the economic ideal and American dream behind, took a pay-cut and became a lecturer in a Higher Education institute.

1.6 Rethinking My Practice as a Software Engineering Lecturer

While reflecting on the nature of my practice in the couple of years preceding this PhD study, I became critical of the discourse on the commodification of knowledge as it relates to the definition and development of an educated person within Higher Education (Giroux, 2002). I recognised that I had come to characterise an educated person by the explicit knowledge they acquire through engagement with accepted Higher Education institutional policies and practices. Within this discourse, education is perceived to reflect 'humanity's urge to shape nature through the application of rational knowledge [where] through learning about and knowing the world, we can better control it' (Share, Corcoran and Conway, 2012, p.146).

For me this discourse highlighted that I had neglected within my practice that a primary purpose of education is to 'help [students] grow up, to learn who they are, to search for a larger purpose for their lives, and to leave college better human beings' (Lewis, 2006, p. xii). I have reflected that within my past practice that I did not 'provide students with the opportunity to initiate and pursue an inquiry into their role in society, an inquiry that makes learning personal, meaningful, and relevant' (Barbezat and Bush, 2014, p.8).

As a Software Engineering educator, I had become concerned that the role of Higher Education in society was narrowly conceived with its primary focus on the development of productive money-making individuals for entry into the economic marketplace. I reflected that these educated persons or graduates are valued for the formal qualifications bestowed upon them by their institutions.

I had observed within my professional practice that I had privileged explicit software engineering discipline knowledge over tacit knowledge within such formal qualifications (Murphy *et al.*, 2008). I have experienced that this has resulted in graduates who have no 'professional ethic, [no] sense of communal responsibility, or even simple compassion [resulting in] an ethical gap between an educated person and a world that is inevitably impacted by his or her actions' (Palmer cited in Barbezat and Bush, 2014, p. i). However, I thought this ethical gap can be bridged through my professional practice if I as a member of society remember once again that the primary purpose of education is to ensure the 'social continuity of life' (Dewey, 1916, p.1) by taking into account the ecological knowledge of communities in connection with their environment (McIntosh, 2012) and different ways of knowing (Ryan, 2009), to inform solutions to real-world problems which no longer relied on rational thinking as the dominant way of knowing.

In my mind this meant recognising that the conception of learning or ways of knowing within my practice was inadequate as 'the simple acquisition of knowledge is not enough to count as education' (Hunt, 2011, p.57). I began to explore the nature of Software Engineering Knowledge that should be incorporated within the Software Engineering curriculum that I specify and enact.

Chapter 2 - The Role of Knowledge within my Pedagogical Practice

2.1 Introduction

In this chapter, I inquire into the nature of the knowledge that should be privileged or valued within a Software Engineering curriculum. In doing so, I describe the Software Engineering knowledge that is the focus of my pedagogical practice. I discuss the notion of 'professional knowledge' (Schön, 1983, p.13) as it applies to the Software Engineering profession. I further explore the concepts of explicit and tacit knowledge and how they relate to the notion of professional knowledge. I describe an epistemology of Software Engineering Professional practice, built upon the concepts of reflective practice (Schön, 1983; 1987) and communities of practice (Wenger, 1998), which privileges both the explicit and tacit professional knowledge required by Software Engineers. I finally discuss the implications of such an epistemology for a Software Engineering curriculum.

2.2 Software Engineering Knowledge

Software Engineering or '[s]oftware development is a knowledge intensive process, where knowledge is created and shared, when different aspects of a software development process (concepts, products, tools, processes, people, etc.) interact with each other' (Ryan and O' Connor, 2013, p.1614). It is also a 'profession in which a knowledge of the mathematical and computing sciences gained by study, experience, and practice is applied with judgement to develop ways to utilize, economically, computing systems for the benefit of mankind' (Tockey, 1999, p.2).

As a software engineering practitioner, experience has shown me that Software Engineering is a practice-based or hands-on profession normally structured around group work. It is a practical 'profession [that] involves the application of general principles to specific problems' (Schön, 1983, p.21) requiring software engineers as professionals to employ knowledge of their profession or practice typically in the context of unique, uncertain, and complex problems mediated by particular situations or contexts. As such, I perceive Software Engineering as an applied profession

concerned with the production of software (or software products) to solve complex computer problems across an array of possible business domains, such as, finance, automotive, retail, telecommunications, and medical (Sommerville, 2016).

Production of software typically follows a defined Software Development Life-Cycle consisting of a series of planned activities (Sommerville, 2016). These software development activities involve specifying the requirements or functionality for the software system, designing and developing the software product, testing the product, releasing the product for use, and maintaining the product after release to the customer. Software Engineers can choose from a variety of Software Development Lifecycles, such as the Waterfall Model, the Spiral Model, or the Scrum Approach, that exist to structure and manage these software activities required to create a software product (Sommerville, 2016). Software Development Lifecycles are typically categorised as either employing a plan driven approach or an agile approach to the production of a software product.

2.2.1 Plan Driven Approach

In a plan driven approach all software development activities are planned in advance and progress is continually measured against this plan as the product is being built (Sommerville, 2016). Normally, a plan-driven approach starts by eliciting and documenting a complete set of customer requirements or features for the product to be built. Based on the identified requirements, the goal is to deliver the completed software product at the end of the development activities to the customer. Critics of plan driven approaches, such as the Waterfall Model, view the organisation of the project as 'too linear, dogmatic, systematic and constraining' (D'Souza and Rodrigues, 2015, p. 829). This results in plan-driven Software Development Lifecycles being reliant on well-defined processes, identifying how the software activities should be carried out, and corresponding documentation, detailing these software activities, in an effort to meet the plan put in place before the project even started. Essentially each software activity produces one or more outputs, typically in the form of documentation and/or code, which signify the completion of that activity. These outputs, in turn, act as inputs to start or drive the next software activity identified in the plan.

During the lifetime of a plan driven project this approach to developing software hinders the ability of software engineers to respond effectively and efficiently to changing requirements (Ashmore and Runyan, 2015). Changing requirements necessitates that the original plan be reviewed to determine the impact of any change on all of the software activities within the development cycle, including software activities already completed earlier in the project. If changes are accepted, then in all likelihood, the new adjusted plan will require software engineers to revisit and modify previous software activities that had been already completed. Potentially, this means that the original completion date for the project may need to be adjusted and extended (Sommerville, 2016).

2.2.2 Agile Methodologies

The agile approach was developed in response to such perceived criticisms of the plan driven approach in a knowledge economy where '[c]ustomers became increasingly unable to definitively state their [requirements] up front' (Williams and Cockburn, 2003, p.39), resulting in the world of technology becoming 'increasingly inundated with requests for new (software) features [and software engineering teams needing] a new way to respond quickly to these demands to stay competitive in the changing market' (Ashmore and Runyan, 2015, p.2). Within an Agile approach, planning is incremental in that (incomplete) versions or increments of the software being developed are made available to the customer for review and feedback purposes. Developing the software as a series of increments makes it easier to respond to and incorporate changing requirements as the software product is being developed. Responding to and incorporating changing requirements is based on the 'Agile Manifesto' (Fowler and Highsmith, 2001, p.28). It clearly states that '[w]e are uncovering better ways of developing software by doing it and helping others do it' (Ashmore and Runyan, 2015, p.4). In developing software the Agile Manifesto further states that software engineers must value: 'individuals and interactions over processes and tools, working software over comprehensive documentation, customer collaboration over contract negotiation, and responding to change over following a plan' (Williams and Cockburn, 2003, p.39). The Agile Manifesto concedes that there is value in processes and tools, comprehensive documentation, contract negotiation, and following a plan (essentially the main characteristics of a plan-driven approach)

but it values individuals and interactions, working software, customer collaboration, and responding to change (the main characteristics of an agile approach) more.

Ashmore and Runyan (2015) explain the importance of these values. Individuals working within teams are central to the agile approach. An agile approach requires that people talk and work together face-to-face as it recognises trust, communication, and relationships are more important than following strict processes, use of elaborate tools, and sharing ideas through documentation. Rather than just describe the features of the software product in a document, the value of working software recognises that the software development process is a creative activity that is better served by building working increments of the product with limited functionality that the customer can try and thus provide meaningful feedback on the direction of the product to date. Customer collaboration emphasises the need for continuous and regular interaction between software development teams and customers to ensure that both sets of stakeholders are in constant agreement that the development of the product is headed in the right direction. Responding to change recognises the only certainty within software development - change is inevitable. This idea of change requires software engineering teams to be able to respond and adapt to regular change requests from customers rather than adhering strictly to a plan.

2.3 Explicit, Tacit, and Professional Knowledge

I draw on and relate conceptualisations of explicit, tacit, and professional knowledge throughout this thesis as I inquire into my main research question: *How can I, as a lecturer, improve my pedagogical practice to value tacit Software Engineering knowledge?*

The plan-driven approaches and agile methodologies, discussed in the previous section, are examples of software engineering 'professional knowledge' (Schön, 1983, p.13) that students are expected to learn and to become proficient in applying that knowledge as competent practitioners. Schein identifies three components of professional knowledge that contribute to professional competence:

1. An *underlying discipline or basic science component* upon which the practice rests or from which it is developed.
2. An *applied science or "engineering" component* from which many of the day-to-day diagnostic procedures and problem-solutions are derived.
3. A *skills and attitudinal component* that concerns the actual performance of services to the client, using the underlying basic and applied knowledge.

(Schein cited in Schön, 1983, p.21, my italics)

These aspects of professional knowledge can be classified as either explicit or tacit knowledge. Ryle (1949) defines explicit knowledge as "knowing that" knowledge, which can be definitively articulated and is comprised of 'the theories and techniques of [the] basic and applied science' (Schön, 1983, p.27) components of professional knowledge. Ryle characterises tacit knowledge as "knowing how" to engage with the skills and attitudinal component of professional knowledge needed to solve real-world concrete problems using theories and techniques. Such tacit knowledge refers to a person's ability, disposition, and skill to engage in practice competently, skilfully, and intelligently.

Polanyi (1962; 1966) observed that human beings privileged the codification and acquisition of explicit knowledge even though much of human knowledge is tacit. He introduced the concepts of *tacit knowledge* and *tacit knowing* as he recognised the importance of a person having the ability to tacitly acquire knowledge from experience where, for example, 'important aspects of professional competence and expertise cannot be represented' (Eraut, 1994, p.15) solely in terms of explicit knowledge.

Polanyi (1962) exemplifies the difference between tacit and explicit knowledge through his example and description of riding a bicycle. He recognised that many people, capable of riding a bicycle, when asked did not know how to describe how turning the handlebars prevents falling to the right or left. Although capable of riding a bike these people could not say how they managed to stay upright - essentially a form of tacit knowledge which 'can be understood as an accumulated product of thinking and action, and also as a process during action' (Toom, 2012, p.621).

This notion of tacit knowledge is seen as a form of personal knowledge developed from both an individual's experience and intuition (Polanyi, 1966). It is 'context-

dependent, conceptually structured, [consists of] practical know-how' (Gascoigne and Thornton, 2013, p. 168) and 'expresses itself in human actions in the form of evaluations, attitudes, points of view, commitments, motivation, etc' (Koskinen, Pihlanto and Vanharanta, 2003, p.281). Such personal knowledge is involved in every act of knowing where 'there enters a passionate contribution of the person knowing what is being known, and that this coefficient is no mere imperfection but a vital component of his knowledge' (Polanyi, 1962, p. viii). In fact, Polanyi contends that all knowledge is personal in the sense that it is tacit and rooted in the tacit dimension where there is an unobserved and background structure to thought in which 'we can know more than we can tell' (Polanyi, 1966, p.4).

2.4 An Epistemology of Software Engineering Professional Practice

A Software Engineer typically works on standalone projects and is required to apply the basic and applied science knowledge components of the profession in a 'systematic, disciplined, quantifiable approach to the development, operation and maintenance of software' (Peckman and Lloyd, 2003, p.29) systems. To specify, design, and build these systems software engineers follow processes and procedures, such as those espoused by Agile Methodologies. In doing so, the engineer must also be creative, be a team player capable of working on his/her own if required, be able to bring past experience to bear on a problem, be able to handle unforeseen events and problems, be capable of responding to client needs, and be able to manage time well (Li, Ko, and Zhu, 2015) by exercising the skills and attitudinal component of their software engineering professional knowledge.

Throughout their careers, software engineers work on different projects with different individuals and teams. Within this conception of software engineering professional practice, 'individuals and groups make use of knowledge in interaction with the things and activities of the social and physical world [where] it is possible to draw [from both explicit and tacit] forms of knowledge within the same activity. (Cook and Brown, 1999, p.392-393). It is by taking action and working in this way that Software Engineers use and develop their professional competency. This notion of competency represents

what a person is required to carry out (a given ability) as well as any specific talents (skills, know-how) that the person could employ [in] contexts characterised by repetition, routine and simple tasks, carrying out instructions, and strict regulations. However, in contexts of uncertainty, innovation or complexity, competency is defined more in terms of knowing how to act and react. (Lejeune, 2011, p.93)

In using and developing their competency, software engineers gain tacit knowledge unknowingly. Having being acquired through experiences, such tacit knowledge is intangible and difficult to verbalise.

2.4.1 The Role of Reflective Practice

In the context of professional learning, the terms *reflection* and *reflective practitioner* have been associated with Schön (1983; 1987). In particular, Schön (1983, p.12) recognised that there are times or episodes of practice where professional practitioners, such as software 'engineers', experience not *knowing how to <u>act</u> and <u>react</u>*, within ill-defined situations involving complex problems, where they make use of tacit knowledge to resolve the practical problems they encounter. In such situations, it is possible for professional practitioners to reflect on these problems and solutions developed as a means to 'uncover the tacit dimension of their experience and gain new insights' (Hasenstab and Pietzonka, 2019, p.1). Such reflection provides an opportunity for a reflective practitioner to engage with a learning experience and develop their competence or expertise by honouring knowledge created outside institutions, challenging existing knowledge, and valuing personal experience (Fenwick, 2004).

Schön observed that within professional practice actions played a part 'in shaping the content of tacit knowledge' (Matthew and Sternberg, 2009, p.531). Schön's (1983; 1987) theory of reflective practice employs the concepts of knowing-in-action, reflection-in-action, and reflection-on-action. His theory emphasises the relationship between a person's intuition as they engage with actions and the development of their competence in which the process of reflection is perceived as a means to understand and combine tacit knowledge and ability (Kinsella, 2010).

The concept of knowing-in-action acknowledges the intuitive ability of practitioners to know how to perform a task without the need to overtly think about how they know to act. Essentially knowing-in-action captures a practitioner's knowing how to perform everyday actions of practice that are not problematic. Such knowing-in-action is seen as ordinary practical knowledge that is tacit, inuitive, and spontaneous knowing which enables skilful action or performance (Newman, 1999).

Schön (1983) identified that the practice of reflection can be engaged with when actions lead to unforeseen or unpredictable outcomes within professional practice, where a practitioner's usual response to the situation is inadequate to resolve the presented problem. He argues that alternative responses, employing the processes of reflection-in-action or reflection-on-action, prompt a practitioner to think about the action taken and the outcome observed and in doing so can draw the practitioner's attention to the tacit knowledge present in their response. Reflection-in-action is defined as reflecting on an activity while in the midst of it. Reflection-on-action is undertaken retrospectively after the action has finished. Schön suggests that the knowledge constructed through such reflective conversation is both unique and changeable within the situated context of professional practice.

Both Kinsella (2007) and Harris (1989) observe that Schön's reflective model does not create a dichotomy between explicit and tacit knowledge within professional knowledge. Instead, Schön's (1983) reflective model promotes and acknowledges that professional practitioners, in taking action, learn to develop as competent individuals through engagement with both the explicit knowledge of their profession and their own experiences, where they

- Usually know more than they can say,
- Exhibit a knowing-in-practice, most of which is tacit,
- Have the capacity for reflection on their intuitive knowing in the mist of action, and
- Have a capacity to cope with unique, uncertain, and conflicted situations of practice.

(adapted from Schön, 1983, p. i - ii)

The practice of reflection as described by Schön (1983) is one approach that can be enacted to help to integrate the 'theory and practice' (Hall and Rapanotti, 2015, p.311)

that students experience as they develop their professional knowledge and competence within a Software Engineering curriculum.

2.4.2 Learning Within a Software Engineering Community of Practice

It is recognised that tacit knowledge and knowing can be developed and shared among practitioners 'through methods such as observation, imitation, socialization…' (Lejeune, 2011, p.95). Shared experiences have been identified as the key to developing tacit knowledge and without which it is extremely difficult for people to share each other's thinking processes (Lam, 2000). Such experiences provide the basis for both the development and effective sharing of tacit knowledge and knowing through extensive personal contact, regular interaction, and trust (Goffin and Koners, 2011). This kind of knowledge and knowing can only be revealed through practice in a particular context and transmitted through social networks or a Community of Practice (Schmidth and Hunter, 1993).

'The concept of the CoP [Community of Practice] was developed to account for the social nature of human learning [and] provides opportunities for members to develop professional knowledge' (Min, Noh, and Paik, 2017, p.6370). 'In software engineering, CoPs have been proposed as a possible solution for functional learning and knowledge sharing between… individuals' (Paasivaara and Lassenius, 2014, p. 1557) through the development of a 'learning partnership among people who find it useful to learn from and with each other about a particular domain' (Wenger, Trayner and de Laat, 2011, p. 9).

The concepts of domain, community, and practice underpin the notion of a Community of Practice. A domain provides the community with its identity and is defined as 'the area of knowledge that brings the community together… and defines the key issues that members need to address' (Wenger cited in Smith, Hayes, and Shea, 2017, p.211) as they collaborate to share and create knowledge. A community consists of the members who come together to learn about the domain through practice by actively engaging in joint activities, forming relationships with each other, and sharing information (Wenger, 1998). Practice is defined as 'a field of endeavour and expertise [experienced as] a way of acting in the world' (Consalvo et al., 2015, p.3) which

requires both knowledge of and engagement with a domain, where members 'develop a shared set of resources for addressing problems… of interest' (Paasivaara and Lassenius, 2014, p. 1557).

2.4.2.1 Negotiation of Meaning

Software engineers are involved in actions (e.g. designing black-box test cases for a method) that require established meanings (e.g. which is the most suitable technique(s) to use or what level of test coverage has been achieved) that must negotiated. Wenger (1998, p.53) asserts that such lived experiences are a 'negotiation of meaning', or meaning making, requiring synergy between the processes of 'participation and reification' (Wenger ,1998, p.63). Wenger argues that all lived experiences, where people interact with the world, are a negotiation of meaning.

'Participation involves acting and interacting' (Smith, Hayes, and Shea, 2017, p.212). Participation is the social engagement in a community by members who perceive their experiences of thinking, being, doing, talking, or feeling as both personal and social. Such participation in a community of practice shapes members' experiences of the world, which in turn shape the community.

'[R]eification involves producing artifacts (such as tools, words, symbols, rules, documents, concepts, theories, and so on) around which the negotiation of meaning is organized' (Smith, Hayes, and Shea, 2017, p.212). The concept of reification is concerned with either conceptual or actual products as well as the process of creating the products of participation. Reification is capable of taking many forms, such as the following software products: a User Requirement, a software architecture, a test case, or a piece of code as well as the processes and practices (capturing, developing, designing, or writing) associated with the creation of these products. In its many forms '[r]eification can refer to both a process and its product [where] the process and the product always imply each other [because] at the level of meaning, the process and the product are not distinct' (Wenger, 1998, p.60).

Participation and reification exist in a duality and complement each other where the 'interplay' (Wenger, 1998, p.43) between the processes structures how learning or

meaning is negotiated within a community of practice. Products produced through participation are understood as reification and together they enable negotiation of meaning. The interplay between participation and reification is delicate, so it is important that the processes of reification and participation complement each other because '[w]hen too much reliance is placed on one [process] at the expense of the other, the continuity of meaning is likely to become problematic in practice' (Wenger, 1998, p. 65). For example, products on their own may be valuable to a community but they may be not completely meaningful. As an illustration consider the process of capturing a User Requirement and the User Requirement itself, which together represent the reification of a software requirements engineer's participation within their community of practice. Although the User Requirement itself can standalone as a product, the engineer might be required to explain the User Story to make it meaningful to other members of the community so that they can design, code, and test an implementation of that User Story.

2.4.2.2 Identity Development

Within a community of practice, the processes of reification and participation shape each member's 'identity' (Wenger, 1998, p.11). Identity reflects how a person sees themselves and how that person is seen by other members of the community. It is temporal, always in a state of flux, is influenced by each individual's 'history of participation' (Murphy *et al.*, 2008, p.74) within the community, and is constantly being constructed through negotiation of meaning where

> learning transforms who we are and what we can do, it is an experience of identity. It is not just an accumulation of skills and information, but a process of becoming – to become a certain person or, conversely, to avoid becoming a certain person. (Wenger, 1998, p. 215)

This idea of identity transformation recognises that individuals may be on different learning pathways or trajectories that mediates how they participate in activities with others and consequently learn. Typically, new members join a community as novices on a trajectory to developing competence and becoming experts. Sternberg (cited in Murphy *et al.*, 2008, p.211) argues that each individual's trajectory in developing competence and expertise is dependent on the 'amount of time for participation and

degree of guidance' available, which results in members (both novice and expert) participating in different ways in the same activity.

When novices join a community their participation begins on the periphery, 'a region that is neither fully inside nor fully outside' (Wenger, 1998, p.117). In such a situation, Lave and Wenger (1991) describe how individuals with different histories of participation can engage in different ways in the same activity. They describe how a newcomer to a community of practice can engage in '[l]egitimate peripheral participation' (Lave and Wenger, 1991, p.29) with an activity structured by an established member or expert of the community. These structured activities 'must engage newcomers and provide a sense of how the community operates' (Wenger, 1998, p.100). This approach enables members, both novice and expert, to create and use knowledge as they collaborate through sharing information and experiences as they assist one another to resolve problems of practice and learn about practice. The knowledge generated and used is dynamic, explicit, tacit, social, and individual (Wenger, 1998; Wenger, McDermott and Snyder, 2002). As long as the ability to negotiate meaning and participate in the activity is present, the newcomer or legitimate peripheral participant 'is enabled to engage in what is important and … to move deeper into practice' (Murphy et al., 2008, p.75).

From an educational perspective, communities of practice have been used to structure the specification and enactment of a software engineering curriculum (Gates, Villa and Salamah 2018).

2.5 Knowledge to be Privileged within a Software Engineering Curriculum

The three components of professional knowledge (see Section 2.3), that underpin professional competence, is the knowledge that must be privileged within a Software Engineering curriculum. In doing so, a Software Engineering curriculum should privilege this explicit and tacit knowledge in a world which recognises that people's actions, senses, and claims about the world are subject to some degree of uncertainty.

In Ireland, the Software Engineering professional knowledge to be privileged within a curriculum must be specified using the learning outcome strand categories established within the *National Framework of Qualifications* (QQI, 2016). There are three learning outcome strands defined, 'Knowledge… Know-how and Skill…[and] Competence' (QQI, 2016, p.21), with each strand consisting of two or more sub-strands. In specifying the curriculum, it is the educator's responsibility to determine how best to capture the various components of professional knowledge using the learning outcome strands mandated by the *National Framework of Qualifications*.

2.5.1 Assessment of Professional Knowledge

The professional knowledge specified in a Software Engineering curriculum must be assessed. Assessment practices must take into account that both the explicit and tacit dimensions of professional knowledge must be evaluated. From an assessment perspective, this means that a curriculum cannot solely employ 'high-stakes summative' (Murphy *et al.*, 2008, p.224) assessment practices, which measure only explicit knowledge as a commodity that belongs to an individual. A curriculum must also incorporate formative approaches (Bloxham and Boyd, 2007) to encourage active student engagement with the learning process in which the assessment of tacit knowledge, 'present in the activity of practice and made available ...through participation' (Murphy *et al.*, 2008, p.218), must take into account the ability of students to act in a range of varied and specific contexts, where they are required to exercise substantial personal autonomy. Such formative assessment approaches encourage student participation, agency, and identity transformation.

The purpose of formative assessment practices must be to explore 'what the learner knows, understands or can do' (Pryor and Crossouard, 2008, p.5). Within such assessment practices both teachers and students should be enabled to initiate feedback, which can be 'exploratory, provisional or provocative, prompting further engagement rather than correcting mistakes' (Pryor and Crossouard, 2008, p.4). This approach is further characterised as employing 'helping questions rather than testing questions' (Pryor and Crossouard, p.4) and encouraging 'self-assessment' (McCormick and Murphy, 2000, p.12) through reflection as learners move between their tacit and explicit understanding of knowledge encountered and learned.

Formative Assessment strategies, which 'focus attention on how people participate and how others change this participation' (Fleer and Richardson cited in Murphy *et al.*, 2008, p.234), can be enacted by an educator to guide and encourage student participation in the negotiation of meaning. These assessment practices must honour knowledge as knowing, embrace a horizontal notion of expertise, recognise the social, cultural and historical experiences of learners, accommodate and guide in a non-deterministic fashion the interplay between reification and participation for the learning task being pursued while promoting agency and identity development (Wenger, 1998; Murphy et al., 2008). In engaging with such assessment practices, students and teachers must understand that 'controlling both participation and reification affords control over the kinds of meaning that can be created in a certain context and the kinds of person that participants can become' (Wenger, 1998, p. 93).

Crossouard (2009, p. 79) suggests 'that educational assessment is powerful in shaping individuals' identities'. In particular, self-assessment encourages and promotes agency, identity development, and learning of professional knowledge. Self-assessment can extend the 'identity-forming processes by making them explicit' (Murphy *et al.*, 2008, p.107) 'which helps learners to see a future trajectory they can identify with' (Boud *et al.*, cited in Murphy *et al.*, 2008, p.231). Through self-assessment learners develop critical awareness and become self-managing in the process of identifying their next steps in learning (Murphy *et al.*, 2008). Hubbs and Brand (2010, p.57) state that reflective journals can be employed, amongst other things, as 'a strategy for meaning making' within self-assessment practices. Reflective journals can stimulate 'thinking about and interpreting experience in order to learn from it… [and] can be a means for developing self-awareness and self-knowledge' (Rykkje, 2017, p.2). Such reflection takes many forms where it can be 'tacit or embodied, or intentional and based in reason' (Kinsella cited in Rykkje, 2017, p5).

Section 2 – Methodology

Section 2, *Methodology*, consists of two chapters.

In chapter 3, *Living Educational Theory*, I discuss and justify my choice of the Living Educational Theory approach using Action Research as my chosen methodology for this educational research inquiry. In doing so, I explain why I found myself drawn to the concept as a means to think about and report on this research into my practice.

In chapter 4, *Implementing my Action-Reflection Cycles*, I introduce and briefly explain the three action-reflection cycles that I undertook as I worked towards developing and generating my living educational theory as I inquired into my main research question.

Chapter 3 – Living Educational Theory

3.1 Introduction

In this chapter, I explore the origins of the Living Educational Theory approach to educational research and discuss why I found myself drawn to the concept as a means to think about and report on this research into my practice. I describe how an action research methodology underpins the Living Educational Theory approach adopted in this research. I discuss both the role that values and the idea of being a 'living contradiction' (Whitehead, 1989, p.41) have in the generation of a living educational theory. I explain how the values of justice, democracy, and care are the living standards of judgement by which I judge my practice and the validity of the living educational theory that I have created.

3.2 Approaches to Educational Research

As part of my doctoral studies, one of the earliest decisions that I had to make during my enquiry was to choose an appropriate research paradigm or worldview to identify the set of ontological and epistemological assumptions, methodological restrictions, data collection and analysis approaches, and judgement criteria that I would employ to direct my PhD study (Cohen, Manion and Morrison, 2011). The reason for choosing a worldview as a means to conceptualise an educational research project is to provide me, as a researcher, with a lens to structure and direct my enquiry into my own practice (Cooper *et al.*, 2011). From my perspective, as a researcher, the choice of worldview forefronts 'what a researcher thinks can be researched (her ontological position) linking it to what we can know about it (her epistemological position) and how to go about acquiring it (her methodological approach)' (Grix, 2004, p.68). It is a particular position 'on the best ways to think about and study the social world' (Thomas, 2009, p.77) that is my professional practice.

Positivism and interpretivism are two examples of recognised research paradigms employed within educational research (Crotty, 1998; Cohen, Manion and Morrison, 2011). Interpretivists view theory as a collection of 'concepts and sets of relational

statements [to]… be used to explain, in a general sense, what is going on' (Strauss and Corbin, 1998, p.145) within the social world. Such explanation contrasts with the positivist notion of theory 'as a set interrelated constructs [concepts], definitions, and propositions that presents a systematic view of phenomenon by specifying relationships among variables with the purpose of explaining and predicting the phenomenon' (Kerlinger, 1970, p.9). For me, one of the main difference between these research traditions is that the nature of theory as a form of explanation within the interpretivist approach does not equate to the notion of prediction within positivist theories.

Ercikan and Roth (2006, p.21) state that '[t]he purpose of research is to generate knowledge … [and] suggest that research questions, not method, ought to drive educational research'. On the basis that I had posed the question *How can I, as a lecturer, improve my pedagogical practice to value tacit Software Engineering knowledge?*, I identified that I needed a research paradigm which supported me to theorise my own professional practice as I took action to transform it for the better. Such a research methodology requires a 'personal-professional orientation [which] attends to the insights gained by the researcher as she or he engages in a critically reflective process before, during, and after a situation that she or he is facilitating and inquiring into' (Orland-Barak and Becher, 2011, p.120).

I had determined that my research question is the type of research question in which 'teachers as researchers' (Kincheloe, 2012, p.17) participate, is practical in nature, and open to change with a view to continuously transforming practice. Teachers as researchers position themselves both as a practitioner and researcher within their inquiry (McNiff and Whitehead, 2011). As a practitioner-researcher I am interested in understanding my practice and my position within it, rather than trying to quantify and measure what I do as a lecturer. While reflecting on this perspective, I discovered the writings of Jack Whitehead (1989, 2000, 2007) in which he critiqued the traditional positivist approach to research within the academic discipline of education. Instead, he proposed an alternative and systematic research approach, called 'Living Educational Theory'(Whitehead, 1989, p.41), to describe and explain professional educational practice.

3.3 Origins Of Living Educational Theory

Kurt Lewin (1946) is credited as being the first person to employ the term *action research*. He described *action research* as a 'a comparative research on the conditions and effects of various forms of social action and research leading to social action' (Lewin, 1946, p.35). Such research employs 'a spiral of steps, each of which is composed of a circle of planning, action, and fact-finding about the result of the action' (Lewin, 1946, p.38) to enable researchers to best understand social situations by trying to change them.

Within the context of practitioner research, where there is a professional intent to intervene to improve social practice, Norton (2009) identifies two schools of thought or traditions within Action Research, British and American, while Mills (2018) recognizes a third, the Australian school. Another perspective is provided by Feldman, Paugh and Mills (2004) who, in describing a taxonomy of practitioner research, identify three traditions under the umbrella of action research. These approaches are traditional action research, the teacher-as-researcher movement, and the North American movement. Norton (2009, p.51) states that the British school 'links research to improvement of practice and is education oriented [while the American school] links research to bringing about social change' and has its roots in John Dewey's progressive education movement (Noffke, 1994). Research within the Australian tradition is 'located within a broad ranging movement toward collaborative curriculum planning' (Mills, 2018, p. 12).

The teacher-as-researcher movement came about in response to the tradition of social science research in education where a professional researcher enquires into a classroom setting with little or no regard for the pedagogical practice of the teacher. The teacher-as-researcher movement was initially developed as a means for teachers to engage in school-based curriculum development. Within the British school of thought, it was nurtured by Stenhouse (1981) and Elliott (1991) and 'advocated a view of teachers as highly competent professionals who should be in charge of their own practice' (McNiff and Whitehead, 2011, p.42). Key to this approach is that the teacher-as-researcher 'acts "within" rather than "upon" the environment' (Feldman, Paugh and Mills, 2004, p.945). Within this perspective the practitioner-researcher embraces a

practical orientation focused on understanding the knowledge of themselves as teachers and the students involved in the study.

McNiff (2002) has advocated that action research can be used within professional learning contexts such as education where individuals have already acquired professional knowledge and are also capable of learning for themselves. In this context, action research can be seen as a means to assess and appraise one's professional practice. It builds on the notion that incremental learning is a key component in Continuing Professional Development 'when people build on previous learning, developing and transforming past practice in new contexts' (McNiff, 2002, p.1). Such action research inquiries begin with an individual asking the question: 'How do I improve my work?' (McNiff, 2002, p.1). McNiff concludes that this methodology requires a professional person to evaluate what they are doing, to constantly check that what they are doing really works, and to ask themselves if they are influencing their practice or are they fooling themselves.

Whitehead and McNiff (2011) worked separately in the field of action research in the 1970s and then together in the 1980s. Working together they perceived action research as a disciplined and systematic process consisting of one or more action-reflection cycles. Each action-reflection cycle consists of the following steps:

- take stock of what is going on;
- identify a concern;
- think of a possible way forward;
- try it out;
- monitor the action by gathering data to show what is happening;
- evaluate progress by establishing procedures for making judgements about what is happening;
- test the validity of claims to knowledge;
- modify practice in light of the evaluation.

(McNiff and Whitehead, 2011, p.8-9)

Within the teacher-as-researcher tradition Jack Whitehead 'developed a self-study perspective' (McNiff and Whitehead, 2011, p.43) utilising the steps of the action-reflection cycle described above. It is a perspective that recognises action research as a form of practical research legitimising teachers' efforts to comprehend their practice from their own point of view, where

[e]ffective teaching is more likely to be achieved when the teacher himself is operating in reflective and empirical modes and [where teachers] operating in this way cease[d] to be tiresome intervening variables and become self-conscious instruments of the educational process. (Whitehead, 1983, p.175)

At that time, Branch (2020, p.34) observes that this perspective began 'to challenge the orthodox view of … research in the academic discipline of education' and embraced the notion of theory-building within educational practice by moving 'away from the narrow purpose of contributing to a field of knowledge toward a living inquiry that is integrated in the lives of all those involved' (Reason, 1996, p.15).

Whitehead's self-study perspective championed this idea of theory-building to develop theories consisting of 'the descriptions and explanations which professional educators created for their own learning as they answered practical questions of the kind, "How do I improve this process of education here?"' (Whitehead, 1998a, p.5). It is through developing these type of theories that teacher-researchers must hold themselves accountable for their professional practice (McNiff, 2007). Whitehead (1989, p.41, my italics) called this a '*living educational theory*' approach to educational research. This approach has been 'referred to variously as self-study action research, first-person action research, living theory action research, or just plain action research' (McNiff and Whitehead, 2011, p.31) as a way to describe the research methodology which underpins the development of a Living Educational Theory. For consistency throughout this thesis, I will use the term *action research* where such 'research should be about the self studying the self, the living 'I' studying their own practices' (McNiff and Whitehead, 2011, p.31) by the 'I' reflecting on and taking action to improve their practice.

3.4 Living Educational Theory as a Paradigm

Since the 1980s, Whitehead (1983, 1989) has defined, explained, and disseminated the Living Educational Theory approach as a means to engage in research within the discipline of education. The Living Educational Theory approach 'bears all the hallmarks of a paradigm' (Branch, 2020, p.29). From a paradigm perspective, the Living Educational Theory approach specifies both the rationale for, and the steps by

which, contributions to knowledge within the discipline of education can be made by practitioner/teacher-researchers through action research. Whitehead explains that such action research is

> [e]xtended into theory in the form of an explanation of one's own practice. This process has ensured that the theory generated from such research is grounded in the important area of the classroom; it ensures that explanations and theoretical observations and analyses remain linked closely with what has actually proved to be of value in the school environment; it ensures that the theory evolving out of the personal research programmes is tailor-made for the individual who is putting it into practice. The personal explanation which constitutes an individual's personal theory grows out of his own practical experience. This means that his own values in education are included as well as the unique traits which make up an individual teacher. (Whitehead, 1983, p.175)

Based on this description I have reflected that the Living Educational Theory approach, with its inherent ontological and epistemological characteristics, is compatible with my view of the teaching profession 'as consisting of practical problems requiring deliberation and action for their solution' (Calderhead, 1989, p.44). The Living Educational Theory is an approach to educational research that privileges these activities of deliberation and action of practitioners over professional researchers in ivory towers as it 'is epistemologically and methodologically distinct from [traditional] social science because it includes the values [of practitioners] which contribute to the idea of "educational"' (Lomax, 1994, p.4) and it privileges the practitioner's personal knowledge (Polanyi, 1962). I found this idea of privileging a practitioner's values and personal knowledge within the research approach congruent with my desire to value tacit knowledge within a Software Engineering curriculum. I have reflected that

> by taking action within this inquiry to value tacit knowledge within the s/w eng. curriculum, I am engaged in a form of professional development where I [must] develop my own Living Educational Theory of practice. In doing so, from a teaching perspective, I must bring together educational theories (e.g. on cooperative group work or assessment approaches), my own personal experiences of teaching and values. I now see that my living educational theory must be constructed from both explicit (educational theories) and tacit (my personal experiences and values) knowledge. It is both of these forms of knowledge which underpin the skill, competence,

and expertise that I bring [,and develop,] to my practice as a teacher. (Research Diary, 17/09/15)

Personal knowledge is used and created within living educational theory research by a practitioner-researcher engaging in a process of reflection to become 'aware of one's context, of the influence of societal and ideological constraints on previously taken-for-granted practices, and gaining control over the direction of these influences' (Carr and Kemmis, 1986, p.37). In constructing a Living Educational Theory I am conscious that the practitioner-researcher must reflect on their understanding of their 'ontological values as the deeply spiritual connections between [themselves] and others… [and these values] are embodied values, which we make external and explicit through our practices and theories' (Whitehead and McNiff, 2006, p.86).

3.4.1 Action Research as My Chosen Methodology

The development of a Living Educational Theory is synonymous with engaging with an action research methodology where the focus of the research is 'not about showing a causal relationship (i.e. if I do this, that will happen) but the aim is to improve practice [where] (1) the object of the inquiry is the "I" [and] (2) knowledge is uncertain' (Research Diary, 6/3/2015).

As a methodology, the purposes of action research are: it is research into social practice; it is aimed towards improvement; it is cyclical; it is a systematic enquiry; it is a reflective process; it is participative (has both the researcher and researched as active participants); and the research is determined by practitioners (Kember, 2000). Also, action research aims to 'improve practice in line with [practitioner-researcher] values that are rational and just, and specific to the situation' (Farren, 2005, p.86). It is a methodology which emphasises the 'active involvement of people in reality construction' (Bryman, 2008, p.21) where 'particular people on their own work, to help them improve what they do, including how they work with and for others' (Cohen, Manion and Morrison, 2011, p.346).

Developing a Living Educational Theory through action research has evolved 'as a form of educational action research … in reaction to the tradition of [the] social

scientist coming into classrooms to do research on pupils and teachers' (Hartog, 2004, p.24). It recognises my identity as a practitioner-researcher. Such a methodology allows me to inquire into any 'concern' (McNiff and Whitehead, 2011, p.31) or situation that I have with my own practice. In doing so, action research takes practitioner-researchers (like me) upstream where they inquire into their basic assumptions, desires, intentions, values and philosophy of life (incorporating one's professional practice) and it takes them downstream where they inquire into their behaviour, ways of relating, and action in the world (Coghlan and Brannick, 2010). Engaging with such an action research methodology

> encourages (through a range of activities such as reflective practice) exploration of [one's] concern in the context of one's practice, values etc., which leads to the development of the research questions that enables one to address the concern by developing and improving (this would be the goal) one's practice. (Research Diary, 8/5/2015)

Action research, for me a form of research in a local and self-contained context, is also an appropriate methodology for me to meet my goal of continuing professional development (Coghlan and Brannick, 2010). Action research is an acknowledgment that the one thing I can change is myself and my practice within a profession strongly regulated by legislation, educational standards, and societal expectations. As a lecturer, I understand that I work to improve both education and society. I have employed in this enquiry action research as the vehicle for me to take charge of my learning, my professional development, and to improve my pedagogical practice. It is a methodology that requires me to 'adopt an insider approach [and] is relational in character' (James, 2009, p.284).

Within the Living Educational Theory framework, action research advocates and supports McNiff and Whitehead's idea of the *teacher as a theorist*, an evolution of Stenhouse's *teacher as researcher* and Schön's concept of the teacher as a *reflective practitioner* (Roche, 2007). Within this inquiry, I position myself as a teacher as a theorist who investigates his own practice, questions assumptions, and 'understand[s] contextually their own situations' (Kincheloe, 2012, p.41). As a teacher as a theorist my 'goal is to develop, evaluate, and improve' (Norton, 2009, p.87) my practice and

contribute to my continuing professional development through 'a continual quest for ways in which to change [my] practice for the better' (Denscombe, 2010, p.128).

In particular, the *teacher as a theorist* concept visualizes the 'reconstruction of educational theory into a living form of question and answer' (Whitehead, 1989, p.49). Within such a context, action research as a methodology allows me to recognise, honour, and describe my learning, values, and actions as an educator focused on inquiring into and improving practice in terms of what happened and why as I inquire into my research question:

- How can I, as a lecturer, improve my pedagogical practice to value tacit Software Engineering knowledge?

3.4.1.1 Limitations of Action Research

'A criticism of action research… is that it is always concerned with the particular' (McAteer, 2013, p.157). Within this context, Denscombe (2010) identifies both scope and scale of the study and the impartiality of the practitioner-researcher as limitations or disadvantages of doing an action research project. He observes that the scope and scale of such projects are limited by the practitioner-researcher's direct involvement and particular practice studied, which in turn impacts the 'representativeness of the findings and the extent to which generalizations can be made on the basis of the results' (Denscombe, 2010, p.134). While engaging with a self-study using action research, Casey (2012, p.231) discovered the scale and scope of the methodology to be limiting in that 'while it gave me the tools to elicit change in my classrooms it did little or nothing to change the meta-practices of my department and my school'. Another potential disadvantage that a practitioner-researcher must be aware of is that they are 'unlikely to be detached and impartial' (Denscombe, 2010, p.135) as they engage with and evaluate their action research study. To counter this limitation the researcher must be aware that the 'action research paradigm requires its own quality criteria' (Coghlan and Brannick, 2010, p.14) which articulate 'standards of judgement that… draw on the practitioner's own values and objectives' (McNiff and Whitehead, 2011, p.38).

A practitioner-researcher must choose from the many representations of action research models that exist where 'variations of the action research cycle… include circles of action, spirals, varying combinations of circles and spirals' (Drummond and Themessl-Huber, 2007, pp. 432-433). A major problem with such models is that their rigid nature 'may restrict the flexibility with which teachers undertake their studies' (Costello, 2011, p.12) and may not be representative of the research and practice context that practitioners will experience. Following a chosen particular action research model blindly has the potential limitation to 'trap teachers within a framework which they may come to depend on and which will, consequentially, inhibit independent action' (Hopkins, 2008, p.55). I initially fell into this trap during this inquiry (Chapter 4) before coming to learn that '[p]ractitioners need to see these models for what they are: guidelines for how we hope things will eventually fall out' (McNiff and Whitehead, 2002, p.55).

I consider how action research is perceived by some individual researchers and the research community at large to be a limitation of the methodology. Kitchen and Stevens (2008, p.20) observed that some researchers struggle to identify a research question of personal interest and relevance to their practice due to their 'difficulty reconciling action research with their pre-existing conceptions of research as objective, statistical, reproducible, and requiring control groups to assess validity'. Additionally, for lecturers who teach within traditional research-oriented departments such as Software Engineering, 'engaging in pedagogical [action] research might be difficult to gain support for and a careful case has to be made for it being a research area in its own right' (Norton, 2009, p.10) due to preconceived notions of what constitutes research and scholarship where

> [i]t is not only that teachers are thought to be inadequate to the task of conducting quality research… also, some consider the kind of knowledge that teacher research produces to be inferior to and less valuable than other kinds of academic work. (Roulston et al., 2005, p.182)

3.4.2 The Role of Values

A key aspect of educational research enquiry is that it is not free of 'the values and beliefs we hold' (Cohen, Manion and Morrison, 2011. p3). I reject the view of research

that describes reality in a value-free way, ignores ethics or moral intent, and locates the researcher outside the site of inquiry on the basis that the researcher's personal involvement does not influence the study in any way. As a practitioner-researcher, I embrace the idea that a living educational theory can be developed through action research

> done by people who are trying to live in the direction of the values that inspire their lives …[and] often begins by articulating your values and asking whether you are being true to them. (McNiff and Whitehead, 2011, p.28)

In terms of the role of values within educational research, Whitehead explains that a living educational theory is characterised

> by the explanatory power of the values and understandings which a practitioner-researcher embodies in their explanation for their own learning as they work at living more fully their values and at extending their understandings. [Living educational theories] are characterised by the use of values and understandings as the standards of judgement they use to test the validity of their claims to educational knowledge. They are characterised by the dialectic between explanations, the action researcher's present practice and the intention to create a better future. (Whitehead, 1998b, p.9)

My understanding of the concept of values in relation to my practice can best be described as follows:

> What is the meaning of the word value as it is used here in relation to educational decision-making? It should be thought of as a verb, to value. "To value" means to make a choice of procedures with the expectation that the results will be desirable, according to the tentatively projected system of values. Whatever the basis may be for selecting and validating them, the values must be translated into observable behavioural characteristics whose achievement would represent attainment of the value choice. (Pounds, 1966, p.63-4)

3.4.3 Values, Living Contradiction, and Social Formations

The development of a Living Educational Theory is typically triggered by a concern that a practitioner has with one's own professional practice (McNiff and Whitehead, 2011). Such concerns arise for practitioners because '[they] are experiencing tension

at work because [they] are not fully living [their] educational values in [their] practice'
(Whitehead, 1990, p.34). To identify and address the concerns that prompted the
research question that I ask within this inquiry, I was guided by Whitehead who offers
the following ideas in the development of living educational theories utilising an
action research methodology:

i. That one should include 'I' as a living contradiction in educational enquiries of the kind, 'How do I improve my practice?'
ii. That one should develop systematic forms of action enquiry including 'I' as a living contradiction.
iii. That one should seek to create and test living educational theories as explanations for learning in educational enquiries of the kind, 'How do I improve my practice?'
iv. That one should devise a process for clarifying the meanings of embodied values in the course of their emergence in practice and for transforming embodied values into living and communicable standards of educational judgment.
v. That one should identify ways of influencing the education of social formations through the creation and testing of living educational theories in a range of cultural and social contexts.

(Whitehead cited in Farren, 2005, p.92-93)

By asking oneself if you are being true to your values, Whitehead observes that many
practitioner-researchers as action researchers experience themselves 'as a living
contradiction [as they hold a set …] of values such as freedom, fairness, and enquiry'
(Whitehead, 2000, p.93) that are denied within their practice. Whitehead explains how
the 'I' as a practitioner can exist as a living contradiction, which in turn acted as the
impetus for me to take action to improve what I do as a lecturer:

> I imagine that you will understand what I mean by living contradiction in
> that you will have had experiences of holding together your values and
> their negation. In your teaching you may believe in enquiry learning whilst
> at the same time recognise that you have acted in a way which has stifled
> this expression in your pupils. You may believe in a curriculum which
> supports autonomy but find yourself 'teaching to the test' in a way which
> shirked this value. It is the experience of recognition that you hold certain
> values whilst at the same time experience their denial which characterises
> my meaning of 'living contradiction'. (Whitehead, 1998a, p.9)

The concept of 'social formations' (McNiff and Whitehead, 2011, p.174) is important
in understanding how practitioners, like myself, can act as agents in influencing the
learning of others as people work together and cooperate in a way to help them to

transform their social contexts. Social formations are comprised of agents who are capable of making decisions about how they should think and act. However, these

> decisions can become solidified into accepted rules and structures, and sometimes the rules and structures take on a life of their own to rise above the heads of the people who make them in the first place. (McNiff and Whitehead, 2011, p.174)

I consider that a Living Educational Theory approach to inquiry provides me with the means to critically think, reflect on, challenge, and transform the accepted rules and structures which influence what I do as an educator.

3.4.4 Articulating My Identity and Values

Developing and articulating your values as a practitioner-researcher is very much part of engaging with an action research methodology (McNiff and Whitehead, 2011). To do so is to recognise that there is both a synergy and contradiction between a person's identity and values in a world where

> [e]ach of us lives with a variety of potentially contradictory identities and which of them we focus on depends on many factors. At the centre are the values we share or wish to share with others. Identity is not simply imposed. It is chosen and actively used, though in specific social contexts and under particular constraints. (Share, Corcoran and Conway, 2012, p.265)

I have identified that I hold multiple identities. For example, I am a son, brother, husband, father, friend, software engineer, and a lecturer. For the different identities that I relate to, I have internalised meanings and expectations of what it means to be each type of person as I ask *"Who I am as a son or software engineer?"* or *"What does it mean to be a father or a lecturer?"*. By engaging with this research, I am taking on the identity of being a practitioner-researcher.

'Identity relates to our basic values that dictate the choices we make' (Heshmat, 2014) in our personal and professional lives. The choices that I make and what I think is important in life reflect who I am and what I value. For example, as a lecturer I value education and helping students. As I started to develop my identity as a practitioner-

researcher, I determined that values are of significance, and especially a person's own values, to any research project.

I understand the purpose of values is to draw my attention to priorities that inform me how best to use my time (Pavlina, 2004) and the actions that I take. The beliefs and values I hold as a lecturer, in relation to knowledge and how students learn and develop as competent software engineering professionals, influence what I select for inclusion in the specified curriculum, how I teach the enacted curriculum, and the nature of my role and relationships with students as they experience the curriculum.

As a practitioner-researcher, I acknowledge that values 'underpin the framing of one's research question and can also be used to formulate the criteria for assessing the research project' (Sullivan *et al.*, 2016, p.2). Therefore, I now take this opportunity to analyse and articulate the values, which have underpinned and inspired this study.

3.4.4.1 The Values Underpinning this Study

I was taught that it was important to have values to direct me in living a good life. Within the context of this action research methodology, I asked myself

> What are my values? ... What are the values triggering my research? ... Some of my values are: (i) opportunity for all, (ii) need to benefit all aspects of society, (iii) practice as knowledge (Schon, Dewey), (iv) equality [and] respect, (v) knowledge has many forms, (vi) all forms of knowledge should be equally valued, (vii) learning through participation, (viii) give individuals the opportunity to demonstrate where their skills/strengths lie so that they can contribute to society. (Research Diary, 30/03/2015)

I have employed the values that I hold to inform this inquiry and the generation of my living educational theory of practice (Whitehead, 1989). In particular, this inquiry is grounded in the values that I hold about research, education, pedagogical practice, and relationships with others.

From an educational and research perspective, I value inquiry as a form of professional development (National Forum, 2016). Privately, as I grew up and in my working life,

I have valued respecting, caring for, treating fairly, and helping people that I have met. I see respect, fairness, trust, and a good work ethic as 'inclusive values [which are] connected to the development of democratic participation and global citizenship' (Booth, 2011, p.303) which recognises that each person is treated equally. This idea of inclusion for all is enshrined within the principles and values of justice, democracy, and care that I strive to live life by. I have reflected that these are the values that I want to share with students as I enact and they experience the curriculum. I see these shared values providing a basis for students and me 'to shape our lives together' (Booth, 2011, p.304) within a shared practice where I no longer

> mistakenly suppose that [students] want to live exactly as [I] do – that they want the same knowledge, the same kinds of work, the same forms of worship, the same daily customs. (Noddings, 1998, p.116)

This has resulted in the research and educational commitments that I hold being driven by a sense of honesty towards others and lived through the values of justice, democracy, and care. Within both research and educational practice I value knowledge as provisional, subject to transformation, and not separate from the knower, within an epistemological position that acknowledges that explicit knowledge must be contextualised within the knower's attempts to know (Hartog, 2004; Roche, 2007). I do not subscribe to the default traditional view that knowledge exists separate from the knower. I have come to understand and value that reality is constantly negotiated and interpreted in different situations where both subjective interpretations and objective phenomena can provide knowledge (Wenger, 1998). I value that people learn best by applying their thoughts and experiences to problems as they occur where an individual constructs knowledge through their interactions with both their social and natural environments (Biesta and Burbules, 2003).

To me, values of justice, democracy, and care are built upon the belief that every individual is unique and has a valuable contribution to make to society. 'Caring has been described as a fundamental human capacity that translates into a coherent pattern of behaviours in life affirming interpersonal interactions' (Roche, 2007, p.86). I have reflected that a person's value of care (or lack of it) plays an essential part in directing 'the interactions and organisation of schools and classrooms' (Lin, 2001, p.108). This idea that the value of care underpins interpersonal relations within the classroom made

me consider that it is a value which complements the values of justice and democracy. I feel that the values of justice and democracy can be best accomplished by 'caring people in caring communities' (Bergman, 2004, p.151), where acts of care require give and take by all. These values (justice, democracy, and care) manifest themselves in numerous ways and can be lived within the classroom by 'putting [these] values into action' (Booth, 2011, p.308). Putting values into action within one's practice relies on 'the quality of relationships between one and the other; it is inter-relational and inter-actional' (Jones, 2019, p.25). This idea instilled within me the need to value relationships between students themselves and myself in such a way that advocates

> [w]orking in an inclusional way… to embrace boundaries as places of creativity, connection and dynamism rather than places that create silos and severance and as a consequence create barriers to effective relationships. (Naaidoo, 2005, p.19)

Within effective educational relationships, I value respect and expect each student to be appreciated for their personal, social, and academic uniqueness. This idea extends to valuing 'diversity in the world, the differences between individuals within families, the same culture/society and the differences between societies/cultures' (Research Diary, 14/01/2016). I have a sense of justice and care that fosters a sense of belonging, which for me is the foundation for effective democratic relationships and enables honest true communication between me and students. Democracy and true communication sees people talking with each other and not at one another. For me, '[d]emocracy [is] not majority rule: democracy [is] diffusion of power, representation of interests, recognition of minorities' (Calhoun cited in Laidlaw, 2008, p.72). This idea of democracy within one's practice extends to the notion that a

> democratic society is not simply one where governments are subject to periodic elections, with competition between political parties and majority rule. Rather, it is one that enables and facilitates public engagement of citizens shaping their own society. (Share, Corcoran and Conway, 2012, p.67)

The values I cherish are informed by an ability to think and create knowledge for myself as I help students to do likewise. I aspire and strive to bring these values to bear in the everyday interactions I have with others. The values and beliefs that I wish to live by, as a lecturer, can be best realised within my practice by acknowledging that

- Knowledge is constructed by combining new knowledge with a person's previous knowledge,
- Learning occurs through working as part of a collaborative group focused on solving authentic problems,
- Learning within groups involves individuals negotiating and working towards a mutual understanding,
- Learning must be student-centred and promote active engagement by students,
- Learning can be scaffolded by a more knowledgeable person (lecturer or peer), and
- Assessment should be authentic and not be treated as a separate activity but integrated into the learning task itself.

(adapted from O' Neill, 2015, p.21)

To live my values requires that I see '[e]ducation as the practice of freedom [which] denies that man is abstract, isolated, independent, and unattached to the world; it also denies that the world exists as a reality apart from people' (Freire, 1970, p.54).

3.4.5 Values as Living Standards of Judgement

I am conscious that '[a]ny kind of research can be dismissed, thrashed, and trivialized if inappropriate criteria are imposed on it' (Sparkes cited in Farren, 2005, p.96) to determine the quality of the work. Mills (2018, p.151) suggests that teacher-researchers need to understand the concepts of 'validity… and generalizability' to both engage with and assess the quality of action research. However, I perceive the concepts of validity and generalisability, that have historically being associated with quantitative and positivist research (Lincoln and Guba, 1985; Kincheloe, 2012), as being inappropriate for assessing the quality of a living educational theory, which 'is inherently value-laden, because researcher values inevitably influence the choice of *phenomenon*, choice of *method*, choice of *data*, and choice of *findings*' (Hirschman, cited in Branch, 2020, p.38).

Instead, I suggest that the quality of social inquiry should be assessed, through the application of a practical philosophy which challenges the notion of '[c]riteriology … the quest for permanent or stable criteria of rationality founded in the desire for objectivism' (Schwandt, 1996, p.58). This position emphasises and recognises that values and concerns must be addressed through critical reflective dialogue and by cultivating a more open approach to transforming one's practice. Assessment of these

aspects of social enquiry must recognise that the judgement or determination of the quality of a practitioner's research 'takes place through debate, discussion, and the use of exemplars' (Farren, 2005, p.46). Such judgement or deliberation relies on the practitioner-researcher's values becoming the 'standards of judgement' (McNiff and Whitehead, 2011, p.151) by which living educational theories are assessed and validated.

In the next chapter, I discuss the standards of judgement that I established for this inquiry to test the validity of my claim that is my living educational theory.

3.4.6 More than Propositional Knowledge

To create a living theory of practice requires that I inquire into my own personal and educational stories 'that arise out of [my] own challenges, frustrations, and dilemmas' (Samaras, 2011, p.2). In doing so, the benefit and strength of engaging with the living educational theory concept

> comes from the unification of theory and practice in the experience of educational practitioners as they evaluate past actions and imagine future actions, in response to particular learning relationships and contexts in which they enact their values in practice (Hartog, 2004, p. 48).

The living educational theory paradigm recognizes that practitioner-researchers can and do draw on traditional research propositions or theories (Whitehead, 1998a). I anticipated that my living educational theory of practice would draw upon and incorporate concepts from propositional theory. However, I also recognised that the values I hold shall influence this research and how both I and the students experience being in the classroom. Therefore, I did not want this inquiry to only produce propositional knowledge that 'masks the living form' (Whitehead, 1989, p.42) of what I do as

> I do not believe that values are the type of qualities whose meanings can be communicated solely through a propositional form. I think values are embodied in our practice and their meaning can be communicated in the course of their emergence in practice. (Whitehead, 1989, p.45)

Instead, I wanted this inquiry to create and use knowledge that honours who I am as a lecturer through recognising the values that I bring to the actions I take within my practice

3.4.7 Academic Writing Style

The academic writing style employed in the development of a Living Educational Theory embraces the use of the "I" as a means to situate a person's research within an action-focused, participative, collaborative, and reflective form of inquiry in which the practitioner-researcher provides an account of their applied knowledge within their professional practice (Wong, 2004; Wong, 2008). This involves the practitioner-researcher reflecting on their experiences and commenting on what they think they have learned from those experiences (Williams, 2000). The purpose of this writing approach is to underpin Whitehead's 'idea of an epistemology of educational enquiry [where practitioner-researchers] would offer their explanations of how they learned to improve practice with educational intent' (McNiff and Whitehead, 2011, p.251).

Chapter 4 - Implementing My Action-Reflection Cycles

4.1 Introduction

In this chapter, I describe and reflect on the struggle I had to begin to engage with my chosen research methodology and progress this inquiry. I introduce the three action-reflection cycles that I undertook as I worked towards developing and generating my living educational theory as I inquired into my research question. I describe how I looked for and collected data as I monitored my practice. I explain how I managed and analysed the collected data, which in turn allowed me to turn the data into evidence to support my living educational theory or claim to knowledge. I describe how I employed the values of justice, democracy, and care to establish the criteria to be used to assess the validity of my living educational theory. I describe the role of literature and theory within this inquiry. Lastly, I discuss the ethical considerations that directed how I engaged with this study.

4.2 My Struggle to Begin

As I started this inquiry, I continued to think seriously and contemplate the nature of my practice in comparison to what I observed in Aalborg University. I felt that my practice limited or restricted the type of knowledge that I valued within the curriculum and my pedagogy. As I prepared to identify and engage in the first actions to transform my practice, I reflected on the following question:

> "What is my concern?" This question posed by McNiff and Whitehead (2011, p.8) is suggested as a good starting point for any AR project. In my mind my concern is that in s/w engineering education in HE institutions I/we limit the knowledge that is valued (and hence taught, learned, and assessed) to explicit knowledge. This excludes tacit knowledge. I now realise that I need to be clearer with my definitions of what I mean by explicit and tacit knowledge. This question also needs to be addressed in the context of another question "Why am I concerned?" (McNiff and Whitehead, 2011, p.8). I know as a s/w engineering project manager that there are skills needed by the industry that are not addressed through formal HE courses. By addressed I mean that these skills are not valued from an assessment perspective even though they may be employed in the teaching and learning practices. These skills … include problem-solving, critical-thinking, group-work, creativity etc. Some are recognised in

> policy documents such as the Hunt (2011) report but their value is only
> partially recognised in taught courses at HE. (Research Diary, 30/3/2015)

On reflection, I felt that my initial statement of my concern was overly simplistic by stating that only explicit, rather than tacit knowledge, was valued/present within my practice. I started to 'realise that I must also speak about explicit/tacit knowledge in the context of the various ways of knowing' (Research Diary, 25/4/2015). I continued to reflect on my concern and the implications for employing a living educational theory methodology:

> 'Personal experience' (Bryman, 2008, p.5) and 'concerns' [(McNiff and Whitehead, 2011)] with my own professional practice are the driving forces behind this research. My personal experience of lecturing is that within HE the knowledge and ways of knowing offered to students is limited. My concern is that within HE we have missed an opportunity to extend the knowledge and ways of knowing that students could engage with. I believe that explicit and tacit (personal) knowledge should be equally valued and assessed. I am interested in my research project to explicitly incorporate and value tacit knowledge and assessment thereof. I propose to do this through AR, a methodology that allows me to plan for, implement and reflect on changes that I make within my practice. In this approach to research, I will collect data as I undertake changes to my practice in order 'to build theories' (Bryman, 2008, p.1) that represent 'my living theory of practice' (Whitehead et al.). My living theory of practice is my attempt (Bryman, 2008, p.7) 'to understand and explain a limited aspect of social life'. (Research Diary, 20/5/2015)

This passage captures my thinking and frame of mind as I started this inquiry. Although I had recognised the role that *"Personal Experience"* plays in the identification of a concern with practice, I had at this point not yet acknowledged the role that such experience must play in my planning and implementation of a solution to address my concern and transform my practice. However, my inquiry had begun. I had identified a concern and the purpose of the inquiry based on personal and professional experience. But, I was grappling on how best to proceed. Even though my intent was to develop a Living Educational Theory, I had not yet explicitly considered the role values could play within educational research (Greenbank, 2003). I had not yet heeded the advice of McNiff and Whitehead (2011) which stressed the need for educators to live in the direction of their educational values.

Reflecting now it has become apparent to me that I wished to dive into my inquiry and engage with actions that immediately involved making changes to teaching, learning, and assessment activities within my practice. My frustrations and thoughts on this desire to immediately engage with direct change(s) to my practices were:

> I have struggled with the nature of the AR process. I felt that I could just state my concern based on just pure experience, my experience of my practice of nearly 20 years. For me stating the concern was the starting point in AR and not part of the AR process. However, I have struggled with expressing or rather with focusing my concern and am also impatient to start what I consider the first cycle in the AR process where I implement change. It is now clear to me that AR is a complex process and that each stage or step in the process is not necessarily about implementing a change…(Research Diary, 3/6/15)

This passage demonstrates a naivety on my part. I had concluded that once I had identified a concern with my practice all that remained for me to do was to plan and implement the change to arrive at a solution that I would reflect upon. At the time of writing the Research Diary passage above my mindset was such that the concept of *"implementing a change"* was based on an expressed concern applied only to my pedagogical activities and not to myself. It is an example of my then rational-approach to thinking in that I had yet to appreciate the 'more social aspects of knowledge [and] understanding how knowledge develops and is transferred between individuals and among groups' (Lejeune, 2011, p.92). I had simply viewed the action research process as a series of sequential steps to be followed where each activity is driven by inputs and produces outputs. I considered an output from one activity to be the input into the next. If followed in the correct manner, I surmised that my concern would be resolved because I employed the action research process correctly.

As I now reflect on that time, I see that I initially 'adopted the ontological perspective of one who is separate from the action and outside the study' (Roche, 2007, p.14). Apart from acknowledging the role of my experience in identifying my concern there is nothing in the above passage from my Research Diary to suggest that I was thinking about how I, as the practitioner-researcher, influence the actions to be taken and learn about myself from engaging in the change process itself.

4.2.1 Overcoming My Struggle to Engage with the Action Research Process

I sought answers to my struggle. I identified that by interrogating my past and present practice I had an opportunity to learn from my experiences as a means to direct my inquiry to transform what I do as an educator (Pye, 1994). I started to discover that the 'action research cycle unfolds in real time and begins with seeking an understanding of the project' (Coghlan and Brannick, 2010, p.8). I came to the conclusion that my first step or action within my inquiry was to observe and document my existing practice as a way to question my values and interrogate how I was a living contradiction within my practice (Kaplan, 1998). I had recognised that I can also '[u]se action research when you want to evaluate whether what you are doing is influencing your own or other people's learning or whether you need to do something different' (McNiff and Whitehead, 2011, p.15). In making this discovery, I came to realise that

> I have been too preoccupied in my reading of different AR models in trying to comprehend the number of cycles required, the purpose of each phase, what steps or tasks to undertake etc. In particular I was looking for a cookbook recipe to follow (almost without [the need for] thinking) …(Research Diary, 3/6/2015)

Prompted by this reflection, I decided to jump in and *"start doing"* action research. In doing so, I discovered that identifying and developing one's concern is an integral part of the action research process and can constitute distinct steps within its own action cycle (McNiff and Whitehead, 2011). I also thought that I had already stated my concern multiple times and in multiple ways within my diary. For example, in the previous two weeks, I had restated and rewritten my concern:

> My professional practice is constituted /bounded by the rules and regulations of the institute involving/including curriculum development/specification and enactment of that curriculum within a classroom setting incorporating students. Specification and enactment and experience of the curriculum are influenced by such structures as the Curriculum Development Policy, Assessment Standards, Government Policy such as the Hunt Report. Similarly enactment and experience of the curriculum is dependent on the interactions and social relations that exist between lecturer and students as well as student to student relationships. I have a concern that the curriculum as currently constituted is limited in the knowledge, ways of knowing and pedagogical practices of teaching,

> learning (ways of knowing) and assessment [valued]. (Research Diary, 21/5/2015)

I realised that I was procrastinating within my inquiry. I was trying to express my concern cleanly and clearly before I take action. I did so in the mistaken belief that a clearly stated concern provided the basis for identifying the subsequent actions to be taken without the need to experiment with various competing actions. However, I discovered that action research could be 'an imaginative, expressive, tacit approach to integrating reflection and action' (Coghlan and Brannick, 2010, p.11) that does not follow an action-reflection cycle rigidly but embraces spontaneity and creativity. It occurred to me that '[i]t is important not to get too preoccupied in the cycles at the expense of the quality of participation' (Coghlan and Brannick, 2010, p.11).

In a telephone conversation with Dave (my PhD Supervisor) we discussed that

> [p]rofessional practice is both relational and messy. It can be difficult to apply AR (Action-Research) in an instrumental way to my practice. Remember my practice is my lived experienced. Lived experience is not instrumental. …[I] expect that the (1-dimensional) procedural steps in the AR process (or in fact any process) must be followed without questioning. I need to push back at accepted methodologies and question them. Remember I am engaging in my practice experientially …I may need to establish more flexible patterns of engaging with methodology. Keep searching for sound structures and patterns. …Every process can be questioned. Every process can be re-invented. (Research Diary, 10/03/2016)

I continued to reflect on my struggle to begin:

> I have worked on the assumption that the start of my research would start with improvement. However, (Sullivan *et al.*, 2016), notes that in addressing the question 'Why I am concerned?' suggests that a researcher may be concerned about developing ideas around understanding your practice. I now realise that I need understanding of my [past] practice, in order to improve it. I now see that I need to be able to theorise and problematise my practice through engagement with educational theory and reflective practice. Up to this point I have always seen AR as an improvement process rather than an understanding process. However, I now know that understanding is a key part of practice in order to improve it. Understanding how to understand one's practice is crucial and I now see my [first] AR cycle addressing this part of my practice. …It has taken me awhile to realise this situation … I got caught up with the mechanics

> or steps involved in the various AR processes and believed if I followed the processes as given I would successfully improve my practice and complete my research. However, my research supervisor questioned my tacit acceptance of the existing processes and suggested that I should critique these processes to determine suitability for my research. (Research Diary, 18/04/2016)

4.2.2 Questioning My Tacit Acceptance of Existing Methodologies

While accepting that the purpose of my methodology is to provide a rationale and structure for how I carried out my research in generating my living educational theory, I reflected that 'I am struggling with my [past acceptance and] experience of following rules and processes as described and not questioning/challenging these rules/processes' (Research Diary, 10/03/2016). As a practitioner-researcher or a 'Living Theory researcher' (Whitehead, 2018, p.2), this insight made me think further about the development of living educational theories. I started to tell myself: '[d]on't be instrumental in my AR approach. Challenge the AR approach, change/adapt the AR [process]' (Research Diary, 10/3/2016) because I had finally recognised

> that there is no existing methodology that is appropriate for exploring the implications of asking, researching and answering the question, 'How do I improve what I am doing?' The reason that no existing methodology can answer the question is because of the dynamic nature of the question. 'What I am doing' is continuously changing with the evolution of both 'I' and context. Hence the necessity for the Living Theory researcher of recognising the need to create an appropriate living theory methodology in the course of its emergence in researching and answering the question and in generating a unique living-theory. (Whitehead, 2018, p.2)

Even though I had decided to primarily employ action research, Whitehead's questioning and insight into the "appropriateness of existing methodology" for my inquiry, led to me engaging with my own

> …methodological inventiveness [because…] the most important new insight for [me] has been awareness that, for some practitioner researchers, creating their own unique way through their research may be as important as their self-chosen research focus. [I recognised] that substantive choice was fundamental to the motivation and effectiveness of practitioner research…; that what practitioners chose to research was important to their sense of engagement and purpose. But [I also recognised] how practitioners chose to research, and their sense of control over this, could

be equally important to their motivation, their sense of identity within the research and their research outcomes.(Dadds and Hart, 2001, p.166)

As I planned to take action to transform my professional practice, where I engage with 'students as people [and] not as machines who must follow prescribed processes' (Research Diary, 10/03/2016), I realised that my sense of control over or the direction of the inquiry could not be fully predetermined at the start of the inquiry as my changing identify and learning during the inquiry itself would guide the inquiry and influence choice of actions taken. It was at this point, I realised that I needed to allow for flexibility within my methodology because I needed

to ensure as far as possible that [my] pedagogical approaches match the message that [I] seek to communicate [and where no] methodology is, or should be, cast in stone, [as I now] accept that professional intention should be informing research processes, not pre-set ideas about methods of techniques...(Dadds and Hart, 2001, p.169)

As a result, within my methodology I ended up primarily drawing on insights from the methodologies and methods of action research where I employ action-reflection cycles as advocated by McNiff and Whitehead (2011). Within action-reflection cycles, I have also drawn upon the methodologies and methods of narrative research (Clandinin and Connelly, 2000) where I tell stories of myself and others. These stories have allowed me to develop a better understanding of my existing practice, my values and how I live those values within my practice. As I have engaged with each action-reflection cycle to improve my practice, I have also drawn on insights from reflective practice and self-study teacher research (Schön, 1983; Schön, 1987; McNiff and Whitehead, 2011; Samaras and Freese, 2011; Samaras, 2011).

4.2.2.1 Narrative Inquiry

Narratives can be employed to describe and explain Living Educational Theories (Whitehead, 2007). Bamberg (2012) distinguishes between research on narratives and research with narratives. In the former narratives are the object of the inquiry and in the latter narratives are typically deployed as tools to explore human experiences. In this inquiry and thesis I recognised the importance of engaging with the social constructions of my reality in an effort to understand my lived experiences. To do so,

I employed narratives, which allow practitioners like myself to re-visualize our setting particularly if it matters to our story (Samaras and Freese 2011).

In this section, I briefly examine how research with narratives supported and challenged me in creating my own narratives or stories to explore the different realities and knowledges that I have held or hold with respect to my teaching and learning practice. In doing so, I remembered that I was engaged in a self-study action research investigation inquiring into my living educational theory - a form of iterative practitioner enquiry in which both research and practice are inseparable and continuously developing.

Within my methodology, I saw narrative inquiry as a method. Narrative inquiry as a method is an 'approach that views individuals within their social environments as actively conferring meaning onto objects in the world, including others and selves, [and] is necessarily subjective and interpretive' (Bamberg, 2012, pp.79-80). Such research 'characteristically begins with the researcher's autobiographically oriented narrative associated with the research puzzle' (Clandinin and Connelly, 2000, p.40) or concern. It provides a way by which human beings come to understand and give meaning to their lives through story (Andrews, Squire, and Tambokou, 2008). Through written, oral, and/or visual means individuals focus on the meanings they attribute to their experiences in an effort to gain insight into the 'complexity of [their] human lives' (Josselson, 2006, p.4). Such stories allow practitioners to describe and tell both first-person and third-person experiences (Bamberg, 2012; Clandinin and Connelly, 2000). In doing so, these epistemological foundations of narrative enquiry support my belief that experiences or social 'constructions are the product of social forces, either structural or interactional' (Burr, 2003, p.20) and that any narrative descriptions of these social constructions must confer my subjective meanings onto these experiences.

Connelly and Clandinin describe how educational practitioners' narrative ways of knowing develop into ways by which they make meaning of their experiences:

> Narrative for us is the study of how humans make meaning of experience
> by endlessly telling and retelling stories about themselves that both

refigure the past and create purpose in the future. Deliberately storying and restorying one's life or a group or cultural story is, therefore a fundamental method of personal and social growth: it is the fundamental quality of education. (Connelly and Clandinin, 1990, p.24)

Telling a story gives a 'narrative form' (Bamberg, 2012, p.77) to experience through positioning the narrator in time and space in an attempt to explain what has happened, to describe the way things are or have become. However, while recognising that narrative inquiry allows a person to come to retrospectively understand and give meaning to past experiences, I have come to learn that

[m]aking stories from one's lived history is a process by which ordinarily we revise the past retroactively, and when we do we are engaged in processes of languaging and describing that modify the past. What we see as true today may not have been true at the time the actions we are describing were performed. Thus we need to resist the temptation to attribute intentions and meanings to events that they did not have at the time they were experienced. (Bochner, 2007, p.203)

I recognise from a self-study perspective that I am a participant or 'a member of the landscape' (Clandinin and Connelly, 2000, p.63) in my enquiry. As such, I have influenced and structured the descriptions of my autobiographical experiences between educational 'theory and the stories of life contained in [my] enquiry' (Clandinin and Connelly, 2000, p.41). I note this conceptualisation of capturing and recording my experiences through stories and description of (educational) theories evolved during the action reflection cycles as I wrote, reflected, rewrote, and reflected again on numerous versions of my life story that is my educational practice as I refined my understanding of various educational theories and the actions that I took.

4.2.3 Beginning the Inquiry

I had begun to grasp that I needed to take some action to firstly clarify further my understanding of my concern in relation to my existing practice before implementing changes within my actual practice. In attempting to understand my concern, I thought about how life would be different if I stopped worrying about things that I cannot control. I realised that I was not yet in a position to determine the number of action-

reflection cycles that would constitute my inquiry. All I could do was to start my first action-reflection cycle and see where it would take me.

These insights changed the nature and quality of my engagement with this inquiry. I began the first action-cycle to better understand my concern, *"How can I, as a lecturer, improve my pedagogical practice to value tacit Software Engineering knowledge?"* To do so, I realised that the concern or research question must identify a clear starting point for the inquiry, 'what Elliott … calls a reconnaissance phase [by incorporating] questions of the form 'What is happening here?'' (McNiff and Whitehead, 2011, p.16). Based on Elliot's observation I entered a reconnaissance phase and started the first action-reflection cycle to inquire into the question *"Why do I feel that I am a living contradiction within my pedagogical practice?"* as a means to comprehend my existing practice. It was only on completion of this first action-cycle that I identified that I needed to engage with two further action cycles to address the main research question and set about transforming my practice.

4.3 Three Action-Reflection Cycles

This inquiry evolved into three 'action-reflection cycle[s]' (McNiff and Whitehead, 2011, p.9) to structure and direct the research. To transform my practice I identified that '[r]eflection on its own is not sufficient to effect change, action must be taken … which will lead to a modification of practice' (Norton, 2009, p.35).

I decided that each of the action-reflection cycles should consist of five but not necessarily sequential, steps - Observe, Reflect, Act, Evaluate, and Modify (McNiff and Whitehead, 2011, p.9), where the first two steps require that I interrogate a concern or research question as means to imagine the actions I need to take to transform myself as a practitioner and/or my practice. I employed an 'Action Plan' (Farren, 2005, pp.253-4) to direct my engagement with each of the steps within each action-reflection cycle. I found McNiff and Whitehead's corresponding Action Plan 'questions' (McNiff and Whitehead, 2011, p.9) to be helpful as they ensured that I followed the Action Plan as intended. This approach to engaging with an action-reflection cycle is encapsulated in the Action-Reflection Cycle Planning Template in Figure 4.1.

Figure 4.1 :   Action-Reflection Cycle Planning Template

Action Cycle Steps	Action Plan	Action Plan Questions
Observe	I experience a concern.	What is my concern? Why am I concerned?
Reflect	I imagine a solution.	How do I show the situation as it is and as it develops? What can I do about it?
Act	I act in the direction of the solution.	What will I do about it?
Evaluate	I evaluate the outcomes of my actions.	How do I test the validity of my claims to knowledge? How do I check that any conclusions I come to are reasonably fair and accurate?
Modify	I modify my problems, ideas and actions in the light of my evaluations.	How do I modify my ideas and practices in light of the evaluation?

The action-reflection cycles were planned, developed and undertaken on the basis that my 'study involves thinking critically about one's practice and one's own role within that practice' (Research Diary, 18/04/2016). It became apparent to me that to address my main research question that I would need to take multiple-related, and dependent actions to meaningfully transform my practice by changing what I do both outside and inside the classroom.

Between 2014 and 2018, as this enquiry evolved, I engaged in three action-reflection cycles to address my main research question.

4.3.1 Action-Reflection Cycle 1 - I am a Living Contradiction

I engaged with the first action-reflection cycle (Chapter 5) during 2014-16. I was concerned and asked the question: *"Why do I feel that I am a living contradiction within my pedagogical practice?"*. To address this concern, I narratively described my existing practice as I took my first action to begin to address my main research question *"How can I, as a lecturer, improve my pedagogical practice to value tacit Software Engineering knowledge?"*. I employed the living contradiction lens as a means of stepping back to critically look at my situated self within my existing practice as a means to understand my thoughts and actions which constituted my existing educational practice. In doing so, I figured out why I was concerned. I had negated my values in practice. I became worried that within my teacher-centred "banking" approach to curriculum and pedagogy I had limited the knowledge valued within my practice as well as ignoring my personal and professional values to the detriment of preparing students to become competent software engineers (Freire, 1970; Whitehead, 1989).

In examining what I learned from the first action reflection cycle, it became apparent to me that I have a dual mandate within the structures and culture of Higher Education to both specify (*outside* of the classroom) and enact (*inside* the classroom) the curriculum to shape the learning environment and experiences for students (McCormick and Murphy, 2008).

I reflected that I needed to take further action to both specify and enact the curriculum in a way to address what I had learned from the first action-reflection cycle. I imagined that the best way to move the inquiry on was to engage with two further action reflection cycles to transform my practice.

4.3.2 Action-Reflection Cycle 2 - Specifying The Curriculum

In 2015-16, I engaged with the second action-reflection cycle (Chapter 6) to address my concern: *"How can I, as a lecturer, improve my pedagogical practice by **specifying** the curriculum to value tacit Software Engineering knowledge?"*. Within this second cycle, I took action to re-design the specified curriculum for the Agile Methodologies 4.1. and 4.2 modules (Russell cited in Rahilly, 2015) that I taught as I moved away from the banking model of education in favour of adopting a dialogic problem-posing pedagogy as a means to value tacit software engineering knowledge within my practice.

Having re-designed the specified curriculum I began to implement the third action-reflection cycle to enact the curriculum.

4.3.3 Action-Reflection Cycle 3 - Enacting The Curriculum

I engaged with the third action reflection cycle (Chapters 7 to 10) to enact the Agile Methodologies 4.1 and 4.2 curriculum over two academic years, 2016-17 and 2017-18, with each year having a different cohort of students. I asked myself the question: *"How can I, as a lecturer, improve my pedagogical practice by **enacting** the specified curriculum to value tacit Software Engineering knowledge?"*. I undertook several related and concurrent actions to address this concern. I took action to develop lesson plans (Chapter 7) to bridge the gap between specifying the curriculum (**what** is needed) and enacting the curriculum (**how** it is delivered), to build teamwork to encourage students to engage (Chapter 8), to help students to reflect (Chapter 9), and to develop self-assessment methods (Chapter 10).

Prior to enacting the curriculum, I had previously sought and received ethical approval to invite the students, who enrolled on the Agile Methodologies 4.1 and 4.2 modules in both the 2016-17 and 2017-18 academic years, to participate in this research project. Before engaging with this action, I informed the students about the research project and invited them to join the study.

On presenting this methodology, after it had evolved, to my PhD support group in Maynooth, 'Fergal [Lecturer in Adult & Higher Education, Maynooth University] suggested that my research was more than just valuing tacit knowledge - I had delved into my pedagogical practices in more depth …' (Research Diary, 19/11/2016). It was this pedagogical "depth" within the context of valuing tacit software engineering knowledge that became the focus of this inquiry and, in particular, the action-reflection cycles as I transitioned from a banking model of education to favouring a dialogic problem-posing pedagogy.

4.4 Generating Evidence to Support my Claim to Knowledge

I collected data to generate evidence to support my living educational theory or claim to knowledge to explain that I now know something that I did not know before (McNiff and Whitehead, 2011). In this section, I describe how I looked for and collected data as I monitored my practice. I explain how I managed and analysed the collected data, which in turn allowed me to turn the data into evidence to support my claim to knowledge.

4.4.1 Looking for Data (Monitoring Practice)

As I engaged with this inquiry, I employed 'diaries' (McNiff and Whitehead, 2011, p.144; Bell, 2010, p.177), 'observation' (McNiff and Whitehead, 2011, p.142), 'interviews' (McNiff and Whitehead, 2011, p.144; Bell, 2010, p. 160), and 'analysis of documentary evidence' (Bell, 2010, p. 24) to collect and record data pertaining to what I do as an educator. Within each action-reflection cycle, I employed research diaries to record my activities within my practice and my own reflections on these activities. These diaries 'are the records [I] keep of personal action, reflection on the action and the learning arising from it' (McNiff and Whitehead, 2011, p.144). Within action-reflection cycle 3, I also observed, and recorded within my diaries, the students' participation in class, as 'it can reveal characteristics of groups or individuals which would have been impossible to discover by other means' (Bell, 2010, p. 191), such as student to student communication, lecturer to student synergy, learning environment and culture. Additionally, as discussed in Chapter 7, I employed a Group Observation Form (Appendix N) as I facilitated each team of students as they engaged with their

group project. I used interviews to complement these observation methods to ensure that I understood peoples' reasons for behaving in the way they do and comprehend processes employed, cultures, and decision-making. I describe the interview process that I employed in the next section. Within each action-reflection cycle, I undertook documentary analysis of societal and institutional standards, procedures, and templates as well as work products, such as lesson plans and learning logs (Chapter 10), produced either by myself or the students as a means to understand my practice.

I selected these methods of data collection to inform me as I reflected on how my learning through this inquiry influences my practice.

4.4.1.1 The Interview Process

I employed interviews during the third action-reflection cycle as I took action to enact my specified curriculum. For the first cohort of students (2016-17), I interviewed twelve students once at the end of the academic year after they had completed both Agile Methodologies 4.1 and 4.2. I conducted the following interviews as summarised in the table below:

Figure 4.2 : Interview Schedule for Academic Year 2016-17

Name	Date	Number of Participants	Participant Names (Anonymised)
Interview 1	14th March 2017	4	Jack, Mary, Peter, Emma
Interview 2	14th March 2017	2	John, Pat
Interview 3	15th March 2017	3	Denis, Mark, Ronan
Interview 4	15th March 2017	3	David, Anne, Eoin

While analysing the interview data from this first cohort of students, I reflected that I should have also interviewed these students after they had completed Agile Methodologies 4.1 and before they commenced Agile Methodologies 4.2 to gain a better insight of how their experiences evolved throughout the year. As a result of this reflection, I decided that I would interview the second cohort of students twice in the academic year 2017-18, firstly, when they had completed Agile Methodologies 4.1

(January 2018) and secondly on completion of Agile Methodologies 4.2 (April 2018). Seven students from the second cohort of students participated in the interview process where I conducted the following interviews as summarised in the tables below:

Figure 4.3 : Interview Schedule for Academic Year 2017-18 (January)

Name	Date	Number of Participants	Participant Names (Anonymised)
Interview 1	26th January 2018	3	Bernard, Jacob, Sam
Interview 2	26th January 2018	3	Dillon, Amy, Brendan

Figure 4.4 : Interview Schedule for Academic Year 2017-18 (April)

Name	Date	Number of Participants	Participant Names (Anonymised)
Interview 1	20th April 2018	4	Amy, Dillon, Brendan, Bernard
Interview 2	20th April 2018	3	Jacob, Nigel, Sam

In all interviews, across both cohorts of students, I asked the following questions:

1. Describe your experience of engaging with the Agile Methodologies curriculum to date. In doing so, can you differentiate between your classroom/lecture experiences and your practical/agile project experiences?
2. Identify, if possible, three (3) aspects of your experience with Agile Methodologies to date that you think or believe helped your learning and knowledge acquisition. In answering this, please consider your lecturer's role in structuring the learning environment.
3. Why and how did these identified items aid your learning?
4. Describe the types of knowledge that you learned and acquired to date. Is there a particular type of knowledge that you value more than other types? If so, why?
5. Identify, if possible, three (3) aspects of your experience with Agile Methodologies to date that you think or believe did not help or even hindered your learning. In answering this, please consider your lecturer's role in structuring the learning environment.
6. Why and how did these identified items not help or hinder your learning?

7. What are your thoughts or attitude with respect to the weekly Learning Log and Reflection?
8. Taking into consideration the types of knowledge that you value, what are your thoughts on the assessment approach employed in Agile Methodologies?
9. Is there anything you believe that I, as a lecturer, could do differently to improve how I teach and structure the delivery and your learning of Agile Methodologies?
10. Are there anything additional thoughts that you would like to add about your experiences on Agile Methodologies that have not been covered by my questions?

As I reflected on the actions that I took to develop my lesson plans (Chapter 7), to build teamwork to encourage students to engage (Chapter 8), to help students to reflect (Chapter 9), and to develop self-assessment methods (Chapter 10), I analysed the interview data that I collected, which captures the students' experiences of engaging with the Agile Methodologies curriculum, as a means to understand and learn about the actions that I had taken to structure the enacted curriculum and learning environment. In doing so, I have included relevant extracts from the interview data in Chapters 7 to 10 as I present my findings.

4.4.2 Managing and Analysing My Collected Data

> Started thinking about data collection, the data I have & will collect and the need to analyze that data. I now realise that I need some way to store and sort that data. I started looking @ NVivo and have decided that I can use this for all the data I collect. I can reference my diaries as externals and I can scan in my observations, student learning logs etc. into Nvivo … Need to investigate how to handle scanned documents with handwriting. I think I can select regions. What data do I have? (Research Diary, 2/2/2017)

As well as storing and organising my collected data within *Nvivo*, I also employed the software package to manage the qualitative analysis of my collected data (Bazeley and Jackson, 2013).

I analysed my collected data using the Braun and Clarke (2006, p.87) six phase thematic analysis approach summarised in Figure 4.5 (next page). They state that their six phase process is not linear but rather a recursive process 'where movement is back and forth as needed throughout the phases' (Braun and Clarke, 2006, p.86).

Phase	Description of the process
1. Familiarizing yourself with your data	Transcribing data (if necessary), reading and re-reading the data, noting down initial ideas.
2. Generating initial codes	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes	Collating codes into potential themes, gathering all data relevant to each potential theme.
4. Reviewing themes	Checking if the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic 'map' of the analysis.
5. Defining and naming themes	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names for each theme.
6. Producing the report	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis.

After familiarising myself with the data I generated initial codes by employing a number of First Cycle Coding Methods recommended by Saldana (2016).These coding methods also aided the familiarisation process. In particular, I engaged with three particular methods: In Vivo, Process, and Values coding. In Vivo coding

'prioritize[s] and honor[s] the participant's voice' (Saldana, 2016, p.106) in order to 'capture the meanings incoherent in people's experience' (Stringer, 2014, p.140). Process coding sheds light on 'the routines and rituals of human life ... that occur when persons act or interact for the purpose of reaching a goal or solving a problem' (Saldana, 2016, p.111). Insights into 'intrapersonal and interpersonal participant experiences and actions' (Saldana, 2016, p.132) are achieved through Values coding. Analysis using these coding methods was undertaken 'in an inductive or bottom-up way' (Braun and Clarke, 2006, p.83) resulting in the generation of initial codes.

Next, I searched for themes. This involved grouping together initial codes dealing with the same issue into a 'category' (Saldana, 2016, p.9). A category groups together related codes. The same initial code could be included in more than one category.   For me, 'a theme is an *extended phrase* or *sentence* that identifies what a unit of data [initial code/category] is *about* and/or what it *means'* (Saldana, 2016, p.199, original italics). A theme typically consists of one or more related categories.

My generated potential categories and themes were systematically reviewed 'to ensure that the name, definition, and exhausted set of data [initial codes] to support each category [and theme] were identified' (Frith and Gleeson, 2004, p.42). For Ryan (2006, p.100) in this approach to thematic analysis the 'meaning of the data extract is taken to be self-evident and refer unproblematically to what 'really happened'' resulting in the written analysis staying close 'to the original data although organising them in a different format'. Continual analysis and reflection, involving selection of compelling extracts from the data and constant moving back and forth between the phases, resulted in the definition and the naming of themes produced for this thesis.

4.4.3 Turning My Data into Evidence

In this thesis I present what I do as descriptions and explanations of my lived experiences, which constitute my living educational theory of practice. I regard that my living educational

> theory is a set of ideas about what [I] claim to know and how [I] have come
> to know. If [I] can show that what [I] know ([my] theory) stands up to

> public scrutiny in relation to agreed criteria and standards of judgement, [I] can claim that [my] theory has validity (has truth value and is trustworthy). (McNiff and Whitehead, 2011, p.23)

Generating evidence is part of the process of testing the validity of my living educational theory or 'claim to knowledge' (McNiff and Whitehead, 2011, p.161). I have engaged with the following steps to generate evidence from my collected and analysed data (McNiff and Whitehead, 2011):

- I employed my standards of judgement to examine my claim to knowledge (see next section),
- I examined my data to see if there is evidence of the claim to knowledge using my standards of judgement as set out, and
- I generated evidence to back up my claim to knowledge by describing and explaining my living educational theory using specific instances of the data that demonstrate my values in action within my practice.

In making a claim to knowledge, I am not only making a claim to have improved my practice, I am also making a claim to have a new living educational theory about that practice. The standards of judgement I set and established for my claim to knowledge are ones that emerged during the course of my research.

4.5 Establishing Standards of Judgement to Test Validity of my Claim to Knowledge

To test and evaluate my claim to knowledge, I have identified and established criteria for the 'standards of judgement' (McNiff and Whitehead, 2011, p. 151) that I want to have employed to determine the potential benefits of my practice and the validity of my claim. In establishing these standards of judgement, by which to evaluate the quality of my practice, I have employed my values of justice, democracy, and care as validity criteria to examine the conduct of my practice and my relationships with the students. These criteria require me as a practitioner to:

- Listen and learn to hear both myself and the students through the process of self-reflexive inquiry,

- Establish an ethic of care in my relationships with students,
- Develop an educative "community of practice",
- Equally value both the emotional and cognitive processes of learning,
- Be critical of the dominant worldview and of the taken for granted assumptions about the ways things are normally done around here,
- Link education and democracy in a way to encourage students to question the activities that they engage with in my practice, and
- Become a reflective practitioner who is attentive to both my own needs and those of the students.

(adapted from Hartog, 2004, p.32-36)

In applying these standards of judgement I recognised

> [t]he educational significance of the use of [the] action research methodology … it can demonstrate how the values of the [action] researcher can form, in the course of their emergence and clarification in practice, the explanatory principles and living standards of judgement for evaluating the validity of the educational knowledge being created. (Whitehead, 2007, p.6)

Therefore, in testing the validity of my claim to knowledge I have asked myself questions of the kind:

- Have I clearly articulated the values of my practice and is there evidence of my commitment towards living them within my practice?

- Have I shown how my understanding, learning, and practice has changed over time?

- Have I as a researcher demonstrated commitment to a continuous process of practice improvement?

- Have I taught and assessed in ways that recognise students as creative independent knowers becoming competent Software Engineering practitioners?

- Have I contributed to the learning of students through living towards the values of justice, democracy, and care in my educational relationships?

- Have I demonstrated originality of mind and critical thinking in the development of my living educational theory?

My descriptions and explanations within this thesis articulate my living educational theory as an educator by addressing the questions posed above to underpin the validity of my claim. It is against these standards of judgement that my claim to knowledge are my original 'contribution to educational knowledge and the professional base of education' (Lloyd, 2009, p.13).

4.5.1 Critical Friends and Validation Group

To demonstrate that I know what I am doing and why I am doing it, I am also required to test my descriptions and explanations (claim to knowledge) against the critical insight of others in order to establish their validity (McNiff and Whitehead, 2011). As an action researcher I must allow my research to be subject to public critique with a view to 'establishing the trustworthiness' (McNiff and Whitehead, 2011, p.159) of my claim. I have sought and acted upon critique from my PhD supervisor, PhD Support Group in Maynooth University, critical friends, and validation group (McNiff and Whitehead, 2011).

A critical friend is defined as 'a person who will listen to a researcher's account of practice and critique the thinking behind the account' (Whitehead and McNiff, 2006, p.256). During this study, I became part of a three-person group of 'critical friends' (McNiff and Whitehead, 2011, p.93) that had the roots of its formation in a discussion between myself and Lisa, who at the time participated in the same monthly PhD study group attended by both PhD supervisors and students within the Department of Adult and Community Education in Maynooth. At the time, although not sharing the same academic discipline, we both were starting to undertake a PhD in Adult and Community Education and had similar interests in how group work and reflective practice enables the teaching and learning process. I, in particular, having decided on action research as my PhD methodology was eager to establish a Critical Friend group. Lisa offered to join the group but also introduced me to Kate (who was not studying for a PhD but was lecturing in Software Engineering) in the belief that Kate would make meaningful contributions to the critical friend group as she shared the same academic discipline and subject modules as me. Kate also had similar interests in group work and reflective practice as Lisa and I.

After initial introductions and discussions, both Lisa and Kate became critical friends for my project. However, this arrangement quickly evolved where Lisa and I acted as critical friends with Kate and where I and Kate also served as critical friends for Lisa. What made this arrangement more interesting was the fact that our critical friend meetings occurred over Skype across three separate locations (two in Ireland and one in the US) and also that Kate and I had never met in person. As mutual critical friends we provided a 'constructive critique about [each other's] evidence and claims to knowledge' (McNiff and Whitehead, 2011, p. 93) as we engaged in improving our individual practices. (An additional benefit to using Skype is that our meetings were audio recorded and these recordings provided me, from a PhD perspective, with both the evidence that my critical friend meetings occurred and a recording of the constructive critiques into my practice.) For each of us, improvement to practice included enacting group work and reflective practice within our respective curricula. I had found a critical friend forum where the participants constructively shared and critiqued each other's practice.

A number of my teaching colleagues and a former software engineering colleague from industry agreed to be part of my validation group. This group had a different task to my critical friend group. My validation group was essentially a community of equals who, whether they are 'participants, practitioners or judges' (Whitehead and McNiff, 2006, p. 102), their role was to analyse my data and evidence, consider my claim to knowledge, and provide critical feedback as they examined my research-conclusions in the light of the standards of judgement that I put in place for this inquiry. In addition to the standards of judgement that I established, I also asked them to apply the 'criteria of social validity' (Whitehead and McNiff, 2006, p. 138) that Habermas states are necessary to address the truth of a claim to knowledge within the context of communication between speaker and hearer:

- The speaker must choose a comprehensible expression, so that speaker and hearer can understand one another;
- The speaker must have the intention of communicating a true proposition…so that the hearer can share the knowledge of the speaker;
- The speaker must want to express his intentions truthfully so that the hearer can believe the utterance of the speaker;

- The speaker must choose an utterance that is right…and can agree with one another in the utterance with respect to a recognized normative background.

(Habermas, 1976, pp. 2-3)

Within the context of written communication, Whitehead and McNiff simplify Habermas's criteria of social validity by stating that what has been written must be:

- Comprehensible, in that a form of language is used that is commonly understood by all;
- Truthful, in that all recognize these as true accounts and not fabrications;
- Sincere, so that all parties can trust what the other says;
- Appropriate for the context, while recognizing the unspoken cultural norms in which their discourses are embedded.

(Whitehead and McNiff, 2006, p. 102)

4.6 Role of Literature and Theory within my Inquiry

Action research is distinctive from other research methodologies in its treatment of the review of literature within the inquiry process. In an action research thesis 'you do not have to write a literature review but you must show that you have reviewed and engaged with literature' (McNiff and Whitehead, 2011, p.117). Rather than writing a dedicated literature review chapter at the beginning, a literature review should be spread across the thesis within the context of each action taken. Within the circumstances of taking action theoretical resources cannot be predicted in advance but become evident through the process of inquiry itself. Unlike other research methodologies, engagement with the literature in action research is motivated or driven by 'a process of improvisation as we draw on different aspects of our prior professional and general knowledge' (Winter, 1997, p.2). The role of the reviewing the literature within one's inquiry is unchanged, it is still necessary to demonstrate engagement with what you have read and provide 'informed commentary about it' (McNiff and Whitehead, 2011, p.117).

Based on these observations, and my own experience of action research (Russell, 2009), I do not engage with or present theories, drawn from the literature, upfront within my thesis as the body of knowledge or standard against which to measure my

inquiry. Rather, I can say that my literature review emerged throughout this inquiry process. Within each action taken, as questions arose in relation to my teaching and learning relationships, I was able draw on different theories or ideas to address my concerns. For example, I engage with ideas of "cooperative learning" (Johnson and Johnson, 1999) as I take action to enact group-work within my practice (Chapter 8). Because I 'must decide how best to intervene here and now' (Winter, 1997, p.3), while taking into account my own specific educational values and purposes, this example demonstrates that my engagement with the literature is integrated within and for the actions I undertook.

As a consequence, while my living educational theory is comprised of the descriptions and explanations based on my desire to live the values of justice, democracy, and care within my practice, I recognise that my living theory is also informed by the work of others. Their ideas 'speak to and affirm my own values, beliefs and experiences, thus becoming a means of supporting and validating my own living theory approach' (Hartog, 2004, p.87). I acknowledge that these ideas of others have enhanced my learning as I progressed with my inquiry.

4.7 Ethical Considerations within my Research Context

This research was undertaken as part of a PhD in Adult and Community Education supervised by Maynooth University. The research itself was undertaken within Athlone Institute of Technology where I as a PhD Student Researcher investigated through action research my professional practice as an educator in Software Engineering. This involved me identifying change and implementing change within my practice as I taught undergraduate Software Engineering modules. As the research required the involvement of undergraduate students from the Institute of Technology that I worked in, I sought and received ethical approval from both Maynooth University and Athlone Institute of Technology.

Participants were invited to voluntarily to participate in the research by me. The only criteria for inclusion was that the participant must be an undergraduate student studying on the Agile Methodology modules within the Bachelor of Engineering in

Software Engineering (Level 8) programme that I taught on. The students were required to collaboratively participate over a single academic year.

Ethically, I recognised, my perspective and proposed action must not impact on how I treat students, who 'are acutely aware of their social and intellectual status in class' (Jordan, Carlile and Stack, 2009, p.77). Also, I acknowledged to myself that my perspective and intervention must support all students in reaching their academic potential. Additionally, I designed my investigation not to harm the participants and not to deceive them (Bryman, 2008). I sought 'informed consent' (Norton, 2009, p.181) from students as my research involved interaction with and observation of participants. With respect to 'privacy' (Bryman, 2008, p.123), I have ensured the students' 'confidentiality' (Bell, 2010, p.49) in my reporting, but due to my proposed design which required researcher participation, observation, and interviews I was unable to provide them with 'anonymity' (Norton, 2009, p.185).

I ensured that my consent procedure addressed the following elements defined by Diener and Crandall (cited in Cohen, Manion and Morrison, 2011, p.78) – competence, voluntarism, full information, and comprehension. At the start of each academic year, I verbally informed my potential student participants that lecturers constantly and informally make changes to their professional (teaching) practice in order to improve practice and then determine the effectiveness of any change on practice to determine their next change, if any. The student participants were informed that my study was an Action Research project in which I formally study or investigate ways to improve my professional (teaching) practice by making changes to that practice. I explained that such formal investigation requires participation from them, as undergraduate students, so that the nature of the changes I make may be understood from their perspective so as to inform my understanding and learning of my practice which in turn may prompt further action and changes from me. I described how an Action Research study is an extra activity undertaken by me in collaboration with participants, critical friends, and validation group in a way that would not detract from my responsibility for delivering the modules or interfere with the students involvement with those delivered modules. I made it clear that participants would be observed and be interviewed as part of the action research cycle(s).

I also discussed the potential benefit that the study may have for students, whether they participated in the study or not. I identified Agile Methodologies as a key process component in the Software Engineering industry today. Within this process, the construction of knowledge incorporating the skills and attitudinal (tacit) component of professional software engineering knowledge is significant to the success of Agile Methodologies. I highlighted the benefits that could accrue to students by changing my professional practice to value and incorporate both the explicit and tacit components of professional software engineering knowledge in my teaching, learning, and assessment practices. I suggested that these benefits would help the student participants to be able to better recognise, generate, share, capture, and assess tacit software engineering knowledge within their learning environment in preparation for doing the same when they graduate as qualified Software Engineers.

I supplemented my verbal explanation and request for participation by providing the students with a written Participation Information Sheet (Appendix A) and a written Participant Consent Form (Appendix B). I asked the students to read the Participation Information Sheet in their own time and if they were interested to return a signed Participant Consent Form within a week to me.

In 2016-17 the class consisted of forty-one Software Engineering students all of whom, except three, were male. The group consisted of a range of nationalities and cultures. The majority were from Ireland and China but the class also comprised of students from Eastern Europe and India. All students had completed a recognised Software Engineering or equivalent Level 7 Degree to allow them register for the Level 8 Add-On Bachelor of Engineering (Software) degree. The majority had completed their Level 7 degrees elsewhere and were attending Athlone Institute of Technology for the first-time. It would be my observation, based on nearly twenty years of teaching experience, that the composition of this group of students is typical of a Fourth Year class on the Level 8 Add-On Degree within the institute that I teach in.

In 2017-18 the class consisted of thirty-two Software Engineering students all of whom, except two, were male. The group consisted of a range of nationalities and cultures. The majority were from Ireland and China but the class also comprised of

students from Poland, Czech Republic, India, and Nigeria. Similar to the 2016-17 cohort these students had completed their Level 7 degree with just over half of the class attending Athlone Institute of Technology for the first time.

Fifteen students agreed to participate in 2016-17 while a further ten agreed to participate in the following academic year.

Section 3 – Taking Action OUTSIDE the Classroom

Section 3, *Taking Action OUTSIDE the Classroom*, consists of two chapters and is concerned with the detailed descriptions and explanations of the action-reflection cycles that I undertook to transform my practice as I engaged with actions outside of the classroom.

In Chapter 5, *First Action-Reflection Cycle: I am a Living Contradiction*, I describe the first actions I took within this inquiry to explore and understand, *"Why do I feel that I am a living contradiction within my pedagogical practice?"*.

In Chapter 6, *Second Action-Reflection Cycle: Specifying the Curriculum*, I describe the second action-reflection cycle where I took action within my practice to answer the question, *"How can I, as a lecturer, improve my pedagogical practice by specifying the curriculum to value tacit Software Engineering knowledge?"*.

Chapter 5 - First Action-Reflection Cycle: I am a Living Contradiction

5.1 Introduction

In this chapter, I describe the first actions I took within my practice to explore and understand, *"Why do I feel that I am a living contradiction within my pedagogical practice?"*. In thinking about this question, I took action to write a narrative account of how, in 1996, I positioned myself as the knowledge expert within the classroom from my very first day as a lecturer. I further describe the difficulty I had, and how I failed, to relinquish this position within the classroom when presented with the opportunity to do so in 2008. I reflect on how I was a living contradiction within my existing practice prior to engaging with this study. I describe how I began to imagine a way forward to transform my practice in a way that would honour my values, where I would recognise and privilege the inclusion of tacit software engineering knowledge alongside the explicit software engineering knowledge that I currently value within the curriculum I specify and enact.

5.2 Taking Action - Why do I feel that I am a living contradiction within my pedagogical practice?

I took action to examine my pedagogical approaches from 1996 to 2014 to understand how I had become a living contradiction within my own practice. I reflected that I started teaching in 1996 when I was hired as a lecturer in Software Engineering specialising in Software Development Life-Cycles, Software Project Management, and Software Quality Assurance. As

> a S/W eng. professional I was offered my teaching position on the basis of my s/w eng knowledge and not my ability to engage in appropriate pedagogical practices. In fact I had never taught in a classroom. The only experience I would have had in the classroom was as a learner as I participated in my own formal education. As a result preparation for my teaching focused primarily on the explicit discipline knowledge identified in the [given] syllabus. My assessment strategy was already predetermined for me - it was summative and exam-based at the end of the module. Typically the exam was worth 80% while 20% was given to lab-based CA. However, the lab assessments were also summatively assessed based on a written report of the work undertaken in the lab. Although the lab report

> briefly described the process or procedure undertaken it was ultimately the results of the work that determined the mark as the procedure/process was explained before undertaking the work. (Research Diary, 4/7/2016)

This observation resonated with my past experiences as a student and these experiences resulted in me, as a lecturer, unquestionably accepting the written examination as the primary assessment method to examine the explicit Software Engineering knowledge privileged within the specified curriculum. By doing so, I ended up positioning myself as the knowledge expert within the classroom.

5.2.1 Me as the Knowledge Expert

> At the start of my teaching career I never thought about my pedagogical practices, theories of learning, or even questioned the nature of knowledge. I just implicitly accepted that the content in the Module Descriptors I enacted was the knowledge I must hand over to my learners through "transmission"... This required my students to learn on their own by memorising 'abstract, articulated, explicit forms' (Murphy et al, 2008, p.62) of decontextualised knowledge. My assessment practices required my learners to retrieve their memorised knowledge out of context as my testing checked my learners' ability to restate this 'stored knowledge' - see Elwood, 2008 (Research Diary, 22/01/2016).

I have identified that this pedagogical approach can be best described and explained by 'the "banking" concept of education' (Freire, 1970, p.45) where learning or cognition is viewed as the 'individual acquisition of knowledge' (Murphy *et al.*, 2008, p.25). Reflecting now on my experiences of my practice I see that I had positioned myself as the sole knowledge expert within the classroom. My memories of this time are that I spent the majority of my time sourcing relevant content which I condensed, structured, and summarised in Power-Point. These Power-Point presentations were printed out on transparent overheads so that I could "deliver" the content to the students. As there were no Virtual Learning Environments such as Moodle in those days, the students copied by hand the presented content into their notebooks. As the students copied the material, I would discuss the content and explain why I considered the content was relevant or useful. These discussions and explanations were not written down in my Power-Point presentations as the role of the presentation as far as I was concerned was to present content. The content itself only focused on the basic

and applied science components of professional Software Engineering knowledge, which have been described in Chapter 2.

When I reflect on my practice during this time, I recognise that I made a number of implicit epistemological and pedagogical assumptions around the concepts of learning and knowledge. I had assumed that learning 'is an individual process, that it has a beginning and an end, that it is best separated from the rest of our activities, and that it is the result of teaching' (Wenger, 1998, p.3). I had unquestionably accepted that learning occurred in the classrooms where I was focused on teaching the basic and applied science components of the software engineering knowledge valued and listed within the specified curriculum.

As I now think about those days and visualise the classroom, I now see the students furiously writing as I discussed and explained content. I now see that the students had no time to actively engage with me, with each other, or with ideas in relation to the presented content. I also wonder what the students were writing. Were the students just copying the content of the Power-Point as I discussed and explained? Or were the students making notes of my discussion and explanations? Or were the students doing both? Unfortunately, I suspect that the former was the case as my assessments rarely assessed my discussions and explanations but emphasised the "taught" content to be learned.

At this point in my career I never explicitly thought about or questioned the nature of knowledge. I just implicitly accepted that the content, comprised of the basic and applied science components of software engineering knowledge, listed in the specified curriculum I had to teach was the knowledge that I must hand over to my learners through 'transmission' (Murphy *et al.*, 2008, p.58). This required the students to learn on their own by memorising 'abstract, articulated, explicit forms' (Murphy *et al.*, 2008, p.62) of de-contextualised knowledge. I did not encourage students to engage in critical thinking, self-directed learning, or independent self-study within my practice. The students did not construct knowledge through critical reflection based on their expectations or experiences because

> [a]s an educator I …viewed knowledge as a given, i.e. education is about imparting existing knowledge to my students. In that context I valued explicit knowledge over tacit knowledge…I never asked myself how do I know what I know. I treated knowledge as finite and because I thought it was finite I believed that I could learn it and pass it on to my students in the same way I could buy an iPad or any commodity and pass it on to my child. This concept of knowledge being finite meant that it can be quantified and in my mind the more knowledge … you had the more educated you were. (Research Diary, 11/2/2016)

My approach was reinforced by my implicit belief in a 'vertical notion of expertise' (Boreham and Morgan cited in Murphy *et al.*, 2008, p.94), where I firmly thought of myself as the knowledge expert where passive learners individually learned from me by receiving knowledge. I had employed such an approach to my pedagogy as I had a narrow view that the purpose of education was 'the process of training the types of individuals business and industry say they need' (Kincheloe, 2012, p.3) through 'memory work for objective standard tests' (Kincheloe, 2012, p.6). I have reflected that by maintaining a vertical notion of expertise in the classroom, a 'teacher confuses the authority of knowledge with his or her own professional authority, which she and he sets in opposition to the freedom of students' (Freire, 1970, p.46). In doing so, I had negated the students' autonomy and did not allow them to take responsibility for their own learning, key aspects of a '[s]tudent-centered [a]pproach to [t]eaching' (Arman, 2018, p.64).

5.2.2 The Curriculum and Assessment Practices

The content of the curriculum was driven by '[t]he demands of the labour market… to respond to skills shortages identified by industry' (Share, Corcoran and Conway, 2012, p.163) and articulated to me and my colleagues during the institute's programmatic review process by both 'employers [and] professional bodies' (AIT, 2016, p.6). Within the specification process, I had privileged the selection of explicit software engineering knowledge within the curriculum because of its compatibility with the dominant assessment strategy at that time within Athlone Institute of Technology, the summative written Final Examination. I had accepted the practice of the time that the percentage breakdown of marks was typically skewed towards the final examination with 70% to 80% of the marks being reserved for this 'summative assessment' (Bloxham and Boyd, 2007, p.4). I acknowledge that within that context I

was implicitly operating within an epistemological position that favoured and valued explicit de-contextualised software engineering knowledge to be acquired by passive students and which could only be "meaningfully" assessed through a summative written examination. The effect of this assessment approach resulted in a limited notion of student ability based on 'performance according to a set of standardised tests [with] little or no recognition that ability is discursively created, dynamic, contingent and shaped by broader issues of class, ethnicity, age and gender' (Share, Corcoran and Conway, 2012, p.164). At this point in my career, I had not yet recognised students as unique individuals with the ability to participate in different ways in the same learning and assessment activities.

Due to my past experiences as a student myself, the teaching and learning strategies that I had adopted within my specified and enacted curriculum were lectures and computer laboratories (to teach specific practical topics) and reading material (to provide additional content on specific topics). Today, within the specified curriculum, there is an acceptance that independent learning activities outside the classroom need to be respected as valid elements of the educational process (Hunt, 2011). However, during this period of my career, I did not value the time or independent learning processes employed by students outside of class. Other than the recommended reading material and submitted assessments, I clearly did not value the learning, and hence the knowledge, engaged with by the students outside of direct contact with me.

In enacting the curriculum I controlled the teaching, learning, and assessment processes. This is reflected in the experienced curriculum whereby the students' participation was primarily restricted to listening while I "taught" as a means of 'giving knowledge' (Murphy *et al.*, 2008, p.81) – explicit and de-contextualised software engineering knowledge which I presented as having one and only one interpretation or meaning. The students never questioned or challenged (or were allowed to) this approach or my position as the software engineering knowledge expert.

As a result, in my 'figured world' (Holland *et al.*, 2008, p.153) of the classroom, formed by socially enacted and historically situated activities designed around giving explicit software engineering knowledge through lectures, I never considered my

learners' agency or identity as part of my practice. I did not consider how the students individually experienced agency and identity through their interactions with me and/or other students. Subconsciously I had imposed 'positional or relational identities' (Holland *et al.*, 2008, p.150) of being a passive learner on the students where I had positioned myself as the expert lecturer and had decided that the students' learning was motivated by the 'particular number of points' (Murphy *et al.*, 2008, p.78) associated with the curriculum's marking scheme. I had limited the power the students could exercise in their own learning because as 'the teacher [I was] the subject of the learning process, while [my] pupils are mere objects' (Freire, 1970, p.46). I now realise in this figured world I, as the knowledge expert, was the 'entitled' (Holland *et al.*, 2008, p.151) person in the learning environment against which the students must position themselves. However, I never inquired to see how the students identified with themselves let alone develop relationships with them.

I determined that my entitled position as knowledge expert within my practice was also re-enforced by my assessment approach which was summative in nature. On reflection, I can say at this point in my career I did not engage with formative assessment, nor was I able to distinguish between assessment of, for, or as learning (Bloxham and Boyd, 2007; National Forum, 2017; O'Neill, McEvoy and Maguire, 2020). Instead, I have come to understand that I had assessed the students' knowledge from an 'out of context' (Wenger, 1998, p.3) perspective. My assessment practices had required the students to retrieve their memorised knowledge out of context as my testing checked the students' ability to restate this 'stored knowledge' (Elwood, 2008, p.90).

In preparing my assessment tasks I had identified for the students objective assessment criteria to be employed as they undertook the task and I graded it. In doing so, I had assumed 'task stability' (Murphy *et al.*, 2008, p.160) by aligning assessment criteria with a marking scheme to identify a single solution for each assessment. I directly mapped portions of the explicit discipline content to assessment types and marking schemes based on a learning process that was individual in nature and where the student was passive as their mind acquired and stored knowledge, typically for further use within an assessment context. In directly mapping explicit de-contextualised software engineering knowledge to assessment types and marking schemes I was

guilty of constructing a pedagogy based on my then unquestioned belief that the learning process was individual and passive in nature where 'the students listen - meekly' (Freire, 1970, p.46).

The students' passive role did not allow them to collaborate either in the learning or the assessment processes. Back then I considered such collaboration as cheating. I now question how much of the knowledge they acquired was relevant to students in terms of preparing them for the Software Engineering profession and engagement with society in general. I suspect that students perceived my teaching and learning activities as difficult and boring, and potentially questioned their own capability and ability to participate within Higher Education.

I continued to actively position myself exclusively as a knowledge expert until 2008. After I experienced my disorienting dilemma in late 2007 (Chapter 1), I realised that my pedagogical approach treated learning, teaching, and assessment as 'socially neutral' (Elwood, 2008, p.89) activities. I had failed to prepare the students fully for working in the Software Engineering industry, which requires at a minimum, problem-solving skills within teams using explicit software engineering (discipline) specific knowledge in different contexts.

5.2.3 Questioning My Pedagogical Approach

I began to realise, as a teacher and a Software Engineer, that my practice needed to incorporate and promote the ability to work in groups and to problem-solve in different contexts.

In 2008, I designed and specified a new module, called *Requirements,* for the Bachelor of Science in Software Design programme (Russell cited in Rahilly, 2008). To recognise the importance of the ability to work in groups and to problem-solve in different contexts within software engineering I developed the first year *Requirements* module to incorporate 100% Continuous Assessment through the employment of group work to tackle authentic software problems. I started by identifying what I considered was the correct content or explicit software engineering knowledge required for the module. Once the content had been identified, the Module Learning

Outcomes and aligned assessment approaches were developed to ensure that the identified content was engaged with through group-work.

On reflection, by taking this approach to curriculum specification, where I continued to privilege explicit software engineering knowledge as the starting point in the process, I did not think about the role that tacit software engineering knowledge played in educating students to become competent software engineers. Although there are three types or 'strands of learning outcome' (QQI, 2016, p.21) valued by the *National Framework of Qualifications* within the context of formal education (Knowledge, Know-How & Skill, and Competence), in designing the curriculum for individual modules I had failed to heed their significance particularly in relation to the type of knowledge valued by each of the individual learning outcome strands. Placing explicit software engineering knowledge at the centre of the curriculum specification process resulted in me only specifying Knowledge, Know-How and Skill Learning Outcomes to the detriment of the Competence strand.

I have reflected that my approach to the curriculum specification process was flawed. By starting the process by identifying the explicit software engineering knowledge that I valued, I let the curriculum content dictate the choice of learning outcome strands. The result of this approach was that I never specified a Module Learning Outcome that mapped to the Competence strand as defined within the *National Framework of Qualifications*, a necessary element required in valuing tacit software engineering knowledge and competency within my practice. I had misunderstood or did not fully understand on how best to employ the *National Framework of Qualifications* to guide the curriculum specification process. I have since learned that the curriculum specification process should prioritise identifying the Learning Outcomes for a module as these outcomes focus the design process on identifying what students should be able to do after completing the module (QQI, 2016). I now accept that the idea of structuring the curriculum design process around learning outcomes moves the emphasis from valuing curriculum content to both recognising the competencies and various forms of knowledge that students must strive for as they learn to become competent software engineers. Additionally, I also accept that by constructively aligning learning outcomes to assessment approaches, students can be encouraged to engage in a deep approach to learning (Biggs, 1987) where they work

on tasks in an intentional and meaningful way using the 'most appropriate cognitive activities for handing' (Biggs and Tang cited in Wang et al., 2013, p. 479) the task.

However, within the context of this flawed specified curriculum, I did recognise that I needed to value alternative ways of being within the classroom if I was going to enact the *Requirements* specified curriculum using group work to problem-solve in different contexts.

5.2.4 An Alternative Way of Being within the Classroom

I began enacting the *Requirements* module in January 2009. In enacting the new curriculum, I changed how I taught and positioned myself in relation to students, by dividing classes into either a lecture or facilitated workshop. The lecture's purpose was to teach and engage students in learning software engineering theory. Students then employed the taught theory within the workshop. In lectures I continued to position myself as the knowledge expert where I employed Power-Point to teach theory. However, in the workshop I repositioned myself as a facilitator where I supported the students in employing Problem-Based Learning to apply the taught theory to an authentic software problem (Barrett, 2005). As a facilitator, I felt more engaged with my teaching activities and got to know my students better as individuals.

For each class, my documented lesson plan reflected this approach and identified the teacher/student activity to be undertaken. Previously, my "lesson plans" were held in my mind driven by the desire to chunk through the module's content as specified in the curriculum. For the first time in my career I had formally employed lesson plans which identified teaching practices which positioned the students as 'active participants in their learning and where learning from and with others is key' (Elwood, 2008, p.93) within the facilitated workshop but not the lectures.

Within the workshop I divided the students into groups of three to work on a problem over a number of classes. Each member of a group was required to take ownership for a particular part of the project and integrate their work product (what they produced) with what the others members produced. In the workshops I facilitated the groups working on their problem by changing my role to a 'scaffolder of learning'

(Murphy *et al.*, 2008, p.162). This facilitated group-work incorporated elements of authentic activities, such as design discussions or tracking project progress, each of which requires active student participation. However, I still retained my position as a knowledge expert as I continued to dispense explicit software engineering knowledge in both the lecture and workshop classes.

Additionally, I maintained assessment practices which continued to focus on measuring the explicit software engineering knowledge acquired by each individual student. Even though my teaching and learning practices had changed, driven by my recognition that group-work and problem-solving in different contexts are important elements in student learning, my corresponding assessment practice did not take into account this personal and social nature of the enacted learning environment but instead focused on measuring the work product produced by each individual within the group. By continuing to maintain in the assessment practices my identity as the discipline knowledge expert I "mainly" directed and "only partially" facilitated each group through the different stages of the assessment process where I did not allow the students to explore any alternative ways to solving the problem. I had failed to recognise the importance of

> [m]etacognition as a component of authentic assessment [which] establishes the value and importance of both critical reflection and self-evaluation for successful workplace performance, as well as personal development. (Ashford-Rowe, Herrington, and Brown, 2013, p.208)

I found that in taking this approach I continued to assume a task stability within each assessment I enacted. I have learned that this notion of task stability within a software engineering assessment is not possible, as I know that the authentic-like problems I gave the students to solve had potentially more than one unique solution and/or more than one way to solve the problem.

I now see, even though I posed problems for the students and facilitated group-work, I did not do so in the way envisaged by Freire who perceives a problem-posing teacher as one who

> … constantly re-forms his reflections in the reflection of the students. The students - no longer docile listeners - are now critical co-investigators in dialogue with the teacher. The teacher presents the material to the students for their consideration, and re-considers her earlier considerations as the students express their own. (Freire, 1970, pp. 53-4)

Although within the assessment strategy I had allowed the students some discretion to exercise power in how they actively engaged with the learning process itself, I had continued to limit their freedom to think for themselves because my role as the knowledge expert had continued to dominate my practice.

I have reflected that this approach allowed me to maintain assessment practices that measure 'something that is the property of the individual' (Murphy *et al.*, 2008, p.93). In doing so, my facilitation practices employed formative assessment approaches. My approach to formative assessment through my facilitation process can best be classified as 'Convergent Formative Assessment' (Pryor and Crossouard, 2008, p.4) in that the purpose or aim of the assessment was to determine 'if the learner knows, understands, or can do a predetermined thing' (Pryor and Crossouard, 2008, p.5) and is characterised by me as being the knowledge expert in control by 'marking out a correct train of thought for students to appropriate' (Pryor and Crossouard, 2008, p.4). Essentially, my assessment criteria and focus had continued to be only on the work product produced by each individual within the group and not the processes employed in solving the given problems. I now accept the assessment criteria and focus had regulated how students exercised their agency while engaging in their learning. Their engagement was framed and constrained by trying to achieve the maximum grades available in an assessment practice that does not take into account student agency and the social nature of the teaching, learning and assessment tasks. As a consequence, within my practice since 2008, I realise that the knowledge I still valued is the explicit discipline-specific knowledge and not the tacit software engineering knowledge developed through active relational participation in the learning process.

Since 2008,

> I have transitioned to [this] participative approach to teaching and learning but I [still] favour assessment of explicit knowledge ...[and where] tacit knowledge is not recognised from an assessment perspective. It is used by

> teaching and learning practices to structure the formal education setting/environment. I do this at the moment by, e.g., employing group work in teaching/learning practices but I do not assess the process of group work only the work product. (Research Diary, 30/3/2015)

I continued to maintain this stance up to and including the 2015-16 Academic Year:

> I note that my Learning Outcomes for AM 4.2 include the verbs 'Practice' and 'Employ', which on reflection mean the doing of or the engagement in a process that produces some work product. The aligned assessment strategies for these LOs do involve "doing" and "producing an output", but my assessment criteria only focus on the quality of the output and ignores the quality of the doing. It seems to me that I value one type of knowledge over another. I think I value explicit knowledge over tacit knowledge? Why is this? NFQ clearly identifies different types of knowledge that students should engage with. I do have a concern about how you assess tacit knowledge, for example, one's participation in an activity. What else contributes to tacit knowledge - experience, action, ??? … The irony is that I include in my teaching and learning practices the opportunity for my students, for example, to work in groups. I value group-work because that is how the s/w engineering industry normally organises itself in order to deliver software products. As part of group-work I encourage team organisation/roles/teamwork, problem-solving, critical thinking… what else? However, none of this "knowledge" is explicitly assessed? Why? (Research Diary, 12/1/2016)

But I do remember, in that year, one student did question my pedagogical approach:

> In one part of the project, I require each team member to work individually in TDD [Test Driven Development - a Software Process] for a number of end-to-end user stories. This allows me to assess each student in TDD which is a core part of the LOs for the module. However, this one student clearly pointed out to me that in industry a team could structure itself differently so that no one team member had to work on end to end stories. She argued that I was restraining her team in the choices they could make (these for me are process choices). I had to agree with her that I am restricting choices. I now realise that this happened subconsciously as I designed the project where in the design of the project I always had one eye on how I would assess and how I would divide out the marks, particularly to distinguish between individuals within a group. This I don't like, this is a concern, this is something I need to change. I am concerned with the …implications of how I structured the project and assessment. In a truly democratic system both I and my students should be involved in negotiating the project, its tasks and how it should be assessed. (Research Diary, 27/1/2016)

As I reflect on these observations I note (i) my emphasis on my facilitation practices incorporating convergent formative assessment and feedback, (ii) my position as the knowledge expert, (iii) my planning and control in my pedagogic practices, (iv) my total disregard of tacit software engineering knowledge, and (v) a negation of my values within my assessment practices, in favour of summative grading of individual assessment outputs. This approach had resulted in me limiting or hampering the students' agency which in turn damages or disrupts their identity and its' transformation by constraining their participation and what can be experienced in the curriculum.

I have acknowledged to myself that my alternative way of being in the classroom incorporating "my facilitative" approach had continued to restrict the students' agency and re-enforced the identities of expert teacher and novice learner within the classroom.

5.3 Findings and Reflection: I was a Living Contradiction when …

Whether I had positioned myself as a knowledge expert (1996-2007) or facilitator cum knowledge expert (2008-2016) within the classroom, many aspects of my practice were similar. However, the main difference I see is in the pedagogical practices used to engage the students in the learning process – passive individual activities as opposed to active social group activities. Although I have reflected on the learning process and learners within my practice through different lenses (knowledge expert or facilitator cum knowledge expert, passive student or active student), each lens viewed software engineering knowledge in the same way. I had always valued explicit over tacit software engineering knowledge resulting in constrained agency, identity development, and learning for the students.

When I positioned myself as the knowledge expert within my practice, I valued the explicit discipline knowledge that the students studied or learned in a decontextualised way without any reference to the corresponding skills or attitudes needed in the workplace or software engineering community of practice. When I position myself as a facilitator cum knowledge expert, I focused exclusively on changing my teaching practices and what I needed to do to encourage student engagement in solving

problems through group-work, which requires engagement with the skills and attitudinal component of software engineering knowledge needed in the workplace. However, I did not change my assessment approach which still examined learning outcomes based only on explicit software engineering knowledge. This approach encouraged students to favour a surface approach to learning by completing assessment tasks 'with minimum trouble, while appearing to meet course requirements' (Biggs and Tang cited in Wang et al., 2013, p. 479). In taking this approach to my pedagogy, I agree with Cobb (cited in Murphy *et al.*, 2008, p.93) that I still viewed learning as being located within the individual.

5.3.1 Tacit Knowledge is not Privileged

By not privileging or valuing tacit knowing and professional competence within my pedagogical practice and recognising that I should be educating students to become competent software engineers, I have a sense that I had adopted a pedagogy that was easy and safe to enact. In doing so, I now see how this lack of pedagogical challenge developed into a deep frustration within me as demonstrated by my disorienting dilemma. I identified that

> [my past] professional practice favours a particular way of knowing. There are other ways of knowing. Rather than casting my research question around explicit/tacit knowledge, I should be thinking of complementing my practice with additional ways of knowing. Critical Pedagogy is a PoE [Philosophy of Education] and social movement that combines education with critical theory. Critical pedagogy considers [the nature of] relationships between teaching and learning. (Research Diary, 22/4/2014)

I started to look at the specified and enacted curriculum from a critical pedagogy perspective (Kincheloe, 2008; Shor and Freire, 1987). I started to consider my role within my overall practice and the values that I live my life by. I reflected that Higher Education institutes should be sites 'of critical thinking, democratic leadership, and public engagement' (Giroux, 2002, p.427) where the purpose of education is for the development of critical and productive democratic citizens who are capable of meeting the demands of the marketplace and society. I began to question if my role should be to create the pedagogical conditions within the curriculum (specified and enacted) for students to

come to terms with their own sense of power and public voice as individual and social agents by enabling them to examine and frame critically what they learn in the classroom within a more political or social or intellectual understanding of what's going on in the interface between their lives and the world at large. (Giroux, 2002, p.451)

I started to think about critical thinking and democracy playing a central role in the transformation of my practice. I began to consider how I could enable critical thinking and democracy within the specified and enacted curriculum where I now perceived that '[t]eaching is about "transforming and extending knowledge", it is about the "continuity of knowledge" … and its transformation through critical analysis' (Gurm, 2013, p.1-2). To engage with "transforming and extending knowledge" within my practice, I reflected that my starting point must be the specified curriculum. I identified that I needed to

> … investigate the types of knowledge that should be embedded in a curriculum, consider the sources of that knowledge, capture that knowledge within LOs (if this is the correct mechanism to use), employ different ways of knowing …in the learning and assessment process. I believe that the different ways of knowing have implications for the learning and assessment processes but also impact the teaching practices. (Research Diary, 4/6/2014)

It was this type of thinking that brought both the concepts of knowledge (both explicit and tacit) and ways of knowing to the forefront of this inquiry. Within my existing practice, I had perceived learning to be a cognitive process by which the mind takes in facts and information to store them as explicit knowledge to the detriment of other ways of knowing.

I had valued facts and the capacity to think rationally within both the specified and enacted curriculum. While I did recognise other ways of knowing in a limited way within my teaching and learning activities, I had privileged rational thinking as the dominant way of knowing. However, I had not valued that feelings, pain, fear, shame, and care are alternative ways of knowing our world. I had not listened to the students. I now accept to listen is to care. Care involves 'empathy and identification with our own and others' needs' (Ryan, 2009, p.174). I identified I needed to start listening to and caring for both myself and the students. In particular, I started to think about ways

to capture listening and caring within the specified and enacted curriculum. In my diary, I reflected that within my practice I should

> [f]ocus on the process of learning rather than learning as a commodity. I would argue that viewing learning as a commodity influences the nature of the learning process. Viewing learning as a commodity implies that students [and I] have certain expectations around what is taught and assessed but more importantly how it is assessed and how they compare with their fellow students. (Research Diary, 2/10/2014)

As I grappled with the concepts of explicit and tacit knowledge within the context of Software Engineering, my perspective on my role as a lecturer and my pedagogical practices started to evolve. I started to perceive the role of lecturer as someone 'more than an imparter of knowledge [who] guides/facilitates the educational experience to help learners understand their own learning, and to plan and approach it in the most effective way' (Research Diary, 2/10/2014).

5.3.2 My Values are Negated

It was this thinking that made me see that I had ignored my values of justice, democracy, and care within my practice because I had embraced the following 'attitudes and practices' (Freire, 1970, p46) of the banking model of education:

a. the teacher teaches and the students are taught;
b. the teacher knows everything and the students know nothing;
c. the teacher thinks and the students are thought about;
d. the teacher talks and the students listen -- meekly;
e. the teacher disciplines and the students are disciplined;
f. the teacher chooses and enforces his choice, and the students comply;
g. the teacher acts and the students have the illusion of acting through the action of the teacher;
h. the teacher chooses the program content, and the students (who were not consulted) adapt to it;
i. the teacher confuses the authority of knowledge with his or her own professional authority, which she and he sets in opposition to the freedom of the students;
j. the teacher is the Subject of the learning process, while the pupils are mere objects.

(Freire, 1970, p.46)

I have reflected that I was a living contradiction when I failed to engage with the full potential of the *National Framework of Qualifications* in specifying the curriculum because I had privileged the (explicit) basic and applied science components of software engineering knowledge to the detriment of the (tacit) skills and attitudinal component of software engineering knowledge within the curriculum. In doing so, I had positioned myself as a knowledge expert within my practice who embraced the *vertical notion of expertise* and an epistemology which valued explicit software engineering 'knowledge as a commodity' (Murphy *et al.*, 2008, p.185) and as a passive entity that cannot be questioned or changed within the context of my practice. This happened because I embraced 'the stifling character of subject matter curricula, where students are compelled to endure abstract lessons and authoritarian' (Margonis, 1999. p.99) positioning of me as the lecturer.

I was a living contradiction when I did not honour my belief and acceptance in an epistemological position that acknowledged that explicit propositional software engineering knowledge requires 'to be contextualised within the living process of an inquirer's attempts to know' (Roche, 2007, p.4). This resulted in me in ignoring the social nature of learning and discouraging students from active meaning making through developing their skills and attitudinal component of software engineering knowledge concerned with the actual performance of producing software products. By doing so, I had not allowed students to learn by applying their thoughts and experiences to problems as they occurred, a process which would have allowed an individual to construct knowledge through their interactions with both their social and natural environment (Biesta and Burbules, 2003). Instead, I had viewed '(1) education as memory work for objective standards tests and (2) teaching as a low skill activity where teachers do only what they are told' (Kincheloe, 2012, p.6).

I was a living contradiction when I actively disrupted students' opportunities to be agentive or an active constructor of meaning and knowledge by deliberately restricting agentive actions in favour of directing students towards a single solution that I had imagined to posed problems for assessment purposes. In doing so, I had constrained the students' agency and re-confirmed their identity as a learner not capable of becoming competent professional software engineers. On reflection, this demonstrates that students were not credited with all the software engineering knowledge learned

as the full range of learning was not examined by me. I had failed to value the software engineering knowledge generated by students themselves as they engaged in group-work within the enacted curriculum. I did so by only grading the work products produced and not grading the authentic practices or processes employed by the teams of students themselves in their creation of the work products.

I was a living contradiction when I was not critical of the taken for granted assumptions about the ways things were normally done within Athlone Institute of Technology, especially the dominant perspective that the written exam should be the main form of assessment.

Through experiencing myself as a living contradiction I have come to understand that formal higher education should not be driven by curriculum content and should not be teacher focused. By adopting a teacher-centred approach to my pedagogy, built upon 'the "banking" concept of education' (Freire, 1970, p.45), I have reflected that I was being unjust and undemocratic in how I interacted with and cared for the students by predetermining the software engineering knowledge and ways of knowing that they should value. Through my privileging of 'subject matter curricula …[I have taught the students]…to distrust their own knowledge and to assimilate the ideology of the oppressors' (Margonis, 1999, p.99), namely me as their lecturer. It is an approach that I am no longer comfortable with.

5.4 How to Transform My Practice

Instead, I imagined that I would not be a living contradiction if I embraced a student-centred 'pedagogy of knowing and participatory education' (Swart, 2009, pp.4-5) which is both critical and 'founded on the notion that education should play a fundamental role in creating a just and democratic society' (Nouri and Sajjadi, 2014, p.76). Such a student-centred approach encourages learners to take responsibility and ownership for their own learning where students would develop their own metacognitive skills, the ability to be cognisant of their own thought processes (Murphy *et al.*, 2008), to 'enhance knowledge acquisition with understanding' (Peters, 2000, p.166).

From a practice perspective I imagined that I could and should value pedagogical methods which focus on critical thinking, problem solving, projects, experimentation, and students working in groups. Working in groups encourages students to learn to work together (cooperatively) though building just and caring relationships which contribute to the development of a democratic software engineering community of practice (Johnson and Johnson, 1999; Wenger, 1998). Rather than transmitting knowledge to be acquired by students I imagined I would now be committed to teaching, learning, and assessment processes where students apply their software engineering knowledge to authentic problems through enquiry. I identified that such an inquiry-based approach can be achieved within a community of practice where the learning environment provides students with the time and confidence to discover, experience, and examine their activities in their search of knowledge (Wenger, 1998). I felt to do so would require a 'curriculum based on true dialogue that value[s] social interaction, collaboration, authentic democracy, and self-actualization' (Nouri and Sajjadi, 2014, p.99) where students actively participate with their learning and think critically about their experiences.

Within this thinking, I thought that the transformative actions that I imagined enacting represent a '[c]ritical [p]edagogy' (Kincheloe, 2008, p.6), which recognises that I and students have much to learn from each other. I considered that such a critical pedagogy should draw on some elements of 'a Freirean agenda for the learning process' (Shor, 1987, p.23) by incorporating:

- Dialogue-centred teaching focused on 'problem-posing' (Shor, 1987, p.23) discussion that honours both the teacher and student voice within the classroom,
- Critical literacy where both teacher and student problematise in order to understand existing knowledge not 'at the empirical level of memorizing data …but [by going] beneath the surface to understand the origin, structure, and consequences of any body of knowledge, technical process, or object under study' (Shor, 1987, p.24), and
- Situated pedagogy that locates student learning within their everyday lives, their desires, their cognitive and affective capabilities.

However, I thought further on the meaning of "pedagogy" and "critical pedagogy". I determined that

> [w]hile pedagogy is most simply conceived of as the study of teaching and learning, the term critical pedagogy embodies notions of how one teaches, what is taught, and how one learns. Critical pedagogy is a way of thinking about, negotiating, and transforming the relationship among classroom teachings, the production of knowledge, the institutional structures of the school, and the social and material relation of the wider community and society. (Breunig, 2016, p.1)

Reflecting on this observation, it became clear to me that my imagined transformation to my practice emphasised the need for dialogue, collaboration, and openness but that I did not seek to foster 'conscientização' (Freire, 1970, p.41) or social praxis, where '[t]he teacher's role is to equip students with the knowledge, behavior, and skills to transform society into a place where social justice *can* exist' (Ayers, Quinn and Stovall, 2009, p.590, original italics). I had identified that social justice, a key element of critical pedagogy (Freire, 1970; Kincheloe, 2008), did not have a role to play in the actions I planned to take to transform my practice.

In thinking about the Freirean perspective to teaching and learning activities that I wished to adopt, I reflected that

> I also need to be clear on the relationship between the knower and what is known ... Remember Dave's [My PhD Supervisor] comment - "The knower is as important as the known". This statement has implications for how knowledge is acquired but recognises that knowledge should not be treated as a passive entity in the knowledge acquisition process. (Research Diary, 30/3/2015)

The comment that *"The knower is as important as the known"* made me contemplate that knowledge itself is closely linked with ways of knowing and influences choice of pedagogy. I concluded that in order to value tacit software engineering knowledge within my practice, I needed to move away from the banking model of education in favour of embracing a student-centred approach which embraced a dialogic problem-posing pedagogy that does not impede student agency or identity development within the context of a community of practice. I identified that such a dialogic problem-posing pedagogy would promote active participation amongst all participants within

my practice (Shor, 1992). I decided I would transform myself and become a dialogical teacher focused on transforming my practice by embracing a problem-posing pedagogy, where I

- pose thought-provoking, open-ended problems to students so that they feel challenged in thinking them through;
- avoid short-answer questions, which make students feel like robots calling out the right answer; encourage student themselves to come up with thought-provoking questions for discussion;
- be patient in listening to students and in giving them time to think on their feet, to think in groups, to write, and to read with understanding; …[and]
- pose critical interpretations of the course subject matter and invite students to discuss alternative ways of understanding the course content.

(Shor, 1992, p.95-6)

This is the perspective from which I took further actions within this inquiry to transform my practice by both specifying and enacting a student-centred curriculum to value both explicit and tacit components of Software Engineering knowledge. By engaging with this action-reflection cycle, I have imagined a solution which allowed me to overcome my feelings and reasons of being a living contradiction.

Chapter 6 - Second Action-Reflection Cycle: Specifying the Curriculum

6.1 Introduction

In this chapter, I describe the second action-reflection cycle where I took action within my practice to answer the question, *"How can I, as a lecturer, improve my pedagogical practice by specifying the curriculum to value tacit Software Engineering knowledge?"*. I undertook this action to ensure that 'both explicit and tacit knowledge … [is] incorporated into the [specified] curriculum' (Research Diary, 8/9/2015) in a way that treats software engineering knowledge as 'an entity which must be constantly challenged, redefined, and negotiated by all participants in social and educational settings' (Kincheloe, 2012, p.102). To encourage students to challenge, redefine, and negotiate software engineering professional knowledge within the enacted curriculum I took action to re-design the specified curriculum to embrace dialogue as part of a critical problem-posing pedagogy. I did so in the belief that in a specified software engineering curriculum

> professional knowledge cannot be characterized in a manner that is independent of how it is learned and how it is used. It is through looking at the contexts of its acquisition and its use that its essential nature is revealed. Although many areas of professional knowledge are dependent on some understanding of relevant public codified knowledge found in books and journals, professional knowledge is constructed through experience and its nature depends on the cumulative acquisition, selection and interpretation of that experience. (Eraut, 1994, p.19-20)

In taking this action, I specified **what** information (indicative syllabus), **what** Module Learning Outcomes, and **what** teaching, learning, and assessment strategies must be enacted within the curriculum. I designed strategies to allow me build dialogical and educational relationships within a critical problem-posing pedagogy as the basis for students and I to actively engage with the indicative syllabus (Shor and Freire, 1987). Finally, I reflect on the actions that I took to re-design the specified curriculum.

6.2 Taking Action - How can I, as a lecturer, improve my pedagogical practice by <u>specifying</u> the curriculum to value tacit Software Engineering knowledge?

The *National Framework of Qualifications* 'articulates which forms of learning form part of the qualifications systems and how they are standardised, recognised and valued by individuals, the economy and society' (OECD, 2007, p.10). In particular, as already discussed, the *National Framework of Qualifications* identifies three strands of learning which describe the nature of knowledge and the learning that students should engage with: 'Knowledge … Know-how and Skill …[and] Competence' (QQI, 2016, p. 21-2). While the *National Framework of Qualifications* is only concerned with the forms of learning that can be measured against the three stands of learning outcome it also recognises other forms of learning, which cannot be measured, takes place as learners engage with formal education (QQI, 2016).

Within this context of the *National Framework of Qualifications*, I interrogated the curriculum that I taught, and I figured out that within my past practice:

> that there is a disconnect with the kinds [or strands] of knowledge required in the National Qualifications FW … and the knowledge valued in [my] specified, enacted, and experienced curriculum. I am concerned that explicit knowledge is valued over tacit knowledge, particularly in the enacted and experienced curriculum which favour teaching, learning and assessment processes focused on [explicit] discipline specific knowledge. (Research Diary, 29/7/2015)

To address this disconnect, throughout 2015-16, I took action to transform my practice by re-designing the specified curriculum for a Software Engineering curriculum. In doing so, I wanted my re-designed specified curriculum to support the students 'to make use of existing data while learning to produce their own knowledge' (Kincheloe, 2012, p.21) by 'using explicit knowledge (existing data) to solve authentic problems (knowledge production) while at the same time adhering to some (objective, measurable) assessment standard' (Research Diary, 15/4/2015). To privilege such knowledge within the specified curriculum, I planned to structure my learning environment to employ a dialogic problem-posing pedagogy within the classroom where I value

a two-way transformation of subject matter and discourse. On the one hand, the subject matter, a body of knowledge, is introduced by the teacher as a problem for students to reflect on in their own language. On the other hand, the students who come to class with their own universe of words, themes, and experiences are challenged to go beyond themselves, into a new territory not generated from their backgrounds. This dual transformation of subject knowledge and student knowledge is also a transformation of the teacher's role and classroom discourse, from one-way delivery of information to democratic problem-posing. (Shor, 1992, p.77)

Within this two-way transformation '[t]hrough dialogue, the teacher-of-the-students and the students-of-the-teachers cease to exist and a new term emerges: teacher-student with students-teachers' (Freire, 1970, p.53). To enable this two-way transformation within my practice I positioned myself as a critical teacher and facilitator, who situates software engineering knowledge within a problem-posing pedagogy, as I re-designed the specified curriculum.

In re-designing the specified curriculum, I employed the Athlone Institute of Technology's curriculum design process employing its Module Descriptor Template (Appendix C) where I was required to

- describe the indicative content supported by an associated reading list,
- identify, design, and specify the module learning outcomes for each subject and constructively align each with a corresponding assessment method, and
- identify the Teaching, Learning, and Assessment strategies that I plan to employ within the enacted curriculum.

6.2.1 Indicative Syllabus for Agile Methodologies

Dialogue is an important aspect within a critical problem-posing pedagogy which influences the nature of educational relationships within the curriculum (Shor and Freire, 1987; Freire, 1970). In re-designing the specified curriculum, I took action so that

the dialogical character of education as the practice of freedom does not begin when the teacher-student meets with the students-teachers in a pedagogical situation, but rather when the former first asks herself or himself *what* she or he will dialogue with the latter *about*. And preoccupation with the content of dialogue is really preoccupation with the program content of education (Freire, 1970, p.53).

The design of the program content of education or specified curriculum can be structured around one or more of the following themes: generative, topical, and academic (Shor, 1992). These themes delineate between the different types of subject matter to be talked about and who brings that subject matter for discussion within a problem-posing curriculum or class. Generative themes are identified and expressed by students. They are rooted in the students' culture and problematic situations and are one source for critical dialogue within a learning environment. I, as a teacher, can bring topical or academic themes to the discussion. Topical themes focus on important socio-political issues or questions and are introduced as problems by the teacher into the class discussion for cooperative study. However, within this inquiry, I use an academic theme approach as the basis for designing the specified curriculum. An

academic theme represents a scholastic, professional, or technical body of knowledge which the teacher wants to introduce or has to introduce as a requirement. Drawn from specific disciplines - … computer science, …engineering, …[etc.] - this academic material is not generated from student culture. Neither is it a political issue or topic in society. The academic theme is structured knowledge in a teacher's field. (Shor, 1992, p.73-4)

In this enquiry I focused on an academic theme, Agile Methodologies, that I teach within a Bachelor of Engineering (Honours) in Software Engineering programme. I divided the academic theme into two separate modules to be taught within the same academic year. The first module Agile Methodologies 4.1 is taught in the first semester while Agile Methodologies 4.2 is delivered in the second semester.

I took action to develop a table (Figure 6.1) to map the Agile Methodologies academic theme onto the various components of software engineering knowledge (Chapter 2) to be valued and incorporated within the indicative syllabus for the curriculum. I did this because within my past practice 'the s/w eng. knowledge taught/valued is limited due to the Banking view of education [I embraced] and that this is to be addressed by …

Figure 6.1 Software Engineering Knowledge Valued within an Agile Methodologies Specified Curriculum

NFQ Strands of Learning Outcomes	Software Engineering Knowledge Components	Agile Methodologies Indicative Syllabus (Academic Theme Topics)	Knowledge Classification
1. Knowledge	1. An underlying discipline or basic science component upon which the practice rests or from which it is developed.	Scrum, Extreme Programming, Feature Driven Development and Kanban	Explicit
2. Know-how and Skill	2. An applied science or "engineering" component from which many of the day-to-day diagnostic procedures and problem-solutions are derived.	Creating Mock frameworks, Using test frameworks, branching, merging, building, and releasing software systems	Explicit
3. Competence	3. A skills and attitudinal component that concerns the actual performance of services to the client, using the underlying basic and applied knowledge	Quantitative reasoning, critical thinking, communication skills, team-working skills, the effective use of information technology, ability to generate fresh ideas, the practical application of theory, and leadership ability.	Tacit

redefining what knowledge is considered valuable …' (Research Diary, 26/6/2014) within the curriculum. I have already identified that I was a living contradiction because I had not valued the skills and attitudinal component of software engineering knowledge which concerns itself with the actual performance of developing software products using the underlying basic and applied knowledge of Agile Methodologies.

In developing this table, alongside explicit knowledge, I planned to privilege competence or 'tacit knowledge ... present in the activity of practice and made available ...through participation' (Murphy *et al.*, 2008, p.218) within the indicative syllabus through

> [c]onstructive alignment [which] reflects [my] shift of the paradigm from a teacher-centred teaching and learning to a student-centred one, which emphasises encouraging and supporting students' construction of their own knowledge inside and outside the classroom instead of teachers' transmission of the knowledge in class. (Wang et al., 2013, p. 479)

I understand that this form of knowledge, 'knowing [or] operational aspects of expertise' (Murphy *et al.*, 2008, p.211) of practice, is invaluable to the community of Software Engineers.

At the same time that I developed the indicative syllabus for each module, I also prioritised and engaged in a parallel action to specify the 'Intended [Module] Learning Outcomes' (QQI, 2013, Section 5). For me, it made sense to undertake both of these actions in parallel as the Module Learning Outcomes draw from the software engineering knowledge or academic theme captured within the indicative syllabus and vice versa.

6.2.2 Designing Module Learning Outcomes

I discovered that an essential activity in specifying a curriculum is to identify the 'intended [module] learning outcomes [that] represent … the learning outcomes that the teacher *intends* that learners will attain as a result of teaching and learning activities' (QQI, 2013, Section 5). The purpose of the intended module learning outcomes are to capture the expected change in a student's knowledge, know-how & skill, and competence that occurs as a result of their experience and engagement with the (enacted) curriculum (QQI, 2016).

To help me design my intended Module Learning Outcomes in conjunction with specifying the indicative syllabus, I took action to further develop the table (Figure 6.1) to classify and map the indictive syllabus that I wanted to value within the Agile

Methodologies curriculum to the three *National Framework of Qualifications* strands of learning outcome. The purpose of this table was to enable me to clearly see how I could develop a set of Module Learning Outcomes that valued both explicit and tacit software engineering knowledge that was compatible with the indicative syllabus.

Figure 6.1 helped me to change the approach that I previously adopted when designing Module Learning Outcomes where I did not distinguish between the different strands of learning outcome. In the past, the indicative syllabus privileged knowledge that I derived from textbooks (an existing body of explicit disciplinary knowledge) to meet the perceived needs of the Software Engineering industry. As a result the textbook-based syllabus dictated the Learning Outcomes that I had specified. I had unwittingly focused on the expected change to the students' knowledge and know-how & skill to the detriment of building their competency and expertise within the curriculum. I had not valued tacit knowledge or tacit knowing within a multitude of contexts: critical thinking and the ability to generate new ideas, communication and team-working skills, the practical application of theory, and the development of leadership skills.

Instead in this cycle, I did not engage with this approach anymore. I decided that, in the re-design of the specified curriculum, I must continue to value both the Knowledge and Know-how & Skill learning outcomes but additionally must identify, describe, and value Competence learning outcomes associated with the practice of Agile Methodologies. In taking this action, I acknowledged to myself that Competence must be built upon and in conjunction with having relevant Knowledge and Know-how & Skills.

As I wished to educate students to become competent software engineers, I decided that the best starting point in the design of the module learning outcomes is to recognise the equal importance of the basic science, applied science, and skills and attitudinal components of software engineering knowledge that can be attained by learners participating in a "knowing" learning process which equally values creating and using knowledge. I specified the learning outcomes in such a way that would support me in 'teaching for understanding [where the] only learning that matters is a learning that engages understanding' (Kincheloe, 2012, p.6). In taking this stance, I have been influenced by Sternberg (2008, p.25) who states '[s]tudents learn better

when they think to learn … by developing reflective, analytical, creative, and practical thinking with a knowledge base'.

Developing competency requires 'higher-order of understanding that is needed for any type of vocation [or profession] that involves working with data' (Kincheloe, 2012, p.6), such as software engineering. This observation helped me to understand better the "Learning Outcomes" section within Athlone Institute of Technology's curriculum description template for each module. The section starts with the sentence *On completion of this module the learner will/should be able to…* and is followed by the list of module learning outcomes for that subject. This sentence took on a whole new meaning for me when I viewed it through the competence, knowledge, and know-how & skills lenses rather than just thinking passively about explicit software engineering knowledge. This sentence demonstrated to me that I should be able to express within the specified curriculum the learning and knowledge needed to educate the students in becoming competent software engineers.

6.2.2.1 Employing Bloom's Taxonomy

In specifying Module Learning Outcomes for the Agile Methodologies curriculum, I was required to employ a suitable verb which is compliant with Bloom's taxonomy (Bloom *et al.*, 1956) to reflect the level of cognition or thinking required to learn and develop knowledge associated with each individual learning outcome. The taxonomy's framework and typical action verbs to describe each level of expertise in Bloom's Cognitive Domain are illustrated in Appendix D.

In codifying educational learning outcomes, the purpose of the taxonomy is to characterise and link the processes individuals employ to think and learn. It is organised to reflect how individuals think and is structured to correspond to the increasingly complex cognitive processes through which people understand. Key to understanding and employing the taxonomy is that each level, representing a cognitive process, builds upon a previous level. Each level provides an increasing degree of cognitive challenge. As a person moves through the levels of the taxonomy they 'become more knowledgeable, more skilled and develop a better understanding of that about which they are seeking to learn' (Gershon, 2015, loc. 303).

In mapping cognitive learning process(es) to Module Learning Outcomes within the specified curriculum, I was guided by the fact that it 'may be helpful to correlate (but not prescriptively) the six levels of the Cognitive domain of Bloom's Taxonomy with the programme award level[s]' (Dallet, 2013, p.5) specified by the *National Framework of Qualifications*. As a rule of thumb Dallet suggests that the Level 6 standard within the *National Framework of Qualifications* equates to the first three levels of expertise within Bloom's Taxonomy: Knowledge, Comprehension, and Application. Level 7 is at a higher standard in that it must address not only Knowledge, Comprehension, and Application within Bloom's Taxonomy but also Analysis. Level 8 builds on the level 7 standard by including Synthesis. Levels 9 and 10 incorporate all levels, including Evaluation, within the taxonomy.

As part of the process of re-designing the specified curriculum, I engaged with the following steps in relation to the creation of the module learning outcomes. I aligned each of the Module Learning Outcomes with a suitably chosen verb descriptor from Bloom's taxonomy to indicate the level of cognitive learning process required. In turn these were mapped to the applicable *National Framework of Qualifications* strand(s) of learning outcome which in turn were mapped to the required teaching, learning and assessment strategies/activities to be employed. I included within the Module Assessment Strategy assessment of, for, and as learning (Bloxham and Boyd, 2007) as I recognised that software engineering knowledge could not be solely assessed summatively. It was my first time valuing Competence as a form of knowledge within the specified curriculum to be developed through group-work working on a project. It was also my first time acknowledging that that there are interdependencies between Knowledge, Know-how & Skill, and Competence as two or more of these strands can be applied at the same time to an individual Module Learning Outcome.

For the first time in my career, I had explicitly thought about the cognitive learning processes that students needed to engage with and linked corresponding action verbs (e.g. identify, contrast, employ, and evaluate) used to describe individual Module Learning Outcomes to the type of knowledge to be valued by that Learning Outcome. I found the requirement to select the correct action verbs greatly aided the process of specifying individual Learning Outcomes. In turn, within the specified curriculum, I mapped these Learning Outcomes to the Teaching and Learning Strategy, the

Assessment Strategy, and the Assessment Activity to be employed within my practice. The Module Learning Outcomes and corresponding design and alignment decisions for both Agile Methodologies 4.1 and 4.2 are referenced in Appendix E.

6.2.3 Teaching, Learning, and Assessment Strategies

In the specified curriculum I took action to redefine the teacher-student 'relationship to learning and authority' (Shor, 1992. P.35) within my pedagogical activities. I specified Teaching, Learning, and Assessment strategies to be compatible with a dialogic problem-posing pedagogy. In developing these strategies, I re-imagined the educational relationship between myself and students within the context of a student-centred approach within a problem-posing pedagogy. I took the position that 'students and teachers enter the school from distinctive positions and must find a basis upon which to build [educational] relationships' (Margonis, 1999, p.100). I recognised that these educational interactions must recognise, encourage, enable, and support the choice of an

> appropriate "way of knowing" within my pedagogy for the type of knowledge that I and my students are engaging with … I also believe education is about getting students to recognise that there are different ways of knowing, each appropriate in certain situations requiring engagement with certain types of knowledge. I think it is important to ensure that students have the [opportunity] to engage with different ways of knowing and the [freedom] to choose the correct one when a problem presents itself. (Research Diary, 17/1/2016)

In terms of "ways of knowing", I decided that my teaching, learning, and assessment strategies must be concerned with developing students to become competent software engineers who are capable of engaging with others in the actual participation and competent practice of the software engineering profession. To achieve this goal within my practice, I felt that the specified curriculum must embrace 'the interactions and social relations that exist between lecturer and students as well as student to student relationships' (Research Diary, 21/5/2015) by not positioning the students as passive entities whose participation within the classroom would be greatly restricted. To move away from the rote learning that I had previously promoted within the classroom, I took action to specify 'learn by doing and by thinking about … experience' (Shor,

1992, p.17) in my teaching, learning, and assessment strategies by positioning myself as a problem-posing educator.

To do so, I chose to employ teaching and learning strategies that recognise the social and participative nature of the software engineering profession where knowledge, know-how and skill must be deployed competently. To capture my belief that such learning is a participative, social and cultural activity I took action to identify and describe my Teaching and Learning Strategy for both modules as follows:

> Face to face teaching and learning shall occur within in the context of both lectures and practical laboratories. Lectures shall focus on the knowledge to be applied on assignments and projects within the practical laboratories. For assignments and projects, the lecturer shall facilitate the learning process in which students shall be required to work in groups to solve problems. This teaching and learning approach positions students as active participants in their own learning where learning from and with others is fundamental. This approach also acknowledges relationships between individual modules and encourages students to make the knowledge connections between the different modules. (Russell cited in Rahilly, 2015, p.43 & p.67)

I identified that "face to face teaching and learning" and "groups" as participatory and dialogical approaches that could provide the students with active experiences of taking action within the enacted curriculum where they could 'develop knowledge that is reflective understanding, not mere memorization' (Shor, 1992, p.21). I reasoned that my newly specified teaching and learning strategies would allow me to enact a participatory and dialogical pedagogy based on '[c]ooperative learning' (Johnson, Johnson and Smith, 2013, p2), critical thinking, student experience, and democratic authority within a classroom where I see students as capable and responsible human beings who themselves are prepared to take ownership of and direct their own learning with help from me.

In specifying my teaching and learning strategies in this way, my action recognised and acknowledged that

> [t]he teacher is no longer merely the-one-who-teaches, but one who is himself taught in dialogue with the students, who in turn while being

taught also teach. They become jointly responsible for a process in which all grow. (Freire, 1970, p.53)

This process in which all grow I extended to the assessment activities within my pedagogy, where participation and dialogue are central to how students' learning should be assessed. Such participation and dialogue must recognise the components of software engineering knowledge to be valued within Agile Methodologies while honouring the participants' (students and I) ways of knowing. I identified a number of different assessment strategies to be employed to allow for the effective assessment of the various 'strands of learning outcome' (QQI, 2016, p.22) and various ways of knowing. I decided that my

> [a]ssessments shall be exam-based, assignment and project-based. [These] [a]ssessments shall be summative (assessment of learning), formative and diagnostic (assessment for learning) and/or involve students in assessment (assessment as learning). (Russell cited in Rahilly, 2015, p.44 & 67-8).

Within the context of Higher Education in Ireland, a national understanding of assessment and feedback has been developed where

> 1. [a]ssessment of learning [is] described as a judgement on learning that students complete in an assessment. It [is] aligned with the term 'summative assessment' and [is] associated with terms such as 'measurement', 'competence', 'standards', 'grades' and 'regulatory',
> 2. [a]ssessment for learning [is] described in terms of using assessment to give feedback on student learning. It [is] aligned with the term 'formative assessment' and [is] associated with phrases such as 'a learning process', 'practice for learning and improvement', 'the importance of a staff-student dialogue process', 'feedback on learning' and 'scaffolding learning', and
> 3. [a]ssessment as learning [is] described as student empowerment to become a better learner, to self-monitor or regulate their learning. It [is] associated with terms such as 'sense-making' for students, 'intrinsic motivation' and 'student ownership of assessment'. Students [are] seen to have more responsibility in this approach, and it [is] seen to help students understand their strengths and gaps to plan current and future learning. (adapted from O'Neill, McEvoy, and Maguire, 2020, p.501)

In particular, I identified 'assessment *for* learning [and] assessment *as* learning' (Bloxham and Boyd, 2007, p.14) as two assessment approaches that complement a dialogic problem-posing pedagogy. Assessment *for* learning provides feedback on student achievement which allows teaching and learning activities to be adjusted to

meet the needs of the student (Black and Wiliam, 1998). One aspect of assessment *as* learning 'sees student involvement in assessment, using feedback, participating in peer assessment, and self-monitoring of progress as moments of learning in themselves' (Bloxham and Boyd, 2007, p.14). I chose my assessment strategies to ensure that the students' abilities to act in a range of varied and specific contexts, exercise substantial personal autonomy, or learn to self-evaluate are valued.

Within this assessment approach, I also took the opportunity to reduce dependence on the written summative examination by marking it out of 40%. The remaining 60% was assigned to Continuous Assessment through group-work and would involve the students in self-assessment of that group work.

6.3 Findings and Reflection: On Re-designing The Specified Curriculum

In this section, I present my findings and reflect on the actions that I took to re-design the specified curriculum.

6.3.1 Privileging Tacit Knowledge

In taking this action, I started to think how I could privilege tacit knowledge alongside explicit knowledge within the software engineering curriculum. I reflected that to engage with both the explicit and tacit components of software engineering knowledge required 'a concentration on professional work-based (as opposed to academic) practice' (Olssen and Peters, 2005, p.328) which would involve students participating in both "knowing that" and "knowing how" activities to solve software engineering problems. I began to realise that to teach such software engineering knowledge to students required that I must incorporate into my professional practice 'a real world experience for students while at the same time satisfying the academic requirements of a university programme' (Sastry, Mallalieu and Abdool, 2009, p.1). I came to this conclusion because I determined that to become competent as a software engineering professional students needed to experience within the enacted curriculum how software engineering knowledge can be employed to develop software products. Such software engineering knowledge must encompass processes such as identifying customer requirements, writing elegant code, choosing between alternative Software

Development Life Cycles, or settling on a particular architecture for the product (Sommerville, 2016).

In my own experience as a software engineer, engagement with these software processes required not only explicit discipline knowledge but also tacit knowledge or tacit knowing. I also acknowledged to myself that I noticed that my own tacit knowledge evolved over time as I became more professionally competent and successful as a software engineer. As a software engineering professional I recognised that I had both built experience within my discipline and developed a personal and intuitive competence which allowed me to identify solutions without always being able to explain the process(es) I employed to discover them (Polanyi, 1966). Over the years, I had acknowledged to myself, the software engineer, that my judgements, decisions, and 'skillful action[s] often reveals a "knowing more than [I] can say"' (Schön, 1983, pp. 50-51). However, as a lecturer, I reflected that I had not recognised this notion of tacit knowing and professional competency and its value within the past curriculum I taught.

In taking this action, it is these insights that I drew on to privilege tacit knowledge alongside explicit knowledge within the Agile Methodologies 4.1. and 4.2 curriculum.

6.3.2 Curriculum Specification Process

In taking this action to specify the curriculum, I have learned that

> my current understanding of my [past] practice, may be coloured or limited by my incomplete understanding of our curriculum design [process]. I now suspect that the LO framework provides more depth in terms of what I and my colleagues can do. I now suspect that my colleagues and I have narrowly interpreted what we can do in curriculum design due to… not fully understanding the design potential [of the NFQ]? (Research Diary, 22/7/2015)

Interestingly, within the context of the three stands of learning outcome, the *National Framework of Qualifications* foresaw such a deficit with my past practice. The *National Framework of Qualifications* states that Knowledge and Know-how & Skill learning outcomes 'have long formed the basis for awards' (QQI, 2016, p.24) in

Ireland. However, it notes that Competence outcomes are not equally recognised within awards due in part to the difficulty of constructing appropriate methods of assessment to measure the outcomes. These comments are pertinent to my learning from this action-reflection cycle as they reflected the nature of the concern I had with my past practice: '[t]he QQI framework which guides curriculum development in my institute values both explicit and tacit knowledge … but I [only] favour explicit knowledge in [my] curriculum design' (Research Diary, 27/8/2015). I had made an incorrect assumption about the scope of knowledge valued by the *National Framework of Qualifications*. Within my past practice, I had limited the 'cultural capital' (Giddens and Sutton, 2013, p.881).

> that can be acquired by students to explicit knowledge to meet the needs of society in what I believe is a limited view of education as a social sorting mechanism to produce economic beings… Although policy documentation and HE frameworks recognise the need for tacit knowledge to be incorporated in the curriculum, the reality in my professional practice is that tacit knowledge may be employed in teaching and learning practices but is virtually ignored within my assessment practices due to the difficulty of objectively assessing such (tacit) knowledge to meet the expectation of society that wishes to standardise educational practices to allow for objective comparison between students. (Research Diary, 18/4/2015)

Part of the reason this happened is because I considered that education must focus on objective measures to differentiate between individual students in terms of the knowledge that they each had acquired. In this scenario, my past practice encouraged students to compete amongst each other within the learning environment rather than cooperate in their learning. This occurred because I had never really aligned or associated the purpose of my practice with educating students to become competent software engineers. I taught how I was I taught and became the knowledge-expert within the classroom enacting bland pedagogical activities as I transmitted the explicit knowledge that I would objectively assess.

Remembering that education is a political act which can empower or subdue students (Freire, 1970; Shor, 1992), I have learned it is my responsibility to design the curriculum to ensure that students can relate to the specified curriculum in a way that represents 'the needs and interests of the learners (Swart, 2009, p.6). In re-designing

the curriculum's specification, I endeavoured to value the students' knowledge and experience that they would bring to our shared learning environment enacted upon a dialogic problem-posing relationship. I have learned to no longer 'position myself as 'the teacher [who] knows everything and [where] the students know nothing' (Freire, 1970, p.46). In my re-designed curriculum, I no longer treat students

> [a]s receivers of [explicit knowledge who] uncritically take in information in the decontextualised ... framework ...[where] they are anesthetized into believing that meaning resides in the information fragment itself rather in the network of relationships from which it was retrieved. (Kincheloe, 2012, p.12)

Instead, I have learned to link desired ways or "acts of knowing" or learning with cognitive processes identified in Bloom's Taxonomy. I have identified the different forms of knowledge privileged by the various cognitive processes. I have reflected that the lower levels of Bloom's taxonomy, Knowledge and Comprehension, can best be employed to focus me on identifying the basic and applied science components of software engineering knowledge to be acquired within the curriculum, while the higher levels of the taxonomy require me to think about the processes of software engineering itself and the supporting generic skills required (essentially tacit knowledge or the skills and attitudinal component of software engineering knowledge).

Section 4 – Taking Action INSIDE the Classroom

Section 4, *Taking Action INSIDE the Classroom*, consists of four chapters and is concerned with the detailed descriptions and explanations of the action-reflection cycle that I undertook to transform my practice as I engaged with actions inside of the classroom to enact the newly specified Agile Methodologies 4.1 and 4.2 curriculum, developed during the second action-reflection cycle.

I undertook the third action-reflection cycle over two academic years 2016-17 and 2017-18, with each year having a different cohort of students. I asked myself the question: *"How can I, as a lecturer, improve my pedagogical practice by __enacting__ the specified curriculum to value tacit Software Engineering knowledge?"*. To answer this question, I imagined a solution consisting of four related and dependent actions to develop lesson plans, to build teamwork to encourage students to engage, to help students to reflect, and to develop assessment methods.

In Chapter 7, *Third Action-Reflection Cycle: Lesson Planning*, I asked myself *"How can I improve my pedagogical practice by developing Lesson Plans to value tacit Software Engineering knowledge?"* .

In Chapter 8, *Third Action-Reflection Cycle: Building Team-work to Engage Students*, I asked myself *"How can I improve my pedagogical practice to build team-work to engage students?"* .

In Chapter 9, *Third Action-Reflection Cycle: Helping Students to Reflect,* I asked myself *"How can I improve my pedagogical practice to help students to reflect?"*.

In Chapter 10, *Third Action-Reflection Cycle: Developing Assessment Methods,* I asked myself *"How can I improve my pedagogical practice to develop assessment methods which value tacit Software Engineering knowledge?"*.

Chapter 7 - Third Action-Reflection Cycle: Lesson Planning

7.1 Introduction

In this chapter, I asked myself *"How can I improve my pedagogical practice by developing Lesson Plans to value tacit Software Engineering knowledge?"* as I recognised that my re-designed specified curriculum, developed in the second action-reflection cycle, did not provide any detail on **how** to build educational relationships within a dialogic problem-posing pedagogy as the basis for students and I to actively engage with the indicative syllabus. I describe and explain how I took action to develop detailed Lesson Plans to define, manage, and guide the enactment of the curriculum. Finally, I present my findings and reflect on the actions taken. In doing so, I draw on my own experiences of practice as well as the students' experiences of lesson planning within the enacted curriculum.

7.2 Taking Action - How can I improve my pedagogical practice by developing Lesson Plans to value tacit Software Engineering knowledge?

In developing Lesson Plans, I was guided by the principle that

> [f]or the dialogical, problem-posing teacher-student, the program content of education [curriculum] is neither a gift nor an imposition - bits of information to be deposited in the students - but rather the organised, systematized, and developed "re-presentation" to individuals of the things about which they want to know more. (Freire, 1970, p.66)

In systematically constructing detailed lesson plans to organise the *"re-presentation"* of the specified curriculum to be enacted, I planned that I as the 'teacher leads and directs [the enacted] curriculum, but does so democratically with the participation of the students, balancing the need for structure with the need for openness' (Shor, 1992, p.16). I viewed lesson plans as a way to manage and bring software engineering knowledge, learning methods, and personal experience into the classroom as a means to democratically discuss and negotiate the enacted curriculum with students by recognising their interests, needs, and experiences within my pedagogical practices

(Shor, 1992). To do so, I decided that in developing lesson plans I must acknowledge that a

> teacher's role entails designing tasks to enable them to remove themselves temporarily as mediating tools between the student and the discipline, so that students are engaging more directly and more collaboratively with disciplinary cultures. (Research Diary, 17/6/2016)

In taking action to create the lesson plans, I

- adopted a Module Learning Outcomes Based approach to Lesson Planning,
- modelled the classroom as a Community of Practice (Wenger, 1998),
- planned to provide opportunities for students to participate in meaningful learning experiences,
- developed my own lesson planning process, and
- designed Power-Point presentations as resources, based on the indicative syllabus within the specified curriculum, to aid students' learning.

7.2.1 Module Learning Outcomes Based Lesson Planning

In my past practice I took an ad-hoc approach to planning lessons. I typically did not employ formal Lesson Plans to structure delivery of modules that I taught. I identified the curriculum content that I wanted to deliver and

> I would upload the required content [to Moodle for each subject]. My planning for the semester was to divide the content by the number of weeks. I would put the "plan" on Moodle. I would ensure the weekly content was covered. My approach was content driven. I had no detailed plan. I did not refer to [Module Learning Outcomes] MLOs, although I put the module descriptor[/curriculum] on Moodle. (Research Diary, 24/9/2016)

I took action within this inquiry to reject this approach to lesson planning. I realised that the basis for lesson plans must be the Module Learning Outcomes to ensure that I provided the students with the opportunity to engage with and in learning software

engineering practice through 'a process by which we can experience the world and our engagement with it as meaningful' (Wenger, 1998, p.51), while meeting the expectations of the specified curriculum. To begin this process of creating meaningful learning experiences, I decided to create and design lesson plans to

> now become learning outcome driven. My Moodle Page is [now] structured by MLO and the weeks that I plan to cover each MLO outcome. For each MLO I add the following details (where, content, student activities, and assessment)… I now also create detailed lesson plans for each lecture and practical (see template). In doing so, I identify what I call class outcomes. Class outcomes feed into MLOs. Typically it takes a number of lessons to cover a single MLO. Hence I believe I need class outcomes to focus each lesson and also to show how multiple lessons are needed to cover a MLO. I [plan to] identify the class outcomes at the start of each lesson and also use them at the end of [each] lesson as a way to recap and close the lesson. In my detailed lesson plan I break my time into small chunks from 5 to 10 to 15 to 20 mins. I vary student engagement strategies as I switch between chunks. (Research Diary, 24/9/2016)

An example of how I structured my Moodle Page is included in Appendix F.

7.2.2 The Classroom as a Community of Practice

In developing lesson plans, I envisaged the classroom as a community of practice where engagement in any social practice is central to the process by which people learn and who they become (Wenger, 1998). I identified that I needed to plan lessons to enact many social activities within my practice. I planned to employ a dialogic problem-posing pedagogy to support the students engaging with the specified curriculum and in pursuing our overall shared, authentic, and 'valued enterprises' (Wenger, 1998, p.4). In planning lecture and computer laboratory classes I remained fixated on this purpose of my practice. In particular, my lesson planning activities were guided by the beliefs that I hold with regard to learning and the nature of knowledge, knowing, and knowers:

1. Students and I, as social beings, are central to the process of learning,
2. Knowledge is concerned with competence in the pursuit of our joint enterprises,
3. Knowing requires active participation in the pursuit of our joint enterprises, and

4. Meaning is produced through a process of learning in which we experience our pedagogical practice and our engagement with it as meaningful.

(adapted from Wenger, 1998, p.4)

In developing lesson plans I positioned myself and the students as persons 'both acting and knowing at once' (Wenger, 1998, p.47-8) as we pursue our joint enterprise together. I imagined our shared enterprise as a set of social practices which involved doing things, creating and modifying processes, interpreting situations, producing artefacts, working out relationships, and resolving conflicts within the context of solving authentic real-world software engineering problems.

The lesson plans acknowledged that students and I engage and participate within shared practice through both manual and mental actions. These manual and mental actions are co-dependent. This dependency recognises that manual actions are not without thinking or cognition. Likewise, mental actions, thinking or cognition, are not disembodied from physical activities. In planning lessons I deliberately ensured that my practice promoted the pursuit of our shared enterprise through an 'embodied, delicate, active, social, negotiated, complex process of participation' (Wenger, 1998, p.49) as a means to stimulate meaningful learning. My focus within the lesson planning process was to produce a set of plans to enact a learning environment to create, manage, and engage the students in such *"meaningful learning experiences"*.

7.2.3 Creating Meaningful Learning Experiences through Negotiation of Meaning

As a dialogic problem-posing educator, in planning my lessons, I decided 'to diversify subject matter and to use students' thought and speech as the base for developing critical understanding of personal experience … and existing knowledge' (Shor, 1992, p. 32-33). I had reflected that it is through class contact time that students and I experience our reality, for example, through talking, thinking, acting, and solving problems - all forms or ways of meaningful engagement with our world. I planned lessons to enact within the curriculum meaningful learning experiences on the basis that learning occurs within the classroom through the 'negotiation of meaning [involving] the interaction of two constituent processes... *participation* and *reification'* (Wenger, 1998, p.52, original italics).

I understand that ***participation*** represents the social character of a human being's experience of life. I consider participation as an active process that refers to the actions (e.g. doing, thinking, talking) undertaken and the relationships made by human beings through engagement in social and joint enterprises. I note that such relationships can be 'conflictual as well as harmonious, intimate as well as political, competitive as well as cooperative' (Wenger, 1998, p.56) and influence the learning experience.

I see ***reification*** as a process in which particular understandings are given form, for example, designing a procedure, describing a concept, or using a tool. I saw an opportunity within my practice to plan for these reified forms to be 'a focus for negotiation of meaning' (Wenger, 1998, p.59) within the classroom as students employ, for example, procedures to know what to do, employ concepts to understand, or employ tools to perform actions. As such, reification 'can refer both to a process and its product' (Wenger, 1998, p.60). I decided that in planning the lessons I must recognise and utilise both the process of reification and the products of reification such as procedures, concepts, and tools that shape a person's experience and learning as they negotiate meaning.

I envisaged that this process of negotiation of meaning would underpin the development of educational relationships within my practice. In doing so, I was cognisant that

> participation and reification provide dual avenues for exercising influence on what becomes of practice. They offer two kinds of levers available for attempts to shape the future—to maintain the status quo or conversely to redirect the practice. 1) You can seek, cultivate, or avoid specific relationships with specific people. 2) You can produce or promote specific artifacts to focus future negotiation of meaning in specific ways. In this sense, participation and reification are two distinct channels of power available to participants (Wenger, 1998, p. 91)

to shape and control the negotiation of meaning between students themselves and with me.

In planning to enact meaningful experiences I designed lessons to ensure that my teaching, learning, and assessment activities were about participating in aspects of

practice that promotes agency, identity, and belonging where, I, as the lecturer is an experienced and more 'expert participant [and the students] a peripheral participant or apprentice' (Sfard, 1998, p.35) on the path to becoming an expert. This educational relationship that I took action to develop between the students and I has been described as

> "Legitimate peripheral participation" [which] provides a way to speak about the relations between newcomers and old-timers, and about activities, identities, artifacts, and communities of knowledge and practice. It concerns the process by which newcomers become part of a community of practice. (Lave and Wenger, 1991, p.29)

In developing legitimate peripheral participation within my practice, I encouraged students' own identity formation to nurture their 'relational self' (Ryan, 2009, p.165) by paying attention to 'what it is possible to do in certain situations with particular people and structuring resources' (Murphy *et al.*, 2008, p.196). Due to our different experiences, I recognised that in learning to become competent software engineers that both students and I were on a similar trajectory, but at different points, on our journey. I began to see that my role as the more experienced lecturer (and software engineer) was to 'introduce the students to the possibilities for learning in their subject and then step back and let the students discover what they care to learn' (Kohl cited in Shor, 1992, p.75).

7.2.4 My Planning Process

In planning to enact meaningful learning experiences built upon legitimate peripheral participation I took the decision to interweave, on a weekly basis, theory (essentially explicit software engineering knowledge) with practical group activities (utilising the skills and attitudinal component of software engineering knowledge as well as theory) to be undertaken by the students. I employed this approach to structure the enactment of the learning environment to facilitate the creation of meaningful learning experiences built upon the following concepts and elements that I wanted to integrate into my practice:

> Group Work (Inquiry-based?)
> Facilitation
> Authentic Projects
> Formative Assessment (Feedback) AfL + Assessment as Learning …
> Reflective Practices
> Situated Learning   (Research Diary, 30/6/2016)

For the lectures I planned to employ Power Point Slides to supplement my teaching of theory and a variety of techniques to actively engage students. Within the computer laboratory practical class, I decided that students should actively participate and work in groups to apply the taught theory to an authentic software engineering problem, which reflected typical projects found within real-world software engineering practice. I also identified that the need to collaborate within groups would provide

> students with the opportunities to engage in authentic learning activities
> that (a) shift from all students learning the same things to different students
> learning different things; (b) create group problem-solving situations that
> give students responsibility for contributing to each other's learning and
> (c) help students see the value of what they are learning and choose to
> share. (Ashford-Rowe, Herrington, and Brown, 2013, p.210)

To build meaningful learning experiences around these elements within my practice, I required students to immediately apply the theory taught in lectures within the computer laboratory practical class and/or associated group assignment.

In taking this action, I further re-imagined the activities to be undertaken within the computer laboratory classes. In the past, I had enacted activities to be engaged with by individual learners working on their own isolated tasks each week. To realise what I considered was the benefit of social learning through engagement with solving authentic problems as part of the team, I now planned to set aside computer laboratory class time for working on such group projects over a number of weeks. I planned that the work to be undertaken in the computer laboratory should consist of authentic problems to be resolved by a team of learners (applying the skills and attitudinal component of software engineering knowledge) utilising theory (explicit software engineering knowledge) acquired through lectures - a key change or transformation within my practice.

I included within my lesson planning process the need to integrate assessment into the enacted learning activities undertaken by students (Chapter 10). In doing so, a key component of this assessment strategy was to continuously grade the group-work throughout the semester as intermediate project goals were met. I took this approach as it provided both an opportunity for formative assessment to check that the project was going in the right direction and also as a means to encourage continued engagement by students in their group-work. I envisaged that the formative assessment would be a

> process of seeking and interpreting evidence for use by learners and their teachers to decide where the learners are in their learning, where they need to go and how best to get there. (Assessment Reform Group cited in Swaffield, 2011, p. 436)

7.2.4.1 Lesson Plan Template

I designed my own Lesson Plan Template (Appendix G) to document how I would organise both the lectures and computer laboratory classes. I decided to create lesson plans for each lecture and each laboratory class to be taught each week of the semester as a means to structure and manage my enactment of the curriculum. Through the lesson planning process, I incorporated within the enacted curriculum actions and changes focused on group work, student engagement, reflection, student growth, and assessment as a means to value software engineering knowledge and dialogical educational relationships within the classroom. In doing so, my goal was to connect these individual aspects of my pedagogical activities to create and enact a dialogic problem-posing pedagogy within my practice.

In planning lessons to enact the curriculum I focused initially on the structure of the lectures. Within the lectures I taught the basic and applied components of software engineering knowledge, the content of which was driven by the indicative syllabus within the specified curriculum. I decided that pedagogical activities within the lectures should be predominately reification-based as I focused on the theory, concepts, procedures, and tools of Agile Methodologies to be reified within lectures.

Appendix H provides an example of a lesson plan for a lecture class. It highlights that I employ the process of reifying the concept of Agile Roles within a framework for participating within a Scrum team in preparation for participating and engaging with group-work. This lesson plan is also an example of how I divide each class into smaller time-boxed sections and demonstrates how I built active student engagement into my lesson planning, for example, by facilitating question and answer discussions.

In lesson planning and managing activities for the computer laboratory class I decided to focus on activities that were primarily group-based and participative in nature. I privileged the participation process over, but not to the exclusion, of reification because I felt that this approach to lesson planning promotes '[l]inking theory with practice [and] is pedagogically good practice' (Research Diary, 9/3/2016). The purpose of my planned participative activities was to encourage the students to actively engage with their team and me as the team attempts to solve an authentic software engineering problem specified by me.

To promote such group-work within my practice I utilised within the lesson planning process the zone of proximal development theory (Vygotsky, 1978) in the design of problem-solving activities where the students participate in a social context facilitated by an experienced lecturer. This view of practice sees me facilitating the learning process where I encourage team work, promote discussion, engage students in project work, and get to know the students as people, develop relationships, and build trust (Carlile and Jordan, 2005). I planned to enact such a facilitation process to support and encourage the negotiation of meaning in the pursuit of software engineering knowledge as the students engaged with group-work. I viewed facilitation as an important skill for both teachers and students engaged in group work where a skillful facilitator works to engage all members of a group in the team's activities. Appendix I provides an example of a lesson plan for a computer laboratory class. This lesson plan identifies the group-based activities to be engaged with and demonstrates how my planned participation in computer laboratory classes is based on me acting as a facilitator within the class. In doing so, I planned not to position myself as the knowledge expert within the classroom. I had consciously made the decision to move from being the 'sage on the stage to [the] guide on the side' (King, 1993, p.30).

7.2.5 Designing Power-Point Slides

I structured each lesson plan for each lecture around teaching academic topics associated with one or more Module Learning Outcomes in preparation to employ the taught topic or theory within the context of the group-project. To support each lesson plan I created one or more individual Power-Point presentations to present and allow me to reify the software engineering topics to be covered in the lecture. I created very lengthy and comprehensive Power-Point presentations to capture, what I considered, the detail necessary for teaching each topic and to support the students' learning. The content of each presentation was determined by the Module Learning Outcome(s) that were to be the focus of the class. I then drew on the indicative syllabus, the recommended reading list, and other technical resources to create each presentation. Depending on which Module Learning Outcome(s) I was teaching, I constructed the individual presentation to span either a single or multiple lessons.

In addition, the Power-Point presentations provided the students with a resource to refer to as they participated and engaged in the computer laboratory class and group-work to negotiate meaning.

7.3 Findings and Reflection: On Developing and Employing Lesson Plans

I now present my findings and reflect on the actions that I took to develop my lesson plans. In doing so, I draw on both my own and students' experiences of how I transformed my practice to develop and employ Lesson Plans to structure the enacted curriculum and learning environment.

7.3.1 Students' Experiences of Lesson Planning

The students' overall experience of the structure of the enacted curriculum was that '[i]t was balanced theory and lab together. One and one. Hand in hand. I liked it better. What we learned in theory, we answered in the labs. So, it helped me learning more' (Emma, Interview 1, 14th March 2017). The students' past and present experiences with other modules suggested that they did not 'get on well if I was just doing theory [without any] applied knowledge' (Jack, Interview 1, 14th March 2017). They clearly

understood that the main purpose behind the structure of the enacted curriculum 'was that we did theory in the class, and then went into the lab. We were actually practicing that theory …' (Jack, Interview 1, 14th March 2017).

7.3.1.1 Module and Assessment Semester Structure

In terms of the specified curriculum, the students felt that I was best placed to determine the programme content of education, where the specification of Module Learning Outcomes were my 'department…we don't really need to be concerned with [them]' (John, Interview 2, 14th March 2017). The students' main concern was that I knew what the Module Learning Outcomes were and provided the relevant information and guidance for each.

The students' experience of the enacted curriculum was that the module and assessment structure was well planned in advance for each semester. They identified that the planned structure happened at three related levels. Firstly, students identified the linkages and appreciated how the knowledge and learning from Agile Methodologies 4.1 carried over into Agile Methodologies 4.2 where the

> [f]irst semester was very useful because, it was preparing us for a sprint. The fact that we did an assignment on user stories... And then that was brought into the second semester as well. That you were combining them both with one goal. Which I thought was extremely useful. (Ronan, Interview 3, 15th March 2017)

Secondly, they liked that there was a meaningful flow between topics and learning activities between and within both lectures and computer laboratory classes where I 'start at the beginning and… follow a structured way to get through the course. So every little moment sort of relates to each other' (Mark, Interview 3, 15th March 2017). This flow through the course also extended to assessment practices from the perspective that 'the deliverables [i.e. what is assessed] are mapped out by date' (John, Interview 2, 14th March 2017) throughout the semester.

This idea that they could earn marks continuously throughout each semester, while at the same learning knowledge of the discipline, rather than being only assessed towards

the end of a semester appealed to the students. They felt more under pressure in other modules which were structured 'to gain the knowledge first, and then you get the assignments but they all come in the three weeks just before the end of the semester, and you end up doing six concurrent ones' (John, Interview 2, 14th March 2017).

Finally, students identified the importance of having a well-defined structure within each class itself. They found that '[b]efore we start our… class, you have everything up that we have to know. All your notes are already presented on Moodle. So we know what we're coming into' (Ronan, Interview 3, 15th March 2017). The students like that 'the [individual] lectures would get at the industry. We're thinking about industry here …' (Bernard, Interview 1, 26th January 2018) and then 'we went into a lab and every week we had to work towards something, show it off, move on to the next part, I loved that whole process of it' (Sam, Interview 2, 20th April 2018). While 'the whole theory was heavy… it was good heavy. It was kind of like explained with practicals as well, so I really did enjoy it' (Anne, Interview 4, 15th March 2017). The students particularly liked the structure where every Monday was used

> to talk about a lot of theory stuff and then we'd talk a tiny bit about what we were gonna do in the lab the next day, then we'd do the lab work, and then, if there were any things leftover from the lab that needed to be talked about more, we'd often do that on Wednesday, and then do a little bit of theory, which felt like a good way to do it. (Jacob, Interview 1, 26th January 2018)

7.3.1.2 Information Overload: Too Much Presented Theory

Some students felt that there was a large quantity of Power Point slides provided with each module and that there was 'a huge amount of detail in there, that it's almost impossible to take it all in' (John, Interview 2, 14th March 2017). Within the context of the summative written examination at the end of each semester, students suggested that the 'most important things should be pointed out that, this is what you should know, this is what you should learn' (Denis, Interview 3, 15th March 2017) just for the written examination itself. They were concerned that as they prepared for the written examination at the end of each semester that '[m]aybe there's the ambition level of how much you [the lecturer] try to get in might be slightly too high' (John, Interview 2, 14th March 2017) in terms of what must be learned for the written

examination. Although the students identified that I was 'covering the notes' (Denis, Interview 3, 15th March 2017) in class, these students recommended that different categories of theory should be highlighted within the Power-Point presentations to indicate that 'you need this for the exam, and then there's other reading… if you want to do it on the side kind of' (Eoin, Interview 4, 15th March 2017), which meant that this theory and content can be ignored in relation to the end of semester written examination.

They were of the opinion that I should only teach 'the subjects [topics] that were going to come up in the exam [because] that would be very good' (Mark, Interview 3, 15th March 2017). They were disappointed with me because for the end of semester examinations I did not explicitly tell them that this is 'what you should know, this is what you should learn, instead of covering so much. I would say waffle' (Denis, Interview 3, 15th March 2017). With six subjects per semester, these students experienced difficulty 'to find the time… [to go] through those Power Points' (John, Interview 2, 14th March 2017).

Another set of students disagreed with this perspective as they recognised that the theory contained within the Power Point slides was been assessed through either or both a summative written examination and participation through continuously assessed group projects. These other students were content with the "quantity" of theory and Power-Point slides because they recognised that the taught theory, in general, was also to be employed and assessed in a practical way within the group projects. These students recognised that while I did not talk through each individual slide within a Power Point presentation during class I did 'still tend to explain them [and] give the overview of' (Sam, Interview 1, 26th January 2018) the content. These students recognised that the explained theory was presented within the lectures to prepare students for particular practical aspects of the project. Also, this set of students did not like lecturers whose

> slides are real lazy and they don't actually have that much in it. They're fine, they'll talk for two hours and they'll do attractive stuff ... [but] there won't be anything more in the notes … and then they still expect you to talk about that kind of stuff when it comes to exam time. (Jacob, Interview 1, 26th January 2018)

Instead, they enjoyed the security of having a detailed set of notes. These students found it useful to have a reference to look back over 'if I miss something' (Jacob, Interview 1, 26th January 2018) in class because 'you are not gonna remember what people are talking about in the class' (Sam, Interview 1, 26th January 2018) all of the time. Finally, these students identified that I 'even cover the same thing twice, just in a different way …so it's kind of explained differently and that is very handy' (Sam, Interview 1, 26th January 2018) when learning. This latter set of students had learned to move beyond the notion that theory should only be examined through a written exam.

7.3.2 My Experiences on Developing and Employing Lesson Plans

I now describe and reflect on my experiences on developing and employing lesson plans during this inquiry.

7.3.2.1 Enacting Lesson Plans

I have learned that the process of Lesson Planning is not and cannot be a perfect process. During the first academic year (2016-17) of enacting the curriculum, I discovered that Lesson Plans should be employed as guides to enact the curriculum rather than as a prescriptive map to be followed without question throughout a semester.

Within the first month of using the lesson plans to manage the delivery of the enacted curriculum, I initially thought to myself that the process of lesson planning or '[p]reparation, while tough, I find makes my class personally more enjoyable and predictable. I think I am covering the material better - I will have to wait to see what the students have to say !!!' (Research Diary, 7/9/2016). I didn't have to wait long. The following week, after I had facilitated a computer laboratory class:

> One student came to me after class and said he felt that there 'was a lot of oxygen in the classroom'. He indicated the students liked the structure and approach of my lessons. I can now see the value of lesson plans in structuring what one does in the classroom. (Semester 1 2016-17, Week 2 Lab Reflection: 19/09/2016)

I sense that the *"oxygen in the classroom"* metaphor resulted mainly from the question and answer activities that I planned and facilitated in each class to actively engage the students. Throughout the first semester in 2016-17, I observed that '[t']he class engaged in answering the questions' (Semester 1 2016-17 Week 2 - Lecture Reflection), the '[s]tudents were engaged and did ask questions' (Semester 1 2016-17 Week 4 - Lecture Reflection), and the '[s]tudents were well engaged again…[m]any questions asked' (Semester 1 2016-17 Week 6 - Lecture Reflection).

However in that first semester, I also struggled with my own role as a lecturer as I had a tendency to privilege covering the content, that I created within my Power Point slides as the basis to reify the explicit software engineering knowledge that I wished to teach, over active engagement with students.

7.3.2.2 Struggling to Relinquish Control

Even though I planned lessons to encourage negotiation of meaning within dynamic relationships based on the idea that students were legitimate peripheral participants, I have learned that I struggled early on in this inquiry to relinquish the control that I previously held within the classroom. In terms of delivering each class I became fixated on teaching each class as planned. I noticed that I felt that I put myself under pressure to get through every lesson plan as designed. In particular, I have learned that during the first semester of 2016-17, I was still overly focused on "covering content" that had been included in my Power-Point presentations within the allocated time that I had planned for each class, while still trying to actively negotiate meaning with the students.

In my mind, I needed to rationally justify my position as a lecturer by covering my specified and enacted curriculum on a weekly based as planned. As I reflected, after each class, on what worked and what did not work I now see that my primary focus was on whether I had completed each class as planned. Within that first semester, I noted after one class that 'I covered conceptually all the topics I wanted …[l]esson planning and structure working well' (Semester 1 2016-17 Week 3 - Lecture Reflection). But I was more preoccupied and constantly fixated on what I thought did not work. I was particularly concerned whether I had fully completed each lesson plan

within the estimated time or not because at that point in time I considered satisfying such an arbitrary metric to be the measure of how well I was performing as a lecturer

I discovered that I became overly concerned that I '[h]ad reduced time for the S/W Process Activities discussion - only 5 to 7 minutes…[e]ssentially I had a time management issue' (Semester 1 2016-17 Week 2 - Lecture Reflection), or thinking that my planned timing for a class did not work because I '[d]id not get to cover the V Model' (Semester 1 2016-17 Week 3 - Lecture Reflection). This prompted me in the following class 'not to follow the lesson plan [as] I had to complete last week's lesson plan [first]' (Semester 1 2016-17 Week 4 - Lecture Reflection). This action meant that I was now behind in terms of topics or content covered as per the planned lessons, which in turn would have a knock-on effect to the subsequent weeks.

This preoccupation with *"covering content"* on time as I employed each lesson plan to direct my pedagogical activities made me anxious. My anxiety made me fall back on old behaviours because of my fear that I might miss material needed by the students to learn. Later in that first semester, I abandoned one of my lesson plans and instead '[l]ectured material [and] [s]ummarised content in [Power Point slides] and did not give the class any (?)/ much opportunity for interaction [where] I rushed through the content in the PPT to make up time' (Semester 1 2016-17 Week 7 - Lecture Reflection). In my heart, I knew that this action was alien to the change or transformation that I wished to make within my practice.

I began to question my need to continually judge the success of my practice on the basis of the amount of material that I planned to cover or covered within a certain time period. Instead, I reflected that my practice should be judged on the learning experiences made available to the students and my role in facilitating the students to avail of those opportunities, in which curriculum content is just one aspect. I reflected and identified that the success of my practice could only be judged by asking myself if the quality of the enacted learning experiences contributed to the students' learning to become competent software engineers.

7.3.2.3 Learning to Re-Position Myself in the Classroom

In reaction to these experiences and reflections, I decided that I should not focus on covering planned content as the measure by which to judge the quality of my practice. I realised that such an objective measure did not take into account the transformation to practice that I was inquiring into and enacting within the curriculum. I reflected that it was good to have lesson plans provided that they are employed as guides rather than followed prescriptively. Yes, I needed the topics described in my Power Point Slides to act as a focal point within my classes. However, I thought that I do not need to speak through each slide in class. Instead, I decided that I should focus at a high-level on the concepts that I needed to reify as I led the discussions within the classroom. I started to experiment and decided to work through examples in class instead of relying on the content of my slides. I discovered this pedagogical approach one day when I

> [d]ecided at the start of the class not to present my slides as planned. Instead I presented 2 examples [on the white-board] to demo how EP & BVA work including how to document a test design. I felt the class went very well as the examples gave the class plenty of opportunity to participate which they took. …What would I do differently next time? Can I look at existing theory … and figure out are there relevant examples that I can include to explain or demo the theory [on the white-board]. (Semester 1 2016-17 Week 8 - Lecture Reflection)

Throughout that first year enacting the curriculum, I continually questioned and reduced my urge to read each Power Point Slide as the only way to cover theoretical concepts (explicit knowledge) with the students. I began to reflect that I needed to 'explore different ways of engaging with theory other than power point slides' (Semester 2 2016-17 Week 2 - Lecture Reflection). As I reflected, I constantly asked myself: "Am I reverting back to the banking model of education?" I felt that having all the Power Point slides that I had created reminded me of my past practice even though I no longer "read" all the slides in class. However, I finally came to the conclusion that it was not whether I had Power Point slides that determined my pedagogy but rather how I was positioned within the classroom and the actions I took in class as I interacted with students as I "taught" the material or concepts contained within my slides.

I had started to figure out how to leave behind transmitting knowledge to students in favour of a dialogical interaction that can also rely on the information within my Power Point slides as one particular form of reification to structure and focus discussion within the classroom. I started to become more comfortable in using the Power Point slides, which captured content that I thought reflected the indicative syllabus, as a reference point as I worked hard on becoming a dialogical teacher within the classroom. The structure of my classes evolved to focus more on *"chalk and talk"*. After one class, in the second semester of 2016-17, I observed that

> I enjoyed this class, writing on the board, asking questions and finding that this engaged the students. I do note that the code examples I put on the board were "made up on the spot" [in response to queries from my students]. (Semester 2 2016-17 Week 4 - Lecture Reflection)

I carried this approach into the next academic year 2017-18. I no longer felt the need to read through each slide of my Power Point presentations. I became more confident as I continued to use 'chalk and talk on the topic [I was teaching and I] engaged students through Q&A [where] I didn't refer [directly] to Power Point - just examples on the board' (Semester 1 2017-18 Week 3 - Lecture Reflection).

Throughout that second academic year, I reflected that it was I who decided on the time to be allocated and the order in which topics should be taught within lesson plans without any input from students themselves. This observation further strengthened my belief that lesson plans should be employed as guides or prompts to help me navigate my way through each semester in an environment where I must be prepared to respond to and be directed by the needs of the students. Although, I was essentially reusing the lesson plans from the previous year in terms of the objectives, the material to be covered and meaningful experiences to be enacted, I was more in tune with the needs of the students and became

> less prescriptive than I was last year in terms of the order in which I deliver. The material that I decided to present today was delivered two weeks later in the semester last year. However based on what I observed in the labs as the groups worked on their practical work I felt it was better to switch "Tracking" as a topic back to this week and push "Software Test" out until next week. This [change] has two benefits, one they need to

> employ tracking now something which they haven't seen before and secondly by the time I teach them testing they would have already started to engage that process. I'm also more relaxed in my delivery and not been driven by time boxes in terms of what I need to do. Instead I'm very responsive to questions asked and to engagement from the students to drive the direction of the class. I've come to realise that previously I had been very prescriptive in the order in which I deliver topics – however I now see students don't necessarily agree with my prescriptive structure and I am best to respond to how they perceive the topics that I talk about in the lecture (Semester 2 2017-18 Week 4 - Lecture Reflection).

This observation highlights an important transformation within my practice. I have taken the Agile Methodologies academic theme and introduced it as a challenging problem for the students. I feel I have achieved this by changing both my role and the role of classroom discourse 'from one-way delivery of information to democratic problem-posing' (Shor, 1992, p.77).

7.3.2.4 Meaningful Learning Experiences

I placed the creation of meaningful learning experiences to the forefront of my lesson planning and delivery process. The structured and organised lesson planning that I undertook provided me with the basis for designing and enacting various learning activities to promote the students' abilities to negotiate meaning within my practice, which recognises that '[m]eaning exists neither in us, nor in the world, but in the dynamic relation of living in the world' (Wenger, 1998, p.54).

7.3.2.4.1 Within Lectures

I figured out that I could actively engage students when I enact a planned discussion-based question and answer session within a lecture. For example, in my very first lecture in my newly enacted Agile Methodologies 4.1 curriculum, and before I would have had the chance to get to know the students, I presented a list of frequently asked questions about the topic – "What is Software Engineering?" I was pleasantly surprised that '[t]he class engaged in answering the questions…I felt that the whole class engaged with the [questions] and liked the fact that I put their answers on the board' (Semester 1 2016-17 Week 2 - Lecture Reflection). As I continued to enact the curriculum, I observed that

> [e]ven without prompting from me two students asked questions about the assignment as I was explaining/introducing [it]. I was delighted to see this because I believe I am beginning to build trust with the students and they feel they can ask questions at any time - which I think is great. (Semester 1 2016-17 Week 4, Lecture Reflection)

"Asking questions" became an important aspect in how I encouraged the students to engage with the enacted curriculum. It became the norm within the classes where I would regularly observe the '[u]sual level of excellent engagement from the students…[g]ood questions [were] asked of me in terms of content covered' (Semester 1 2016-17 Week 5 - Lecture Reflection).

Students identified that the approach to engaging students within a class was very much question-driven, where I 'often will ask questions to people or prompt us to ask questions or put forward answers and stuff like that' (Jacob, Interview 1, 26th January 2018). They liked that I was 'constantly asking us questions…because it keeps us on our toes' (Sam, Interview 1, 26th January 2018).

They had no issues answering a question incorrectly or for me to explain why the answer was incorrect because that was the 'more interesting part for me when you can point out clearly why it was a mistake' (Bernard, Interview 2, 20th April 2018). The students experienced that in answering questions, or even making a mistake in answering a question, that I used 'whatever answer… as a kind of a point to start into discussion, and learning' (Jacob, Interview 1, 26th January 2018). The students recognised that as I actively engaged them in discussion that I 'always try and learn people's names…and refer to people by their names' (Jacob, Interview 1, 26th January 2018).

The students observed, sometimes, I divided the class into groups and asked them to 'get out a piece of paper, write down' (Sam, Interview 1, 26th January 2018) answers to a question. They felt this was a good variation to just verbally asking questions of individuals within the classroom as it was a different form of engagement that 'force[s] us to think a bit on our own... because it's easy to just check out in some classes if you're [the lecturer] just talking and talking, you know?' (Jacob, Interview 1, 26th January 2018).

I also noticed that as both students and I got to know each other better, the students did not confine their questions to class time and would often approach me in the corridor with concerns that they might have. In one particular instance,

> I had a student come up to me after… class with a set of very precise questions that were the result of his engagement with the practical work and project that I had set in the class. The student appeared to be very engaged in the work, very interested in the work and had developed a set of complex questions as he tried to figure out what he needed to do. I observed to myself that I'd [previously] given [him] enough information to start his practical work and he had the confidence to work with that until he reached the point where he started to struggle again. I went through with him the questions and he quickly saw the mis-assumptions that he had made. He went away and said he will come back if he had any more questions. (Note – I met the same student the following day and he asked me one clarifying question. I answered that question and he understood the answer straight away. It is clear to me that he is engaged with the project that I have set, he is prepared to work in his own, and asked for help when needed. (Semester 2 2017-18 Week 4 - Lecture Reflection)

However, there were some actions that I took in lectures which resulted in student experiences not being what they should be. I must learn to resist the temptation to "force" meaningful experiences upon students. There were times when I was

> trying to promote the whole engaging aspect of the whole engaging environment in class and it became very obvious that some people were just answering because they wanted the class to move on, and there were people not ready to answer, so there was this one… person that was always raising his hand just to answer so that class could move on. (Bernard, Interview 2, 20th April 2018)

Also, I must listen better when students ask a question in class. I have learned that I have a tendency to cut students off in mid-sentence in the belief that I know what is being asked. This left students feeling frustrated and ignored as they did not get a chance to ask fully the question they wanted as I had made an assumption that I thought I knew what the student wanted to ask and

> didn't allow me [the student] to finish the question, and so I'd just let it go, not to keep going back and forth and delaying, holding back the whole class and all that, and the point, I think I couldn't get to ask those questions

… That's as much as I can find about you influencing my learning directly and impeding my [learning]. If that was an impedance, I don't know. (Bernard, Interview 1, 26th January 2018)

Another particular activity that I found to be effective within a lecture was jigsaw reading where I assigned each student to a group for the duration of an individual class. Each individual within the group were assigned their own subsection of a shared document (covering a particular topic/concept) to read for the first fifteen minutes of the lecture. Then for the remainder of the class, each student took it in turns to explain their subsection to the other team members. For such exercises, 'I noticed energy in class when the groups started to work…I also [got] a number of questions from different people' (Semester 1 2017-18 Week 3 - Lecture Reflection).

I also found that it also possible to plan and integrate real-life software engineering activities into the enacted curriculum as a means to engage students. In one such activity, I positioned myself within the classroom as a Software Engineering Client from whom each group must elicit or gather the client's requirements/features to be developed as a software product. This planned activity provided the students with the opportunity to put theory into practice within the context of a simulated real-world activity as they engaged with their assigned group project. As a Software Engineering Client, I told each group how my current Newspaper business (Chapter 8) works as they tried to identify and develop User Stories (an example of theory into practice) for the system they must build. The Newsagent system that I described is required to manage the delivery of newspapers and magazines in some small town or area of a larger town. It is intended for use by newsagents who are only casual users of computer systems I have learned that such simulated real-world activities generates 'plenty of interaction from the students - good questions asked and all show interest and involvement in the [simulated activity]' (Semester 1 2017-18 Week 7 - Lecture Reflection).

Within lectures, I have come to regard the question and answer discussions, the jigsaw reading exercises, and the simulated real-work software engineering activities that I designed and enacted provided me with the basis for managing and promoting learning through a process of "negotiation of meaning" between students and I.

7.3.2.4.2 Within Computer Laboratory Classes

In designing meaningful learning experiences within the computer laboratory classes, I placed each of the students into a group (Chapter 8) where I planned to privilege the participation process over, but not to the exclusion, of reification. In taking this approach to lesson planning for the computer laboratory classes I emphasised and encouraged the students, individually and as part of a group, to take active responsibility for their own learning. I have learned that students will take responsibility if they are encouraged and given the confidence to do so. I noticed that this was the case early in the 2016-17 academic year when, for a computer laboratory class,

> I was five minutes late arriving for class. I couldn't believe it when I entered the class. Each group was already working on the problem with <u>no prompting</u> from me. They didn't even notice me come in. They only noticed as I started to move from group to group. I believe that I've got the students sufficiently engaged that they are prepared to move ahead themselves. (Semester 1 2016-17 Week 4, Computer Laboratory Reflection)

This enthusiasm for taking responsibility and engaging in group work continued throughout the year. I observed that '[a]ll groups (but one) have become more self-reliant/sufficient and require minimal interaction with me' (Semester 2 2016-17 Week 11, Computer Laboratory Reflection).

In creating these meaningful learning experiences, I had to learn how to shift from positioning myself as the knowledge expert within my practice to a facilitation role. In doing so, I discovered that I had become more actively engaged and challenged as I enacted the curriculum. From a personal perspective, I became more engaged knowing that the theory that I taught had a purpose with respect to each groups' project. I was drawn more deeply into the teaching and learning process by the nature and quality of the questions asked by the students and their engagement with the problems that they were required to solve. This resulted in meaningful experiences being created, not only for the students, but also for me which in turn has enhanced my learning. Within classes (both lectures and computer laboratory classes) I have learned that I needed

to be at the top of my game to answer questions that students ask. With the way my curriculum is enacted now, my students do not ask stock questions in terms of just interrogating concepts within theory but ask questions which both interrogate theory but also have relevance to the context of the project that there engaged with. I believe that these questions represent my students both engaging with theory but also putting theory into practice for the particular problems I've given them (Semester 2 2017-18 Week 3 - Lecture Reflection).

7.3.2.4.3 Balancing Reification and Participation Processes

How I enacted the curriculum has enhanced my active participation within my practice because I was challenged to support the students as they attempted to put theory into practice. However, I have discovered that to create a learning environment to encourage negotiation of meaning required that I must balance the interaction between the reification and participation activities that I implemented (Wenger, 1998). I have learned that, initially and naively, I took the position as I first started to engage with the lesson planning process that 'my lectures map to the process of reification and undertaking the CA [Continuous Assessment] maps to the process of participation' (Research Diary, 20/1/2016). However, I soon discovered that this binary division of the processes of reification and participation caused me problems as I attempted to design lesson plans. By attempting to design the lecture lesson plans around the process of reification only, I felt I was reverting to my past behaviour where I employed the banking model of education. By excluding the process of participation within the planning of lectures, I found I was positioning the students, once again, as passive entities within the classroom as I struggled with leaving my identity as a knowledge expert behind me

In the end, I came to discover that reification and participation are complementary and required processes needed to create meaningful learning experiences for both the students and I. I determined that both the processes of reification and participation are always needed but not always in equal measure within my practice. This is evident within the lesson plans (Appendices H and I) that I designed for both the lectures and computer laboratory practical where I balance the 'interplay' (Wenger, 1998, p.43) between participation and reification activities. These plans clearly demonstrate that lectures are predominately (but not exclusively) reification-based and computer

laboratory practical classes are predominately (but also not exclusively) participation-based. I had figured out that at any one time participation and reification activities may not equally contribute to the negotiation of meaning within my practice and that in these learning situations there may be periods of 'intense' (Murphy *et al.*, 2008, p.81) participation or reification.

7.3.2.5 Redefined Student-Lecturer Relationship

In enacting meaningful learning experiences, students' observed that I redefined the student-lecturer relationship that they expected to find within the classroom. They clearly experienced a teaching style within the classroom different from their other modules.

This happened because I positioned myself as a facilitator, rather than a knowledge expert, in relation to my students and this resulted in a 'balance and equilibrium between my authority role as teacher, my relational role as caring adult and my democratic role as "just another person in the classroom"'(Roche, 2007, p.275). I have observed that this "balance and equilibrium" developed in the relationships between students and me because I had come to value each student and myself as a unique or 'concrete other… an individual with a concrete history, identity and affective-emotional constitution' (Benhabib, 1992, p.148) which directs and influences our participation within practice. I have come to see myself and students as being 'one-in-relation with others' (Roche, 2007, p.273) as I now reject the concept that students should passively listen to me in order to 'memorize the contents narrated by [me]' (Freire, 1970, p.53). Instead, I have learned to listen to each student in a way that recognises them as people who have their own individual fears, hopes, and ideas for who they are now, how they see themselves within their reality, and how they want to develop both personally and as Software Engineers.

In caring for students, I listened to and got to know the students as individuals. I also positioned the students as active participants in their learning and encouraged them to learn from and with each other. Students have expressed the importance of such active participation in their learning because they felt that as I taught I was 'trying to make people to think about what they were saying … [while] other teachers are explaining'

(Dillon, Interview 2, 20th April 2018). The students contrasted this approach with their experiences in other classrooms where they were fed information which they learned later on their own after class. The students realised that other teachers only explained or reified concepts while I also emphasised participation by requiring them to actively engage with software engineering knowledge and knowing as part of their own learning. The students articulated their satisfaction with this approach because they 'hate when lecturers just read off the slides. You don't do that.' (Brendan, Interview 2, 20th April 2018). It was an important part of their experience within the classroom that I was 'not just standing up talking about slides… At least you keep us engaged, you're asking us questions and things' (Sam, Interview 2, 20th April 2018).

Students felt that this approach 'broke… the normal cycle of lecturer/student kind of relationship. Your subject built on the understanding of the student. You give the student the ability to actually think and understand and apply their knowledge' (Amy, Interview 2, 20th April 2018). The students recognised that I encouraged and gave them the confidence to 'interact, make mistakes and learn from them' (Brendan, Interview 2, 20th April 2018). The students experienced a relationship with me that was built on the dynamics enacted in the classroom where students also ask questions and in answering them I 'emphasize the points [and] give the right structure to the way [to] interpret the whole Agile process' (Amy, Interview 2, 20th April 2018).

This re-conception of relationships within my practice has allowed students and I to share perspectives through negotiating meaning and continually modifying our interpretations. I regard the knowledge valued within this perspective as dynamic and contextual in nature. It is knowledge which supersedes the 'disciplines of knowledge' (McCormick and Murphy, 2008, p.9) that I have privileged in the past.

Chapter 8 - Third Action-Reflection Cycle: Building Team-work to Engage Students

8.1 Introduction

In this chapter, I asked myself *"How can I improve my pedagogical practice to build team-work to engage students?"* within the context of a specified curriculum focused on the different parts of the Agile software development process needed to create software products. A key component of the specified curriculum is the concept of the 'scrum team' (Ashmore and Runyan, 2015, p.84) comprised, typically, of a group of 4 to 7 software engineers who have ultimate responsibility for delivering a software product. I describe and explain how I took action to transform my practice to enact team-work based on the concept of the Scrum Team to

> provide students critical experience relevant to their future careers, [and] to set problems of greater scale and complexity than could be tackled individually, and [which] are a vehicle for socially constructed learning. (Neill, DeFranco and Sangwan, 2017, p.591)

Finally, I present my findings and reflect on the actions taken. In doing so, I draw on my own experiences of practice as well as the students' experiences of group-work within the enacted curriculum.

8.2 Taking Action - How can I improve my pedagogical practice to build team-work to engage students?

In this section, I discuss how I took action to build teamwork and engage students as I enacted the curriculum. I explain how I encouraged collaborative learning in an environment where students work together, as part of a scrum team (an authentic practice within the Software Engineering industry), using strategies which focus 'mainly on students' exploration or application of course material, not on the presentation of the material by the teacher' (Clarke *et al.*, 2014, p.18:4). I identified that there were implications in modelling such a collaborative approach within one's teaching practice. This involved me promoting aspects of learning such as group-work, leadership and other interpersonal skills, and problem solving skills as well

encouraging the students to take responsibility for one's own learning and actions (O' Neill and Moore, 2008). I also explain how I encouraged these aspects of learning by placing students into individual scrum teams, by asking them to engage with and solve authentic software engineering problems, and by facilitating their group work as they learned together.

In undertaking this action I

- required students to become members of a Scrum Team and asked the students to employ the principles of cooperative learning within their groups (Johnson and Johnson, 1999),
- designed two group projects (one per semester) for each scrum team to work on, and
- facilitated the group-work throughout both semesters and across both projects.

8.2.1 Cooperative Learning within a Scrum Team

Students learn through interacting with their peers as they participate in teamwork, which in turn leads to both academic and social growth. Such interaction or collaboration is a vital element of teamwork that promotes understanding with and within the group. Through collaboration '[s]tudents educate one another and end up knowing more than they would have working alone' (Frey, Fisher and Everlove, 2009, p.1).

I enacted within my learning environment formal groups, where students collaborate together over a prolonged period of time as part of a persistent team (Johnson, Johnson and Smith, 2014; Wilson, Brickman and Brame, 2018). I established that the concept of formal groups allowed me, as an educator, to replicate the notion of a scrum team within the enacted curriculum. I employed the conception of formal teams as a means to engage students in a social, democratic, and dialogical problem-posing pedagogy to promote their learning as they pursue an authentic joint enterprise or project on their journey to becoming software engineering practitioners. I randomly assigned students to their scrum team.

To help students 'to work together on a shared task in order to jointly construct their knowledge and understanding of the content' (Frey, Fisher and Everlove, 2009, p.14) from an academic perspective, I introduced the students to the concept of '[c]ooperative learning' (Johnson and Johnson, 2018, p.1) as a means for them to manage their own and the team's engagement with the process of group-work within a scum team. In a lecture (see Appendix J for the presentation), given early in the first semester of each academic year, I explained (reified) the fundamental aspects of cooperative learning: positive interdependence, face-to-face interaction, individual and group accountability, interpersonal and small-group skills, and group processing. I not only had to explain these fundamental aspects of cooperative learning but I also had to ensure that the real-world projects enacted by me provided students with the opportunity to engage with all of these features of cooperative learning as they undertook their assigned projects.

I described to the students how positive interdependence within a group or scrum team requires that the participation of every member is necessary to the completion of the project. I explained that to achieve positive interdependence each person must clearly understand their own role and their interdependence on others in accomplishing tasks in order to deliver the software product. I told the students that the enacted real-life software problems that they will encounter within the curriculum have many individual and interdependent roles and activities that require each team member to both work individually and with each other in order to successfully deliver the project. For such participation to be beneficial in structuring group-work I made it clear to the students that positive interdependence requires face-to-face interaction, another key component in group work.

Face-to-face interaction, I explained, is needed to figure out the logistics of completing the project as well as to exchange ideas and solve problems. I highlighted that such interaction consolidates and builds new understanding or learning. I ensured that face-to-face interaction was enacted in the curriculum by requiring each scrum team to engage with a variety of authentic meeting types built into the agile or scrum process. Within an Agile process based on the concept of a scrum team, I explained to the students that the logistics of a project are considered and discussed in the 'Grooming and Planning' (Ashmore and Runyan, 2015, p.149) and 'Daily Stand-up'(Ashmore

and Runyan, 2015, p.259) meetings. Additionally, I encouraged the students to exchange ideas within scheduled design meetings and weekly feedback meetings with me.

I facilitated the weekly feedback meetings to encourage discussion and provided formative feedback or 'assessment for learning' (Bloxham and Boyd, 2007, p.15) to both individuals and the group as part of the individual and group accountability system built into the cooperative learning approach. A key aspect that I implemented within this accountability perspective is that I informed the students that each individual within a group will receive a grade for the work undertaken and that each, as well as the group, is a participant in the evaluation process with me. As part of the evaluation process, I required each team member to engage with 'assessment as learning' (Bloxham and Boyd, 2007, p.15) by considering feedback from the various meetings and their own reflections in assessing his or her own performance through structured written reflection. I did this in the belief that maintaining a structured written learning journal encourages and demonstrates a person's commitment 'to critical reflection' (Brookfield, 1995, p.13). I describe the process that I enacted to encourage the students to engage in structured reflection in Chapter 9.

I also facilitated and encouraged each student and team to engage with interpersonal and small group skills. Skills, such as, to resolve conflicts in a constructive manner, to communicate effectively, and to ably draw upon the strengths of others to solve problems are integrated into the enacted curriculum. To help this process, I provided the students with a 'Common Interpersonal Skills' (Frey, Fisher and Everlove, 2009, p.70) checklist, which I included in the Semester 1 Group Project Instructions (Appendix K).

Finally, the concept of group processing provides an opportunity for individuals within a group to talk and reflect with one another about what worked and what did not work while engaging with a project. I described to students how such processing is crucial to future success, not only for group work but also for individual learning. I emphasised that the process is not a matter of blaming individuals but, rather, of figuring out what should change and what should be retained. Group processing provides team members (learners) with an opportunity to notice what they did well

and what got in the way. I explained to the students that team members can also draw on their individual written learning logs in the design, weekly feedback, and 'retrospective' (Ashmore and Runyan, 2015, p.282) meetings as the team engages in group processing to move the project forward. I highlighted that retrospective meetings are also an integral part of the Agile process and happen at predetermined times within the agile process, after a significant piece of work is completed. The focus of such meetings is for the team to reflect on the quality of the work-product produced to date with an emphasis on the quality of agile process used by the team to produce that work-product. An outcome from that meeting may be a commitment to improve the agile process, if necessary.

8.2.2 Two Group Projects

I decided that students would employ the Agile process to specify, develop, and deliver a PC-Based software product to manage the delivery of newspapers and magazines for a small retail shop. A description of the system features for this Newsagent Application (adapted from Sommerville, 2016) is listed in Appendix L.

I divided the Newsagent Application project into two parts. I did this due to the nature of the specified curriculum which I am required to deliver over two semesters. At a macro level, there are two major aspects to the Agile process: User Story Specification and The Scrum Process (Ashmore and Runyan, 2015). User Story Specification begins before, and is a prerequisite, to the Scrum Process being engaged with. In specifying the curriculum, I chose that a major component of the Agile Methodologies 4.1 curriculum should be the User Story Specification process while the Agile Methodologies 4.2 curriculum would be concerned with the Scrum process. Due to semesterisation within Athlone Institute of Technology, I am required to assess each module separately. Therefore, I made the decision to package the activities of User Story Specification as a project within semester 1 and package the Scrum Process activities as another project in semester 2. However, within authentic software engineering practice both User Story Specification and the Scrum Process would be considered related activities within a single project. To capture this relationship within the enacted curriculum, I informed students that the User Stories they created in semester 1 would be employed by them as the starting point for the Scrum Process

project in semester 2. The project in the first semester I enacted over a four-week period while the project in the second semester I enacted over the entire thirteen-week semester. The instructions for each project are described in Appendices K and M respectively.

I was not unhappy with this division of the Agile Methodologies process into two separate projects within the enacted curriculum. My reasoning behind this was driven by a pedagogical perspective as I decided to use the project in semester one as a means to focus-on and introduce the students to the complexities of participating in groups while engaged with a project that focused on a single complex task (User Story Specification) that could be divided among all members to work on. I saw the project in Semester 1 as an opportunity for the students to become comfortable with group-work before engaging with a more complex software engineering task (engaging with the Scrum Process) in semester 2.

To support the process of group work my experience as a lecturer (and software engineer) told me that '[g]oals are the necessary starting point to the learning process [as] all learning begins with setting the final objective' (Sackstein, 2015, p.9). This resulted in me in planning to facilitate groups and individual students to set achievable goals for the project work assigned to them. To start and help this process, I provided the students with 'A Guide to Setting Achievable... Goals' (Sackstein, 2015, p.10), which I included in the Semester 1 Group Project Instructions (Appendix K). In doing so, I stressed to the students the importance of goal setting, delineating between long-term and short-term goals, the concept of clarifying goals, the need to set time-lines, and the need for criteria to both direct the work and assess its completion.

I urged students to use this guide as the basis for creating a detailed plan for each project to meet the goals of the team by identifying the required tasks and the time needed by the members of the group to complete the work. As part of the goal setting and project planning activities, I introduced a variety of estimation techniques applicable to the Agile process, including Story Point Estimation, to be employed by the students in figuring how long certain tasks would take (Ashmore and Runyan, 2015). I had already identified the need for and examples of estimation techniques within the specified curriculum. This is an example within my transformed practice

where I required students to apply the explicit knowledge around the theory of estimation to the particular context of the project that they were working on and who they were working with.

8.2.3 Facilitating Groupwork

To enact group work, I identified facilitation as a key process or action that I must take in building teamwork and to engage students within my practice. In planning the lessons, I intentionally decided to actively facilitate group work within my weekly computer laboratory class. To actively manage the process of facilitation, I took two actions.

The first action I took at the start of each class. Before I met with each group, I collected, reviewed, and summarised each student's learning log (reflections on the previous week's learning) as a means to understand the learning they engaged with, to establish their progress made on the project to date, and to identify any potential difficulties or problems they may have encountered in the preceding week. I did this in order to prepare effectively to facilitate the weekly status meeting that I have with each group. I describe the actions that I took to ensure that the students maintained a weekly learning log in Chapter 9.

Secondly, I designed a Group Observation Form (Appendix N) which I employed during the facilitation process itself to record each group's weekly progress. This form allowed me to keep track of the discussion as I engaged with each group to determine individual and group project progress since the last meeting. Taken in conjunction with the students' weekly learning logs, the previous week's group observation form provided me with context for the weekly status meeting that I facilitated with each team. I used the knowledge recorded from the last meeting to determine both the group and individual student's learning and progress with the project tasks they were working on since we last met.

In facilitating the weekly meeting with each group, I employed the following questions to start the discussion:

- What have you/group achieved?
- Any problems?
- What do you/group plan to do?
- What have you/group learned?

Using these steps I worked with each group individually to review progress to-date and to facilitate any questions or discussion that might arise as the team engage with their current deliverable or project task. In the meeting, I encouraged and guided them to discuss/define/clarify any problems encountered as a group, promoted engagement in independent study, required the group to present and discuss their solution to their current tasks, and review what they have learned from working on any task or problem through self, peer, and teacher review or reflection. As a facilitator I endeavoured 'not to teach or give information but rather to facilitate students reasoning through the problem' (Barrett, 2005, p.60). As a facilitator I encouraged the students' active participation and collaboration within the team. I also required respect and integration of diverse views that may exist amongst individual students within the group (Clarke *et al.*, 2014). While I worked with a team, the other teams in the class were required to continue working amongst themselves on their project.

8.3 Findings and Reflection: On Building Team-Work and Engaging Students

I now present my findings and reflect on the actions that I took to build team-work and engage the students. In doing so, I draw on both my own experiences and students' experiences of how I transformed my practice to build team-work and engage students with the enacted curriculum and learning environment.

8.3.1 Students' Experiences of Engaging in Team-Work

The students unanimously agreed that Group Work was an essential and key activity within their learning experiences. The students felt that 'group work... enhanced our experience on the course' (Amy, Interview 1, 20th April 2018). Their 'overall experience with it was very positive' (Sam, Interview 2, 20th April 2018). They 'found it very insightful' (Peter, Interview 1, 14th March 2017) and considered it to be a 'useful process' (John, Interview 2, 14th March 2017).

8.3.1.1 Random Selection of Team Members

Some of the students were concerned with the random way that 'the teams are set out where everyone was put in a line and everyone was given a number' (Ronan, Interview 3, 15th March 2017) because it resulted in a 'spread of ability across the teams [that] probably wasn't as good as it could have been' (John, Interview 2, 14th March 2017). These students thought every group needed certain types of individuals who were capable and had the ability to organise others in the group. The random nature of the group selection process did not result in such students or leaders being 'distributed more evenly, so that everybody gets the maximum they can out of the experience' (John, Interview 2, 14th March 2017). Another student disliked random selection as he hoped to 'work with people [who] are on a level to [himself], that I know that I don't have to do too much of a hand holding thing and all that' (Bernard, Interview 1, 20th April 2018).

Other students recognised the difficultly for me to ensure a spread of ability across all groups, particularly in a classroom setting where I was meeting students for the first-time. Students recognised that for me to effectively identify each person's set of abilities and then evenly distribute those abilities equally across different groups would require that I 'would have to be with everybody for four years to understand who's strong at this and who's strong at that' (Mark, Interview 3, 15th March 2017). They felt that as fourth year students that they should be mature and experienced enough to engage in the different roles and develop the various abilities required to support a functioning group while still understanding that there will be differences between people where '[s]ome people will be better, some people will be great, but we [all] should still be good' (Mark, Interview 3, 15th March 2017) enough.

Some students commented further that the selection process resulted in teams that realistically mirror the structure of teams within industry. They felt that when 'working with a team, or working with people, really, everybody will never be on the same level' (Bernard, Interview 1, 20th April 2018). Although he had expressed initial doubts about the random selection process, Bernard discovered that he 'kind of liked working with people that had to ask me questions sometimes … because even though

there is this supposed frustrating element to it, it also taught me patience on a work experience level' (Bernard, Interview 1, 20th April 2018).

Students thought that I preferred random-group selection as they observed that I had 'assumed a level of knowledge that not everyone met' (Amy, Interview 1, 20th April 2018) - that all students had already being awarded a Level 7 degree or equivalent. However, this was not the experience students had as they engaged with group-work. The students found that experience and knowledge levels between individuals in each group varied. On a personal level students determined that

> you had to kind of bring everyone to your level of knowledge, but then you discovered your knowledge level isn't a thing, and there's someone better than you, so you have to match everyone, or just go up to someone who's better than you, then go down to someone who doesn't know much. (Amy, Interview 1, 20th April 2018)

This student initially 'thought it should have been better to make the groups pick the team members. Like so there would be friends, so it would be easier to deal with [them]' (Amy, Interview 2, 26th January 2018). However, as the year went by she felt that dealing with somebody who was not your friend and who you didn't really know prompted a more professional approach 'because you won't put off the work, and you won't cover for someone you don't know' (Amy, Interview 2, 26th January 2018). This resulted in students 'gain[ing] a lot of experience working with different people …that did not know each other, so everyone had to do the work. Because you cannot get a pass' (Amy, Interview 1, 20th April 2018).

8.3.1.2 Forming Friendships and Taking Responsibility

Students discovered that getting 'into groups that we didn't know the people [and where] we were all from different backgrounds' (Peter, Interview 3, 15th March 2017) provided the basis for them to experience forming professional (and personal) friendships which resulted in them taking responsibility through participating with the group tasks and activities.

Friendships developed both at the class and individual team level. Students formed friendships that they would never have considered possible because 'we probably wouldn't have talked to some of the Chinese students [but now] we got to know them a bit better' (Eoin, Interview 4, 15th March 2017). The students' experience of academic life to date had being that learning was a solitary experience and that there was no incentive to form learning friendships within the class, outside of your immediate circle of friends. However, they discovered that involvement in team-work

> brought me closer to the people that were there. I don't know if I would have engaged with them specifically, not for any reason, just because we were engaging every week, several times, you just grow to be better friends. (Jacob, Interview 2, 20th April 2018)

In a class where

> [t]here was nine of us from business computing. There was [also] the Chinese students. There was [also] the Middle East students. There was people who had come from computer engineering. We were all sort of sticking in our own little groups. But the fact that you put us into groups, you know, we all mixed. So then. People who we used to hang around with were in another group. Then you talk to your friend again and then you talked to the new members as well. So, you know from my point of view, I think that was ideal in bringing the class as one. Rather than just letting us sort out in our individual groups, with the Chinese sticking together and the business computing students sticking together, so. I thoroughly made some good friends. (Peter, Interview 3, 15th March 2017)

In some cases, although students had been together is the same class for the previous three years, there was no 'communications with each other, but for this year, this project make us, I can say, us four friends' (Nigel, Interview 2, 20th April 2018). Group work provided the framework for students to meet 'students from last year's class [and] we kind of got to know them better as well (Eoin, Interview 4, 15th March 2017). For one group friendship extended beyond the group work itself to recognise and embrace the cultural differences between various members of the group:

> We ended up going doing stuff outside of the group as well. There was the Chinese New Year festival here in the college and they invited myself and [the other team member who is also not Chinese] along to it. Just to hang out afterwards. So it was all unrelated to the group work, but it never

> would have happened if we weren't put into the group. So that was, just a nice experience, you know? (Jacob, Interview 2, 20th April 2018)

Additionally, these experiences of forming friendships within their groups fostered a sense of motivation and responsibility amongst the group members. Responsibility motivated one student to stay on top of his work commitment so as not to 'let the other members of my group down if I'm not doing any work' (Jacob, Interview 2, 20th April 2018). For another, group work motivated him to remain in college because his sense of responsibility to his team members

> did kind of keep me going through college this year ... sometimes I was just ... I kind of wanted to just leave and drop out and stuff but I had responsibilities to the group and stuff that I had to get done, and that's kind of what kept me coming back and I enjoyed it, having responsibility. (Sam, Interview 2, 20th April 2018)

However, there was also a recognition that for a variety of reasons some team members do not take full responsibility within their group. It was recognised that within some groups a small number of members needed to be "carried" (i.e. their work done for them by somebody else) as 'sometimes some of the group members can be lazy or I don't know, busy with other stuff' (Nigel, Interview 2, 20th April 2018). Some groups did not 'really run into much problem with that kind of thing where somebody didn't do something and it needed to be done' (Jacob, Interview 2, 20th April 2018) but others did. For those groups that had to carry people there was a recognition that this is a characteristic of authentic practice that will probably be encountered some time when working within the software engineering industry - 'the job must be done and it doesn't matter if it's five persons in order to do that job or four persons' (Nigel, Interview 2, 20th April 2018). Rather than complaining to me that certain members of the group were not committed to delivering their tasks and recognising 'it's still your choice to carry them' (Sam, Interview 2, 20th April 2018), the students recognised that motivated and responsible members made an informed decision to carry these individuals for two reasons.

Firstly it was recognised that in the real world that requires a project to be delivered that '[s]ometimes you have to carry them a little bit, some members, ... it's part of being a group isn't it?' (Sam, Interview 2, 20th April 2018). Secondly, from an

accountability perspective, hard-working and committed students were not concerned as they honestly believed that 'you'd [me - the lecturer] have an idea who isn't performing' (Sam, Interview 2, 20th April 2018).

8.3.1.3 Learning Opportunities and Knowledge Learned

Working as part of a group with 'people that you didn't actually know' (Mary, Interview 1, 14th March 2017) was considered a learning opportunity by the students. They perceived that group work as a social activity fostered learning opportunities where 'we learned from each other a lot of things... five heads is always better than one' (Nigel, Interview 2, 20th April 2018). The students felt as they participated in group work they 'were showing all the skills ..[a]ll the things we had to use ' (Bernard, Interview 1, 20th April 2018). These skills included 'how to plan [and] to work together, interact' (Bernard, Interview 1, 20th April 2018). Students viewed these skills as necessary and '[v]ery simple things, …[where] we structure the thing properly…[a]llocate the tasks properly.. [h]ow you break them down properly, that kind of stuff' (John, Interview 2, 14th March 2017). Other learning opportunities presented themselves such as developing 'your client skills that would be used in industry' (Brendan, Interview 1, 20th April 2018).

The students discovered that the practice of Software Engineering extends beyond the skills and pure engagement associated with technical activities. Through engagement with group-work, the students had figured out that in the real world they needed to complement their technical skills and 'get on with people and deal with situations [in] the workplace [because] if you're not enjoying the people around you, you're not going to enjoy the work' (Mark, Interview 3, 15th March 2017). They had figured out that in 'going to the workplace, you're always going to end up on a team…that's why I think it's very crucial to get that knowledge of' (Anne, Interview 4, 15th March 2017) group work. This recognition of the role and importance of group-work in professional practice played out in real-life for one of the students. Amy 'went to an interview, and they were asking … how do you work in group, what was your role, and all of it was just ... my answer was based on the Agile Methodology [modules]' (Amy, Interview 2, 26th January 2018).

Group work was seen as a particular type of learning opportunity in that it was perceived as the vehicle which allowed the students to practice 'what was being taught [by utilising theory in] certain situations where problems would arise where you would have to kind of let's say, reference' (Denis, Interview 3, 15th March 2017) theory and concepts. Students were drawn by the practical aspects of working within team - '[p]ersonally, I'm more about the 'do' rather than the learn …Learn by doing... I need to physically see it and physically try myself before I actually get it.' (Anne, Interview 4, 15th March 2017).

Group meetings were identified as social spaces that enabled learning as a social activity through face-to-face interaction. Face-to-face interaction provided an effective mechanism to discuss problems and enhance team-members' learning. Such social engagement within meetings resulted in groups 'generating new ideas' (Nigel, Interview 2, 20th April 2018). Every group meeting was considered 'a learning experience, because you're working on a new problem… [s]o that definitely helped me to learn' (Sam, Interview 2, 20th April 2018).

Team members experienced 'very good cooperation in terms of, when somebody had a problem, there was always somebody who would say yeah, I know how to do that, give me five minutes' (John, Interview, 14th March 2017). If a team-member encountered an individual problem that was particularly difficult to solve then 'if somebody couldn't get something it was everyone versus that problem as opposed to one person within the group kind of not being able to do it and making everyone else fall behind' (Jacob, Interview 2, 20th April 2018). Students felt that this type of learning opportunity was 'irreplaceable, [t]hat to me is the best benefit of group work, is knowledge sharing, information sharing' (John, Interview, 14th March 2017).

Face to face interaction occurred, not only within individual groups, but also across groups. Students availed of other learning opportunities when members of different groups discussed each other's projects, not in order to copy the other project, but rather as a means to extend their own learning by thinking about alternative approaches taken by other teams and to check that their own project was going in the right direction. While acknowledging that such discussion is a form of collaboration between each of

the groups, the discussion was undertaken in the spirit of observing other approaches by reviewing

> each other's projects. How we were getting on and stuff like that. Well, I guess it's kind of everybody had their own opinion… It's not that they're bad opinions. It's just you're kind of stuck to how your group was doing it. You aren't going to go back to your group and say, "Look. This other group were doing something else. I think we should change what we're doing." Well, everything was running smoothly for us and having no problems [so] I was happy enough to stay with what we were doing. (Jack, Interview 1, 14th March 2017)

The students found that the facilitation of their group-work by me provided further learning opportunities as the approach that I employed allowed them to come prepared to the weekly status meetings, where they could ask questions and discuss any project issues that may have arisen. They described my feedback as being 'invaluable' (Mary, Interview 1, 14th March 2017). Even though the feedback I provided was informal in that it was spoken and given to the students, they recognised that that they were getting my 'reflection on what we were doing and we were kind of pointed in the right path and where we could improve and how to get better, depending on what we were doing' (Peter, Interview 1, 14th March 2017).

Concern was expressed that in certain circumstances group work potentially may hinder individual learning. Students recognised that each individually have intimate knowledge of their assigned tasks but not a detailed knowledge of the assigned tasks for other members of the team. Students observed that some learning must be considered second-hand because 'I never worked on a certain part of the project' (Jacob, Interview 2, 20th April 2018). Instead students had to rely on another member of the team to explain how they developed solutions and fixed problems within their own tasks. Some students were a little concerned, that while the explanation of what another team member does 'might seem simple … if I was to sit down and do that maybe I would realize actually it was more difficult than it appeared' (Jacob, Interview 2, 20th April 2018). However, students accepted that such second-hand learning is an authentic characteristic of group work that they will continually encounter within their professional lives. They accepted that secondary learning is just another example of a learning activity within both educational and industrial environments enacted within

groups to resolve problems. Students acknowledged that they must engage in such learning because 'that's just part of working in a group I think. Someone's going to do something that you didn't have to do obviously' (Sam, Interview 2, 20th April 2018).

Working in groups proved to be an insightful learning opportunity from the point of view that it gave students a perspective into 'what it's probably like in the industry [where] you're going to be part of one team as part of [a] massive team' (Peter, Interview 1, 14th March 2017). Learning to work alongside other people and recognising that people have different personalities was seen as an important aspect and key requirement of group work because 'we were putting in to place where we're going to land next year, which is with people we don't know what their strengths, what their weakness is, how they work, how fast they work' (Anne, Interview 4, 15th March 2017). This aspect of group work was considered to be a good learning experience because it was essentially a 'simulation of what it would be like in industry working with people you never met before, and the projects you have to do, and using all the tools and skills that you [the lecturer] showed us' (Brendan, Interview 1, 20th April 2018). In fact, group work was perceived as the conduit within the enacted curriculum that provided the means 'of practicing the real software development process' (Dillion, Interview 1, 20th April 2018). It was within this context and 'environment I kind of had to try and put what I've learned now into practice.' (Bernard, Interview 1, 20th April 2018). The idea of working as a group was seen as an essential and beneficial part of the students' learning because

> hopefully when we leave this and we're software engineers, that's a scenario that we're going to be faced with, working in a group and having to deal with different aspects of different opinions. Different ways of looking at stuff and different cultures. Different ideas of how to do stuff. (Mark, Interview 3, 15th March 2017)

8.3.1.4 Intrapersonal and Interpersonal Skills

Students experienced many intrapersonal and interpersonal skills that had to be mastered so that they could participate productively within group work.

Students identified communication within their teams to be an essential element of the learning process and group work. They identified different forms of communication that they experienced. For many students it was their first time working and having to communicate with international students. It made them realise they needed to work on how they communicate with the international students because 'you could be put into the work place where you're going to have [people] from different countries' (Anne, Interview 4, 15th March 2017). Additionally, communication was considered a key characteristic in how team members collaborated with each other particularly during meetings where you had to justify your thoughts to others and 'get feedback on how they do it and see what they were thinking about' (Jack, Interview 1, 14th March 2017).

Differences of opinions arose within meetings. These differences of opinions were not seen as zones of conflict but rather opportunities to practice explanation and negotiation skills 'if you don't agree with something, [and] trying to put it in their perspective instead of like raising your voice or something like that' (Ronan, Interview 3, 15th March 2017). Students explained that they had learned 'how to talk to each other without arguing' (Sam, Interview 2, 20th April 2018). This helped the students gain

> more skills dealing with people, because you will have to deal with their issues, bad days, and try to meet the deadline, so that pressure of actually having to finish what you started. (Amy, Interview 1, 20th April 2018).

Students learned that 'to communicate in a group you have to learn how to compromise sometimes' (Sam, Interview 2, 20th April 2018). Each of the students agreed the need to compromise at times within a group is a key personal skill needed by group members to ensure the 'dynamic of making things work… with everybody's knowledge level' (Bernard, Interview 1, 20th April 2018).

Students discovered that compromise not only transcends personality but also recognised that the ability or knowledge level of each team member must be understood to determine every person's capability to engage in meaningful work in

line with their knowledge and skills. When working in groups the students recognised the importance of

> being able to perceive certain situations and how to kind of deal with them [because] in certain aspects of a team, certain people are good at certain things and other people aren't'. (Denis, Interview 3, 15th March 2017)

It was deemed a crucial intrapersonal skill to have the ability to perceive the level that people are capable (or not) of performing at. Students learned to

> recognize other people's certain skills, what they could be good at and try and utilize that within the sprint or, to be honest, whatever group work you're doing. There's always somebody who's going to be very good at something. Seeing that and utilizing that is good, like someone who's good at technical stuff and able to sort of work out the commit, you use them to try and sort of fix the problems if they arise because they seem to have a better understanding. You know they'll do it. And then, you also have the people who sort of ... You have to control a lot more because they're so ... Their mindset is all on the individual stuff rather than the teamwork, and it has to be their way ... Yeah. Learning people's skills and how to manage them, I think that was ... That was a good knowledge. (Mark, Interview 3, 15th March 2017)

8.3.2 My Experiences on Building Team-Work and Engaging Students

I now describe and reflect on my experiences on building team-work and engaging students during this inquiry.

8.3.2.1 Creation and Performance of Randomly Selected Teams

Literature suggests that there are two approaches to forming formal groups: random and self-selection (Wilson, Brickman and Brame, 2017).

I decided to randomly assign each student to a single scrum team, consisting of 4 to 7 students, for three reasons. Firstly, in an environment where I assumed that all the students were starting from the same academic position, I had an expectation that the students would be equally capable of engaging in a group-project with other like-minded students. Secondly, I did not want teams to pick their own members as inevitably some students do not get selected which potentially, in my experience, leads

to feelings of inadequacy and isolation for these students even after they are assigned to a team after the original selection process has been completed. Thirdly, I saw it as an opportunity within my classes consisting of many and varied nationalities to create multi-cultural teams that I felt represented the type of groups the students would experience in industry. I did not consider any other specific student characteristics that could contribute to effective group-work and performance. Although groups that are gender-balanced 'have been shown to exhibit enhanced collaboration' (Wilson, Brickman and Brame, 2018, p.3), I was unable to implement this within teams as less than 7% of the students were female.

In the Academic Year 2016-17 I did notice that some students were not happy with randomly selected groups. I made the following observation after the class in which the group assignments were made:

> I randomly selected the project groups. I did notice some "unhappy" faces as people were assigned to groups. I received an email after class from [an international] student … about [their] poor English and not being able to understand [their] group members. [The student] wanted to join an-all [international] group!!! [The student] also expressed concerns about achieving [their] grades… (Semester 1 2016-17 Week 4 - Lecture Reflection)

I remember discussing this situation with a colleague who informed me that there was no one correct way to assign individuals to groups. Regardless of whether groups are randomly or self-selected, he did suggest that it is useful to introduce an ice-breaker exercise as part of the process in forming teams that will work together for long period of times.

In the following Academic Year 2017-18, as I became more confident in my new role as a facilitator where I openly discussed the values of justice, democracy, and care with students, I felt it was only right to ask students if they wished to form their own groups or would I form them randomly. I explained why I preferred random-selection over self-selection and then asked the students to decide on which approach they wished to adopt. Through a show hands from the class I unexpectedly found that the

> …[m]ajority of the class were happy to have groups randomly selected. The first activity [an ice-breaker] that students engaged with was to introduce themselves to their group members. In a [computer laboratory] class of 14 I was amazed at the number of students who didn't know or even have talked to other people in the class. (Semester 1 2017-18 Week 5 - Lecture Reflection)

Over both academic years, I felt that the majority of the randomly selected teams performed well. For example, in the Academic Year 2016-17, I discovered that while the majority of the teams performed well, how each team performed depended on the individuals that comprised the team and, in particular, on certain characteristics that individuals brought to the group. I started to categorise the different groups based on how I observed their performance. I identified and named four types of teams: 'Super, Successful, Normal, [and] Dysfunctional' (Semester 2 2016-17, Week 3, Group Observation Forms, All Groups). The majority of the teams I felt came under the Normal classification, while there was only one team in each of the other categories.

The *Super* group was comprised of all motivated and capable (personally and professionally) individuals who had a shared vision built on determination to successfully complete the project. Personally, many of the team members displayed well-honed leadership, communication, and organisation skills. Professionally, their technical skills were highly developed or in the process of being highly developed.

The *Successful* group formed around a single member whose leadership, communication, and organisation skills he successfully deployed to coordinate the technical work and delivery of the project amongst the other team members. These team members were contented to take direction, focus on their individual pieces of work, and rarely challenged the de-facto (although reluctantly) leader of their group, who ensured that the various individual components successfully integrated. I was surprised at the number of these students who did not take up the opportunity to experience a leadership role within that group.

In the *Normal* group, all participants worked to the best of their abilities and were prepared to work cooperatively with other members, while accepting of their own and others technical abilities and limitations. It was the members of this type of group that

enthusiastically helped each other to solve the individual problems that they encountered.

Unfortunately, I now accept due to random selection, the Dysfunctional group was comprised of students where there was a 'clash of personalities, not the right technical mix [resulting in] two camps' (Semester 2 2016-17, Week 3, Group Observation Forms, B1) amongst the team members culminating in poor communication, lack of trust, and willingness to work together. Too overcome this problem and to ensure that these students had the opportunity to benefit (somewhat) from the experience of engaging in group work, I reluctantly went beyond my facilitation role and actively managed the project on behalf of that group.

I also randomly assigned students to be part of an informal and temporary team to undertake activities within the lectures. Typically, I employed informal groups to work together on an in-class problem requiring anything from a few minutes to a single class to resolve (Wilson, Brickman and Brame, 2018). In one instance, I divided the class into informal groups and '[i]ntroduced jigsaw reading exercise in class' (Semester 1 2017-18 Week 3 - Lecture Reflection).

I had engaged with such informal group work as a means to integrate active participation from the students into the lectures which were typically focused on the reification of concepts, processes, and procedures. I had identified that such action provided students with opportunities for formative assessment and feedback with their peers and from me within class time (Johnson and Johnson, 2009).

8.3.2.2 Facilitation Process

As I undertook facilitation with each group (operating as a Scrum Team), I was always analysing how I performed in the role. An initial problem that I encountered as I started to facilitate the weekly meeting for each group was my inability to relinquish the control that I had employed within the teaching and learning activities of my past practice. I felt that I needed to have everything planned first and then that I should follow the plan without deviation to ensure that learning is happening.

While I implemented my planned facilitation process by engaging in the weekly meetings with each group and working through my defined list of facilitation questions, I was constantly concerned that 'I need to reassess how I facilitate' (Semester 2 2016-17 Week 5 - Lab Reflection). I had noticed that as I met with each team 'I was repeating the same thing … to all groups [and I asked myself] would it be more efficient to do this once at the start of the class?' (Semester 2 2016-17 Week 4 - Lab Reflection). I had to work hard to resist this temptation because although I was covering the same concepts and similar questions with each group, I discovered that I was adapting the concepts and my answers to the immediate and unique context that each group or team-member were experiencing. For example, the format and specification of a User Story was a concept needed to be employed on the Semester 1 project by each group. I discovered that I gave different feedback on the same concept to different groups: 'Talk to your customer. Don't assume anything. Reassess Acceptance Criteria - Are they relevant? Or more needed?' (Semester 1 2016-17, AM4.1 Assignment 1 Observation, Group G02), 'No real framework for discussion' (Semester 1 2016-17, AM4.1 Assignment 1 Observation, Group G03), and 'Suggest starting each A.C. with "Verify". Some A.C. are not compatible with U.S.' (Semester 1 2016-17, AM4.1 Assignment 1 Observation, Group G07).

I had figured out that I too was adapting to the different contexts and requirements of each group that cannot be foreseen and incorporated within any lesson plan. As I worked with each group, I realised that 'I had different experiences' (Research Diary, 24/11/2016) with each. I started to go with the flow and began to change my personae as a facilitator. Instead of just wearing my teaching hat, I also took the perspectives of a Software Engineering Client and Project Manager as I facilitated the group meetings. By doing so, I found that the dynamic changed and the facilitation process/discussion took on the feel of the real-life meetings that I experienced as a Software Engineer. One student was very complementary about this approach as it 'focused the team to have their short-term deliverables ready so that the students could demonstrate progress to me' (Research Diary, 15th February 2017).

Through the regular meetings with the students, I got to know them as individuals. I started to realise that each group was comprised of its own personalities. In some teams, some students started 'to dominate the group discussion' (Semester 1 2016-17

Week 6 - Lab Reflection). To counter this I decided to 'improve the facilitation process to engage all students [in the discussion]' (Semester 2 2016-17 Week 2 - Lab Reflection). I decided that the facilitation process steps did not need to change but that I needed to create a safe atmosphere at the weekly meetings to encourage the students to actively engage with the meeting and not to be afraid to discuss their thoughts. Taking 'on board my own advice on how to manage meetings' (Research Diary, 24/11/2016) my facilitation process has evolved, throughout this inquiry, to encourage the students to develop their own capacity to think and make decisions individually and as a group while constantly critiquing the context within which they are operating. This resulted in the 'majority of students [getting] involved in the group discussion' (Semester 2 2016-17 Week 3 - Lab Reflection) but some still continued not to actively engage. I have struggled with and continue to struggle with '[w]hat tweaks can I make to the facilitation process to get everyone to contribute without explicitly asking each student and putting them on the spot' (Semester 2 2016-17 Week 3 - Lab Reflection).

My own confidence in my ability to facilitate grew over the two academic years that I enacted the curriculum. In terms of my own participation I am very much a better facilitator now than I was at the start of the inquiry. I have developed and adopted an approach that I consider is both effective and that I can use consistently with each group I facilitate. By taking the same approach consistently the students accepted and realised that

> when they come to me that sometimes I will not give them a direct answer to a question but might talk them through potential different scenarios and then ask them what they think about the various scenarios. Other times I will tell students I am not intervening because I expect them to solve it. However I am getting better at gauging when students are stuck and that I may have to take a more active role in helping them to solve a problem in order to learn. (Semester 2 2017-18 Week 4 - Lecture Reflection: 6/2/18)

Students acknowledged this approach within the facilitation process where I suggested or 'pointed out to us' (Peter, Interview 1, 14th March 2017) various approaches to handle any issues or problems that they may have encountered. The result of this approach is that the students recognised that they were being encouraged and guided along the way to 'think about different, different …' (Jack, Interview 1, 14th March 2017) alternative approaches that could be used to address their problems. They

experienced that I varied this approach when I identified that a group might 'have been completely blindsided and not seeing where we were actually going wrong. You kind of put us back on the right path' (Peter, Interview 1, 14th March 2017) with more direct answers. Students discovered that the context of each project for each group was unique and this uniqueness was respected within the facilitation process where I was 'giving different feedback to different groups, rather than ... If you were saying, "That's wrong. Do it this way." Every project would be the same' (Mary, Interview 1, 14th March 2017), an approach that I had adopted in my past practice.

Over time, during each academic year, the weekly facilitated meeting developed and settled into a pattern where both students and I had distinct roles that needed to be fulfilled. I was responsible to meet with each group to review weekly progress on the project. Each group were required to continue working on the project while waiting for me to meet with them. This pattern of working is best summed up through my following observation and reflection:

This is the fifth week of the [second] semester and the second week of Sprint One. I had class A at 11 AM. As normal, for each group I collected the individual learning logs/reflections for me to review. I sat down reviewing the learning logs and became engrossed in the content of what I was reading and in my preparation to meet with the individual groups. At some point in my review, I sensed a quietness in the classroom. Looking up I saw each of the teams fully engaged in their project work. One team, consisting of six members, have decided to employ the "pair programming" approach to their project. As I observed this team I could clearly see that they were working in the subgroups and each pair huddle together in animated conversation over a single PC as they worked on their test/product code. I observed the other teams. They were similarly engaged. I notice one team, three of the five members were in conversation and the other two working on their own. This team opted not to employ pair programming but to divide the work so that they could work individually and then integrate the individual pieces into the final increment or deliverable for sprint one. Later on in the meeting, I asked why those three people were speaking with each other. They told me that they had to agree an interface to ensure that the work that they are about to do individually will be able to be integrated with each other's work. For me this is an example of positive interdependence and face-to-face interaction been put into practice. The third team were similarly engaged but in this case all five were working independently. I learned subsequently that this team had already agreed their interfaces and were happy that their individual pieces of work would integrate at a later stage. (Semester 2 2017-18 Week 5 - Laboratory Reflection)

My facilitation process evolved in line with my values of justice, democracy, and care where I trusted students to engage honestly and to the best of their ability to learn about becoming competent Software Engineers. Their ownership of their projects manifested itself, towards the end of each semester, as groups became less dependent on my input with regards to the group project and became 'more self-reliant' (Semester 2 2016-17 Week 11 - Lecture Reflection) and confident in their own ability to take responsibility for their own learning and complete the projects themselves.

8.3.2.3 Becoming a Facilitator

In becoming a facilitator within my practice, I now ensure that I stand inside the group with the students as we share meaning and, in doing so, I no longer feel the need to control the discussion in a search directed by me for a commodity called "knowledge". I have learned to lessen my need to be fully in control of all conversations to the extent that all interactions now evolve in a dialogical manner in reaction to the ideas and any unplanned contributions from members of a group. I and the students no longer seek closure or correct answers from each other but rather a shared meaning or understanding (Wenger, 1998) will suffice. Students and I now share our understanding and knowledge with each other through 'thinking with one big head' (Murris, 2000, p.262) where I have learned to listen to, draw on, and be directed by the students' experiences as I facilitate them developing their competence or expertise.

The nature of these interactions, developed and evolved throughout this inquiry to encompass the following three interacting activities:

1. Reflex Interaction – where individuals just spontaneously respond to each other,
2. Reflective Dialogue – where individuals make sense of such reflex experience by discussing ideas and invoking and applying theory and concepts upon and to this experience, and
3. Critical Reflexive Questions – requires individuals become more aware of their participation in dialogue, question their ways of being in the world, and how their values and assumptions play a key role in such processes.

(adapted from Kinsella, 2012, p.65)

These activities guided and helped students and I to become aware of the emergent and provisional nature of negotiating meaning. I feel these activities have helped in a

positive way for students to learn to become both competent software engineers and more knowledgeable members of the software profession and for me also to become a more knowledgeable member of the teaching profession. These activities have underpinned the social interactions and relationships between students and I within my practice. They have formed the basis for both students and I to get 'good at something' (McDermott cited in Murphy *et al.*, 2008, p.26) by developing our expertise over time during the academic year.

In engaging with these activities with students, I have noticed that there is a connection between identity and practice (Wenger, 1998). This connection has drawn my attention to the fact that it is important to recognise that each student can be on different learning trajectories from novice to expert as they participate in 'community/institutional, interpersonal, and personal' (Rogoff, 1995, p.58) activities within our shared practice. To support students I have discovered that it is necessary to comprehend that my identity and experiences are different from the students' reality. Therefore for my practice to be just, democratic, and caring I have acknowledged, embraced, and have learned to be directed by the students' unique 'funds of knowledge' (Murphy et al., 2008, p.42) and experiences in my interactions with them through group work, facilitation, reflection, and self-assessment.

Chapter 9 - Third Action-Reflection Cycle: Helping Students to Reflect

9.1 Introduction

In this chapter, I asked myself *"How can I improve my pedagogical practice to help students to reflect?"* as I recognised 'the value of reflection in raising awareness of tacit knowledge and transforming knowing-in-action into knowledge-in-action' (Eraut, 1994, p.15). I describe and explain how I took action to engage students with the practice of reflection as a way to appreciate and value the software engineering professional knowledge that they both create and use as they participate, experience, and grow as software engineering students within the enacted curriculum. Finally, I present my findings and reflect on the actions taken. In doing so, I draw on my own experiences of practice as well as the students' experiences of reflective practice within the enacted curriculum.

9.2 Taking Action - How can I improve my pedagogical practice to help students to reflect?

In identifying reflective practice as a means to help students develop their understanding of the tacit software engineering knowledge that they developed and employed as they experienced the enacted curriculum, I took action to explain to students what the practice of reflection looks like and to enact a Reflective Process within my practice.

9.2.1 What Does the Practice of Reflection Look Like?

Students can employ metacognition to come to know themselves by asking questions and seeking help as they endeavour to cope with various situations within their learning environment or practice (Murphy *et al.*, 2008). 'Reflection is an essential tool' (Sackstein, 2015, p.1) in this process of metacognition and requires 'intention' (Sackstein, 2015, p.4) as learners seek evidence from their experience to determine what they know and do not know. This act of

> [r]eflection seems to be part of the kinds of learning in which learners try to understand material that they encounter and to relate it to what they already know. Relating new material to what one already knows may mean reflecting on what one knows and modifying it [and] enables learners to feel that they 'own' their knowledge and understanding because they have been part of its creation. (Moon, 2005, p.2)

In this section, I explain how I introduced the concept and practice of reflection to the students as a means to develop their metacognitive skills and support them participating within a Scrum Team as part of the enacted curriculum as they took ownership for their learning and becoming competent software engineers.

I chose to model the practice of reflection on Schön's (1983) theory of reflective practice as it recognises that '[o]ur knowing is ordinarily tacit, implicit in our patterns of action and in our feel for the stuff with which we are dealing' (Schön ,1983, p. 49). I explained to students that there are three aspects to this theory of reflective practice: knowing-in-action, reflection-in-action, and reflection-on-action (Schön, 1983; Schön, 1987). I mentioned to students that knowing-in-action refers to a person's intuitive ability to know how to carry out an activity, but in hindsight, did not delve deeper into this aspect with them.

I explained that reflection-in-action, typically triggered by a surprise or something puzzling, refers to thinking about what you are doing whilst you are doing it. Using the concept of reflection-in-action, Schön (1983) sought to explain the creativity, talent, and competence of the practitioner embedded within skilful practice. I discussed with students that practitioners (including students learning to become competent Software Engineering professionals) have tacit knowledge that they 'bring to unique and uncertain situations that cannot be accounted for by simply applying theory to practice' (Hartog, 2004, p.50). However, when presented with problematic situations this practitioner or personal knowledge should not be simply understood as thinking about something whilst doing it but rather as reflection-in-action. I emphasised that reflection-in-action is a problem-solving process that purposefully involves '[p]ausing within a particular situation or experience in order to make sense of and reframe the situation in order to proceed towards desired outcomes' (Johns, 2009, p.10). I noted that re-framing provides the practitioner with the chance to

redesign what they are doing while they do it and is a characteristic of competent (and experienced) professionals.

In contrast, I described that reflection-on-action requires an individual to reflect 'on a situation or experience after the event with the intention of gaining insights that may inform [their] future practice in positive ways' (Johns, 2009, p.10). It requires that a person retrospectively contemplates their experience of practice as a means to uncover or discover knowledge used in practical situations through analysing and interpreting recollections of the activities engaged with. I told them that not only does reflection-on-action increase a practitioner's knowledge but it also challenges the person's existing concepts and theories that they hold (Bolton, 2001).

I informed them that they would experience both forms of reflection as they engaged with the group projects, but that the reflective process to be enacted by me both privileges reflection-on-action and would require a time-commitment from them to engage with the process because

> [t]he concept of reflection-in-action only carries a clear meaning when the action is fairly rapid; because once the pace becomes slower there can be no clear distinction between when reflection is in action and when it is on action. Thus speed of thought and action emerges as a critical variable when considering the nature of expertise [where] deliberation is important in professional work, indeed essential for maintaining its quality. Hence a major problem for all professionals is making sufficient time to engage in deliberative as well as rapid and intuitive modes of thought and action. (Eraut, 1994, p.23)

I described what I considered were the benefits to be derived by the students' engagement with such reflective practice, if they were prepared to make the time within their practice to reflect on actions taken. I told students that I regard '[t]eaching students to track their own progress and continually reflect on their growth is essential to their learning and to the teacher's ability to keep tabs on every student's learning' (Sackstein, 2015, p.29) as a means to support their learning.

I stressed that I perceived Reflective Observation as an important learning mode within the enacted curriculum. I explained that students should undertake Reflective Observation as a means 'to reflect on and observe their experiences from many

perspectives [and to create] concepts that integrate their observations into logically sound theories' (Kolb, 1984, p30). As such, I emphasised that reflection is not only beneficial in playing a role to ensure that students engage in learning activities but it is also helpful in self-assessment by students. I also told students that it was important to be aware of both types of reflection as both contribute to their capacity to develop their knowledge and ways of knowing within the practice of Software Engineering. Finally, I told them that they needed to make time to engage properly with the process of reflection-on-action.

9.2.2 The Reflective Process I Enacted

One approach to engage students in the practice of reflection-on-action is to require the students to maintain a weekly Reflective Journal (McGuinness, 2007). Within such a process students are encouraged to complete their journals outside of class so as to have time and space to engage in focused reflection and to adequately convey their thoughts in writing. Benefits of this approach are that students reflect on their experiences and identify areas in which they can improve. However, there are limitations to this unstructured approach in that students may not understand the reason for reflection or resent the effort required (McGuinness, 2007).

The idea that students complete the reflective journal outside of class appealed to me but taking McGuinness's observation on board, I wanted a reflective process where the students clearly understood the purpose of the reflection and that the process would be seen as an enabler to their learning. I also wanted to create a process which acknowledged the importance and nature of the group projects that I required the students to engage with. These group projects take place over a period of weeks, involve teams of students, and require many different (individual and shared) tasks to be undertaken to complete the project. I wanted to design a reflective process that would allow each student to firstly, reflect on the different tasks as they engaged with each task over a period of hours, days, and/or weeks. Secondly, at the end of the project I wanted the students to retrospectively reflect on the experience of the whole project itself.

For the first part of the process, to reflect on tasks undertaken as part of the group project, I identified an alternative approach to the unstructured Reflective Journal process in favour of an approach that I experienced myself as a learner. I decided to employ a Reflective Process Template that guides each student through a structured Reflection Process after undertaking a piece of work or task, while still requiring the student to complete the written reflection in their own time. I first encountered this approach when studying for the *Postgraduate Diploma in Higher Education*. I personally found that the approach engaged me. I had to reflect on both the individual and group tasks that I undertook. The fact that I had to reflect on group tasks, kept me focused as I participated in the actual group work. I felt I needed to understand the group work in order to be able to reflect on the work and my own role within it.

Based on my own experiences as a learner on the *Postgraduate Diploma in Higher Education*, I designed my own Reflective Process Template which I called the *"Learning Log"*. I asked each student to employ the Learning Log and consider the following points as they reflected on their participation within the group project:

    i.   *The amount of time you spent on this piece of work,*

    ii.   *Your area or tasks of responsibilities in the context of the group's and your own goals for completing the assignment (e.g. what were you trying to achieve in this session),*

    iii.   *Your contribution (role and content) to the group-work,*

    iv.   *What did you learn?,*

    v.   *How did you learn (e.g. individually by referring to a text-book, or by asking group-members/lecturer, or by receiving feedback on work done from group-members/lecturer)?,*

    vi.   *Describe any feedback received and how you acted upon that feedback, and*

    vii. *Identify and justify any Interpersonal Skills you employed.*

In planning this process I did not wish the learning log to be a collection of individual and unconnected reflections at certain points during the student's learning. I explained to students that effective participation in the reflective process requires observation and contemplation throughout all the activities of the learning process. I made it clear

to them that they should not treat reflection as an additional and separate learning activity to be undertaken but rather perceive it as an integral part of the learning process as they negotiate meaning with me and their team members.

I also disclosed to them that there was a second part to the Reflection Process that I wished to enact. On completion of each project I wanted them to reflect on their overall experience of engaging in the group project. In doing so, I explained that I required them to further reflect on the content of their individual learning logs and the work products produced during the group-work to self-assess their learning against identified predefined criteria for each project. These criteria were given to the students at the beginning of each assignment as a means to both structure and assess the group work. I required that this Final Reflection should be essay-based and should address the following points:

1. *Restate in your own words what the assignment asked you to do.*
2. *Discuss your group's and your own processes for completing the project/your task. Reference your group's and your individual achievable goals.*
3. *Individually justify the assessment criteria you awarded yourself by providing suitable evidence/examples from your Learning Journal. Also, where appropriate, identify the criteria in which you can improve, explain why and how.*
4. *As you reflect, consider*
    i. *What did you learn?*
    ii. *How did you overcome challenges?*
    iii. *What would you do differently the next time?*

The assessment criteria, discussed in Chapter 10, for each project are included in both Appendix K and Appendices O to S inclusive.

In describing the Reflective Process to students, I explained that Software Engineering is considered a professional practice (Schön, 1983). I informed them that learning to become a software engineer, who engages meaningfully with practice, depends on their 'ability to be critically reflective' (Sullivan *et al.*, 2016, p.24). To be critically

reflective, I told them, requires that they think deeply, purposely, and deliberately about one or more elements of their practice as they search for insights and improvement.

9.3 Findings and Reflection: On Helping Students to Reflect

I now present my findings and reflect on the actions that I took to help students to reflect. In doing so, I draw on both my own experiences and students' experiences of how I transformed my practice to help students to reflect on their learning within the enacted curriculum.

9.3.1 Students' Experiences of Reflective Practice

Students found the concept of Reflective Practice to be 'brilliant…[y]ou're constantly looking back on what you've learned and what you're intending to do with it, so it was excellent idea' (Anne, Interview 4, March 15th 2017). The 'revising thing was almost key to why I said it was brilliant' (David, Interview 4, March 15th 2017). The students considered that the process of reflection was 'a good learning experience' (Amy, Interview 1, 20th April 2018).

9.3.1.1 Students Engaged with the Process of Reflection

Students found that 'reflections can be more tricky, because they do require a certain mode of analysis about how you felt you've done, and that's not always easy to do' (John, Interview 2, 14th March 2017) but nevertheless found the process of reflection to be beneficial because they were 'reflecting on what you've done, how you've done it, is there any way you can do it differently… and I won't make that mistake again' (Anne, Interview 4, 15th March 2017).

Reflection encouraged students to think deeply on their own interpersonal and small group skills as they participated within the group projects. For example, students learned that different team members may hold diverse positions on particular issues requiring them to compromise by deciding 'we'll meet half way, we'll do it this way' (Sam, Interview 2, 20th April 2018). Other students reflected on pieces of learning

that they had missed or experiences that they did not fully understand to determine if 'I could have been… better, and then know that I have to put effort [in] to get …better' (Bernard, Interview 1, 20th April 2018) by comprehending what they are trying to learn or do.

Students expressed the need to formally reflect on a regular basis was an important part of the process. They found that

> because you are reflecting every week about what you are doing, I think you did start to think about it a bit more, and I think that definitely helped you understand [the subject and project]. (John, Interview 2, 14th March 2017)

Reflection itself was deemed to be more than just writing but the writing itself was considered a crucial and important element in 'getting all my thoughts for that week all down in one place' (Jacob, Interview 2, 20th April 2018). Students found that having recorded and written reflections allowed them to revisit and revise previous thoughts which in turn prompted them to 'think, hang on a sec… I haven't thought of that point that we covered, I can't remember it properly, so I'd go and look it up again or …ask about [it] ' (Jacob, Interview 2, 20th April 2018).

Students acknowledged that any learning or benefits reaped from the reflective process must be grounded in honesty because 'you're just kidding yourself if you're not being honest [if you are] hoping to sort of gauge how [you] could do something better, if there was a case to do something better' (Mark, Interview 3, 15th March 2017). However, in trying to comprehend how to improve, students sometimes found 'being honest about yourself with yourself isn't the easiest thing in the world. That's where I struggle, anyway. (John, Interview 2, 14th March 2017).

Students found that the enacted curriculum both supported and made it easier for them to be honest in their reflections. Students felt that my review of their Learning Logs, at the beginning of each facilitated class, encouraged an honest reflection from them which built trust between the student and lecturer because

> another plus… was the fact in the reflection that you could be honest. Like the fact that you [the lecturer] never came to us over it or anything like that, or criticized us about it. Which I felt was a bit of a trust between student and lecturer as well... Didn't really want it to be overly honest…you don't want to think that you're saying something wrong. The main thing I felt from it was that bit of trust between lecturer and the student. (Ronan, Interview 3, 15th March 2017)

The purpose of the learning log was seen by students as a means to support and actively engage, through reflective writing, with their learning and learning processes. It was seen as part of an overall process where '[y]ou have to do some work, and then you have to reflect in your learning log what you learned, what you did, what you did well, what you didn't do well' (Nigel, Interview 2, 20th April 2018). Using the Learning Log as a tool to aid reflection was seen as a process of

> self-checking. Know when I wrote my reflection at the end of the week, I had to think what exactly we did. What was wrong. I had to figure out what was wrong, and I had to find out why it was wrong. So, that's how it was helpful in the entire process …In reflection, I was evaluating the reasons, for example, why. Why, if it went wrong way, like it happened in our first bit, if it went wrong way, why it went wrong way? So like targeting the issue.' (Dillion, Interview 1, 20th April 2018)

In essence, the written learning log was considered to be 'a list effectively of what you've done, what you've learned' (John, Interview 2, 14th March 2017) and 'keeps you all the time reflecting on what you've done, how you've done it, [and] is there any way you can do it differently' (Anne, Interview 4, 15th March 2017). Within their learning logs students 'looked back [and asked] what did I learn this week?' (Eoin, Interview 4, 15th March 2017).

As well as keeping track of the tasks that they completed or were still working on, students reflected in their learning logs 'on how I was feeling and how I perceived what we were doing that week or … how it affected [the project] overall. It was changing every week' (Denis, Interview 3, 15th March 2017). Students expressed surprise in that they discovered that written reflection 'really enhanced my learning' (Bernard, Interview 1, 20th April 2018) because

> when you're reflecting, you didn't realize before that that you'd actually learned something. When you're sitting there writing it out, it triggers something in your head that, "Oh, I did learn something from this." It's a good way of recognising what you have learned. (Mark, Interview 3, 15th March 2017)

Not only did students realise that they had learned something through reflection but they also ascertained that 'if you didn't learn something, it pushed you to learn something because there's no point reflecting on something if there wasn't something that you could [learn from it]' (Ronan, Interview 3, 15th March 2017).

The concept of reflection meant different things to different students. For some, reflection should only summarize what you learned because '[i]f you focus on your feeling[s]… your knowledge will be affected. That's my problem' (Amy, Interview 2, 26th January 2018). Others disagreed with this sentiment believing that feelings are an integral part of learning through reflection. They considered reflection is more than just compiling your experiences and what you did but must also address 'how you feel you might need to change… or if you're comfortable' (Brendan, Interview 2, 26th January 2018) with what you are currently doing. However, they acknowledged that '[s]ometimes it's really hard for me to find some feelings… I need to think about it' (Dillon, Interview 2, 26th January 2018).

9.3.1.2 Mixed Views on the Need for a Written Learning Log (Reflection)

If given the choice, a small number of students would not have taken the time to write and record their reflective thoughts as they 'never really cared for that sort of thing' (Jack, Interview 1, 14th March 2017) or because 'I'm not somebody to express my feelings at all' (Denis, Interview 3, 15th March 2017). Some 'felt like we were going on and on' (Mary, Interview 1, 14th March 2017) as they recorded their thoughts. Others reckoned that it was just an academic requirement that was a 'kind of burden to have to do it the end of the week' (Jack, Interview 1, 14th March 2017) because 'I considered you [the lecturer] needed that information but [not] me' (Bernard, Interview 1, 20th April 2018). A minority of students considered that the 'time when we were writing… is such a burden, like 20 minutes' (Emma, Interview 1, 14th March 2017). Others thought that it would be sufficient to just make 'a mental note of after

you reflect, just thinking in your head, "Okay. I could do that better." Make a mental note of it. That would be enough for me' (Brendan, Interview 1, 20th April 2018).

But at the same time these students recognised there were benefits in engaging with a written reflective process. These benefits ranged from recognising that 'there are certain things that I learned looking back [and it] makes you structure your week ahead' (Jack, Interview 1, 14th March 2017), to observing that the written reflections provided me as a lecturer with a means to support and 'see how students are doing' (Emma, Interview 1, 14th March 2017), to acknowledging that regular reflection encourages students 'to do certain things…enhanced [their] learning…as [they are] working on things in order to say, "Okay. I missed this. How can I do this better?"'(Bernard, Interview 1, 20th April 2018), to discovering that their reflections 'actually really reflected on how I was feeling and how I perceived what we were doing that week' (Denis, Interview 3, 15th March 2017).

However, students highlighted that the Learning Log Template, at times, stunted both their ability to engage with meaningful reflection. On occasion, students felt that employing the Learning Log Template became difficult and ineffective because of the requirement to address and reflect against a set of predefined questions. They found that it was difficult to reflect within the context of set individual questions because at times they were 'flying through bits of the project, and then you have to try to reflect on all that. It's hard to think of it sometimes…[s]ometimes you're just writing crap, to be honest, into the reflective journal' (Sam, Interview 2, 20th April 2018) just to satisfy the requirements of completing the log as part of their participation within their group-work and to tick a box from an assessment requirement perspective that required the learning log to be regularly updated. Also, students regarded the Learning Log Template as ineffective and 'almost redundant at times. I felt like I was kind of repeating myself in places, but maybe that was just the section I was working on' (Brendan, Interview 1, 20th April 2018).

Students suggested potential improvements to the format of the Learning Log. Some suggested that they 'would do it my own personalised way. I wouldn't maybe… have the set of… questions' (David, Interview 4, 15th March 2017). Others suggested that the set of questions be retained but switch the order of the questions where the 'first

heading should be, in my opinion, maybe I'm wrong, first heading, what you did and then what you learned' (Nigel, Interview 2, 20th April 2018). Finally, other students recommended that the design of the Learning Log Template should be flexible to cater for the 'points which I'd feel were important and didn't fit under any headings' (Jacob, Interview 2, 20th April 2018).

Finally, one student, recognised that writing was not always a necessary catalyst to engage in reflection. Bernard had determined reflection does not require a person to record their thoughts. He experienced both reflection-on-action without writing down his thoughts by sitting 'down in a room and run[ning] things through my mind about how I could have done something better and all that kind of stuff' (Bernard, Interview 1, 20th April 2018) and reflection-in-action while programming (writing computer code) when errors started to suddenly appear

> in front of me. … I reflected on it… for me it was really in that moment that it hit me. Okay this is what you shouldn't do the next time. This is the kind of things you look out for the next time… (Bernard, Interview 1, 20th April 2018)

9.3.1.3 Reflecting on Multiple Ways of Knowing

Throughout both projects, students reflected on the ways of knowing that they both developed and employed as they navigated through each project together with their team members. Communication and dialogue were perceived as common characteristics within the various ways of knowing employed. Many learned through 'talking to my team mates' (David, Semester 1 2016-17, Learning Log) which in many cases generated 'an idea… of the things I would have overlooked' (Jack, Semester 1 2016-17, Learning Log). Talking to team members might involve discussion 'with the group in detail about the topic and by asking group members questions whenever I felt unsure about an opinion' (Peter, Semester 1 2016-17, Learning Log). Students 'learnt by carefully thinking through the points… listed in the [project] brief, and discussing my opinions with my group members' (Bernard, Semester 1 2016-17, Learning Log).

The students employed other ways of knowing in their interaction with both me and the material that I made available to them through the Virtual Learning Environment

(Moodle) and within the classroom. 'Listening and taking notes during [class] gave me some ideas on how my group should go about' (Bernard, Semester 1 2016-17, Learning Log) engaging with the project. Students also reflected that they learned directly 'from the lecturer [for example] the different ways… an assignment can be approached' (Jack, Semester 1 2016-17, Learning Log). Additionally, many students recognised that 'receiving constructive feedback from my teammates [or] feedback from our supervisor' (Peter, Semester 1 2016-17, Learning Log) was crucial in how they learned within the context of the enacted projects. In most cases, the 'feedback we received…was positive' (Jack, Semester 1 2016-17, Learning Log).

Students engaged with ways of learning that I never promoted within my practice. Students relied on 'YouTube videos to help me understand anything I was struggling with' (Liam, Semester 1 2016-17, Learning Log), 'searching the Internet' (David, Semester 1 2016-17, Learning Log), and 'by having the ability to share our work via [a] shared document' (Peter, Semester 1 2016-17, Learning Log) as ways of engaging and understanding the reality of their projects.

9.3.2 My Experiences on Helping Students to Reflect

I now describe and reflect on my experiences on helping students to reflect during this inquiry.

9.3.2.1 I Had to Learn to Reflect Myself

Being a reflective practitioner is a central part of this inquiry and my practice for both myself and students. I have learned that I needed to first be able to reflect on my own practice, if I was to help students reflect on their learning.

As I have engaged with the various action-reflection cycles of this inquiry, I have found that '[r]eflective practice is the counterpoint to action in action research inquiry' (Hartog, 2018, p.230) and is an essential part of the process of self-inquiry and transformation. Reflection has provided me with the means to pay attention to what was unfolding within my pedagogical practice, where each action I took within each situation that I found myself in turned into a learning opportunity. I found that

reflection required a commitment from me to get inside my own experiences. It helped me to see and speak about my experiences. Reflection also provided me with the opportunity to look forward as I tried to imagine the implementation of a specific course of 'intelligent action' (Biesta and Burbules, 2003, p.8) as I thought about how best to transform my practice. Within this inquiry, reflective practice has become for me a form of

> empowerment [that] is about individuals coming to know, express and critically analyse their own realities and having the commitment, will and power to act and transform these realities to enhance personal and collective well-being, security, satisfaction, capability, and working conditions. (Ghaye, 2000, p.79)

It has involved me using reflection-on-action by looking back at some event and analysing it, engaging with theories of practice or different approaches. It required that I examine these items from different perspectives with the aim of trying to explain the situation to myself. I have discovered that engagement with reflective practice generates knowledge which acknowledges the human condition and relationships between people. These, I discovered, are fundamental attributes of any type of practice.

Schön (1983) suggests that such knowledge constructed through reflective conversation is both unique and changeable within the situated context of practice. For me this type of knowledge incorporates personal or tacit knowledge about my practice and is generated through my (human) endeavour as I engaged with this action research project (Polanyi, 1962; 1966).

9.3.2.2 I need to Enact a Better Reflective Process

During the writing of this thesis, as I analysed students' experiences of engaging with reflective practice and reflected on my experiences of the Reflective Process that I enacted within this inquiry, I recognised that I did not engage fully with Schön's (1983) theory of reflective practice. In the Reflective Process that I used in this inquiry and enacted within the curriculum, I emphasised and focused on reflection-on-action to the explicit detriment of knowing-in-action and reflection-in-action. However,

Kinsella (2010) suggests that practitioners who engage with reflection-in-action regularly develop their knowing-in-action expertise or competence. In thinking about this observation I now realise, for both myself and students, I should have equally valued knowing-in-action and reflection-in-action within the reflective process I enacted because in real-world situations practitioners also

- need to be quick thinking by reflecting on an event or problem immediately to determine a solution, and/or
- may not have the time to engage in reflection after completing an activity.

In thinking about how to equally value the three aspects of Schön's (1983) theory of reflective practice: knowing-in-action, reflection-in-action, and reflection-on-action, I have identified an improvement that I could make to both the Learning Log template and the Reflective Process that I enacted within this inquiry. The improvement that I propose would be to structure the Learning Log and Reflective Process as follows:

- Part 1: Focus on your knowing-in-action to think about the intuitive or tacit actions that you know how to conduct effortlessly and without thought as a means to identify the taken for granted assumptions that you have with regards to your professional knowledge and skills,
- Part 2: Describe any reflection-in-action you might have had after the event as a means to think about how you acted and responded to that action in practice, and
- Part 3: Focus on reflection-on-action to retrospectively describe what happened, your own interpretation of events, and how you might change your behaviour in the future.

In making this improvement, I would also take on board the students' experiences of using the Learning Log template during this inquiry by not including a set of prescriptive questions to guide the writing of their reflection as I have now recognised that the questions asked in the existing Learning Log template, not only hampers students' ability to reflect, but also privileges and encourages students to engage with reflection-on-action.

I have also learned that the next time I engage with an action research inquiry that I need to be equally attentive to knowing-in-action and reflection-in-action as well as reflection-on-action as I engage with a reflective process as a means to learn about my professional practice as I take action to improve what I do. I now understand that such an approach to reflection will allow me (and students) to develop new ways of working and that these new ways of working will eventually become intuitive (Kinsella, 2010).

Chapter 10 - Third Action-Reflection Cycle: Developing Assessment Methods

10.1 Introduction

In this chapter, I asked myself *"How can I improve my pedagogical practice to develop assessment methods which value tacit Software Engineering knowledge?"* As my assessment of learning (Bloxham and Boyd, 2007) practices remained unchanged from past practice during this inquiry, in this chapter I focus on the actions that I took within the enacted curriculum to engage students in both formative and self-assessment. I describe and explain how I designed formative and self-assessment processes to take into account that students participated reflectively in the process of group work to jointly produce a work product representing their solution to a given software engineering problem. Finally, I present my findings and reflect on the actions taken. In doing so, I draw on my own experiences of practice as well as the students' experiences of assessment within the enacted curriculum.

10.2 Taking Action - How can I improve my pedagogical practice to develop assessment methods which value tacit Software Engineering knowledge?

In taking this action to develop an assessment approach to value tacit software engineering knowledge, a concern I had was:

> how to value tacit knowledge within the assessment process…A learning process within which people passively acquire knowledge has a relatively straightforward assessment process that closely aligns to the learning process. All knowledge to be assessed is closely defined as an explicit input into the learning and assessment processes. No other knowledge is assessed. However, where learning is social and where individuals construct their own knowledge and meanings, from experiences it is not possible to identify, upfront, all knowledge acquired within the learning process and hence the assessment process must be dynamic and adaptable to recognise and value the construct of knowledge generated by individuals as they engage in social activities in the pursuit of joint enterprises….This is the challenge for me. (Research Diary, 28/8/2017)

I identified that each individual learner should engage with both formative and self-assessment as they are best placed to determine what they have learned from their experiences of engaging with group-work. Such formative and self-assessment requires student involvement in the assessment practice, through reflective practice and discussion of participation, and is classified as 'assessment as learning [which] is a subset of assessment for learning' (Bloxham and Boyd, 2007, p.15).

The assessment context I enacted required students to engage in a process of group work to produce intermediate and final work products developed as part of a solution to the problems given in both Semester 1 and Semester 2. A detailed discussion of these projects can be found in Chapter 8. Within this context, I determined that '[b]efore students can assess themselves, they must understand the criteria against which they will be judged' (Sackstein, 2015, p.16) for the learning engaged with. To ensure that this happened, I identified the need to develop a set of project-specific criteria, discussed below, for each of the two projects that students undertook.

Within this context, the *National Framework of Qualifications* acknowledges that

> [i]t is also important to note that not all forms of learning that contribute to enabling a learner to perform in context can feasibly or reliably be captured by the assessment methods available. While such learning is important, and may be part of the desired learning outcomes for a programme of education and training, it cannot be compared against standards and as such cannot form part of the award standards for the inclusion of awards in the Framework. (QQI, 2016, p.21)

In thinking about the statement that *"not all forms of learning that contribute to enabling a learner to perform in context can feasibly or reliably be captured by the assessment methods available"*, I set about constructing an assessment approach that would allow students to recognise that the forms of learning or knowledge that may not be reliably measured within the context of standards-based education may still be employed to inform the assessment process.

Of particular concern to me was how I could assess the tacit software engineering knowledge generated by the 'forms of learning' (QQI, 2016, p.21) that may not be reliably measured, as tacit software engineering knowledge is knowledge that has yet

(if ever) to be converted into an explicit form (Sternberg and Hedlund, 2002). I felt that assessing tacit software engineering knowledge was difficult because it resides within a person's mind as it is acquired 'from direct experience and accomplishment' (Mohammad and Al Saiyd, 2012, p.113). Essentially, such knowledge is the product of a person's mind, skills, and experiences. However, I figured out that while tacit software engineering knowledge is difficult to articulate and retained by people in their head, it can be shared, and therefore potentially assessed or at least inform the assessment process, in a less tangible form to explicit knowledge through storytelling, interactive conversation, and/or shared experience (Sunassee cited in Mohammad and Al Saiyd, 2012).

Based on these thoughts, in developing the assessment methods, I decided that each student must have an active role to play within the assessment process. I wanted each student to bring their experiences of and reflections on group work to bear on the final assessment grade awarded. To ensure that this happened, I envisaged that the assessment process would involve dialogue (both written and verbal) between students and I as we negotiated together the grade to be awarded. In addition, I felt that in taking action to develop the assessment methods that I must recognise that each student is required to participate in both group and individual activities as they work on each project.

It was these thoughts that influenced how I took action to structure the assessment process and design sets of assessment criteria for each project.

10.2.1 The Assessment Process

I wanted the assessment process to evaluate both the explicit and tacit software engineering knowledge learned by both individuals and groups as they experienced the enacted specified curriculum. I no longer wanted the assessment practice to be enmeshed within an epistemology that privileges individual and explicit knowledge but ignores tacit and group knowledge.

This lead me to design the enacted assessment practice to both distinguish between *knowledge* as a possession and to consider what is part of action as *knowing* (Biesta and Burbules, 2003, my italics). It is the creation and use of this 'knowledge set in human minds, skills, expertise, and intuitions of the individuals' (Mohammad and Al Saiyd, 2012, p.110) that I took action to value in formative and self-assessment activities. In making this decision, I recognised that I could not assume 'task stability' (Murphy *et al.*, 2008, p.160) within each assessment that I enacted.

I spent time at the start of the enacted curriculum to explain to the students both the purpose of and how to engage with the assessment process. I described the different forms of assessment (Bloxham and Boyd, 2007) to be employed within the enacted curriculum that allowed for both explicit and tacit software engineering knowledge to be privileged within both their learning and assessment activities. I explained how assessment of learning (through the written examination) would assess the explicit knowledge or concepts that an individual acquires while both assessment for and as learning would access tacit skills attained by the individual as well as the explicit and tacit knowledge attained by groups.

10.2.2 Integrating Assessment into Learning Activities

Within the context of formative and self-assessment activities, I emphasised to the students that they must work and learn together, as this is reflective of authentic software engineering practice for which they are being educated. I was very clear from an academic perspective that I am required to grade students according to Athlone Institute of Technology's Standards, Assessments, and Awards (AIT, 2010) process which states that any assessment of

> group activity accounts for the possibility that not all learners/group members necessarily attain the same standard of learning or not all contribute equally to the work of the group (this is defined in the programme assessment strategy). Where two or more learners present a joint project, the individual contribution and performance of each learner is assessed, and individual marks are awarded accordingly. This does not preclude assessment of the group's achievement of a group outcome, nor does it preclude formative assessment of a team, and formative feedback to the group. However, unless otherwise specified in the module descriptor/assessment strategy, the assignment is awarded a single mark

> or grade, applicable equally to every member of the group. (Athlone
> Institute of Technology, 2010, p.21)

I described and presented Cooperative Learning (Chapter 8) as a way to enact and model group work within my practice which is compatible with this assessment requirement put in place by Athlone Institute of Technology. I reiterated that a key component of Cooperative Learning is the requirement for individual accountability within the group which requires that learners demonstrate their own learning and contribution to group-work which allows for both their own grades and group grades to be awarded. Within this context, I enacted the project assessments around 'a broad task [that provides] the catalyst for learning to occur' (Lankshear and Knobel, 2008, p.170).

I undertook the following actions in designing and assessing the catalysts (the group projects) to be undertaken in each semester:

1. *Identified the learning outcomes to be achieved,*
2. *Specified an authentic software problem (Newsagent Management Application) to enact the learning outcomes,*
3. *Divided the authentic software problem into two distinct, but related, parts or projects: User Story Specification (Semester 1) and Implementation of the Scrum Process (Semester 2),*
4. *Scoped each project so that individual tasks can be identified and assigned to each student,*
5. *Scoped each project so that individual tasks must interface with each other, requiring cooperation from students with each other,*
6. *Scoped each project so that learning could be assessed or graded at various discrete points during students engagement with the assigned authentic software problem,*
7. *Developed specific Assessment Criteria for each project,*
8. *Emphasised the need to engage with the Assessment Criteria for each project to guide both the engagement with processes of working on the project and the work product(s) produced,*
9. *Built learning logs, reflection, group and self-assessment into the activities for each project,*

10. Facilitated the group-work throughout each semester, and

11. Negotiated individual/group grades within a facilitated group discussion based on evidence (my observations of group work, student learning logs, student reflections, assessment criteria, and discussion).

To ensure fairness within the assessment process, I told students that I would not tolerate any *"hitch-hikers"* participating within a team. Firstly, I required each team to develop a working agreement or contract outlining the agreed rules which team members would follow as they worked together within their respective groups (Ashmore and Runyan, 2015). Secondly, I spoke with the class around my expectations of them as they worked together and, in particular, how each would be individually and group assessed in an assessment process that relied on formative assessment, self-assessment, and discussion with me and their team.

To support the implementation of the assessment process, I informed students of the need to maintain learning logs and engage with a reflective process (Chapter 9) as a means to both develop competence and provide evidence for the assessment process while at the same time employing the given assessment criteria to direct engagement and appraisal of the group project while working on the project itself.

I included a process of negotiation within my assessment practice to encapsulate values of justice, democracy, and care as the students and I came together to respectively agree on the learning achieved and identify, if needed, what additional learning is needed. I decided to base the negotiation on the evidence and experiences of each person (student and myself) captured in our respective observations and reflections (including students' self-assessments) of the work undertaken until mutual agreement was reached. I concluded that this is a valid way for me to meet the requirements of the *National Framework of Qualifications*, as it is the democratic negotiation that determines reliable individual and group grades for the students based on a shared consensus, informed by each individuals' learning experiences.

10.2.3 The Assessment (and Learning) Criteria

In each semester, I developed learning and assessment criteria specific to each project. In the first semester, I created two sets of criteria (Appendix K) to provide guidance on and assessment of the *User Story Specification* project. In the second semester, I constructed five sets of criteria (Appendices O to S) to provide guidance on and assessment of the different phases in the *Implementation of the Scrum Process* project. I gave each set of project criteria to the students at the start of each project to provide a framework within which to engage with the assignment and to think about the nature of the knowledge needed to complete the project. I employed the assessment criteria within the facilitation process as a means to focus the discussion and feedback with students. At the end of each project, each set of criteria provided the basis for the students' self-assessment of the learning that occurred as a result of undertaking each project.

For each individual criteria, I provided three detailed descriptions of what the group and/or individual students can aspire to as they work to meet the specified criteria. Ideally, each group and student should strive to be *well-achieved* in each individual criteria, and if unable to, should then ensure that they are *achieved*. I told the students that I would be concerned if they were *not-achieved* in any criteria, provided that there were no exceptional circumstances to consider. After completing the work, each student was required to self-assess both the group and their individual work by determining whether they are *well-achieved, achieved,* or *not-achieved* for each criteria and providing a justification for their choice. These completed self-assessments then formed part of the evidence in the discussion where individual and group grades were discussed, negotiated, and agreed.

10.3 Findings and Reflection: On Developing My Assessment Methods

I now present my findings and reflect on the actions that I took to develop my assessment methods. In doing so, I draw on both my own experiences and students' experiences of how I transformed my practice as I developed assessment methods within the context of the enacted and experienced curriculum.

10.3.1 Students' Experiences of Assessment

The overall experience students had of the assessment process was that it was challenging and 'tough in terms of we had a lot of deliverables but it felt fair. We were trying to meet these deliverables and we never felt hugely stressed by them' (Jacob, Interview 2, 20th April 2018). They thought that the assessment process was designed to supplement and support their learning with 'the marking scheme structured and… focused more on [the] marks of your work [i.e. the group projects] than the exam' (Bernard , Interview 1, 26th January 2018). The students liked this approach because the 'marks are distributed all the way along, so you don't have risk of haemorrhaging marks at the very end' (John, Interview 2, 14th March 2017). However, the students struggled to award themselves a 'honest mark out of 10' (John, Interview 2, 14th March 2017) when assessing themselves against the assessment criteria for each project in preparation to discuss, negotiate, and finalise their grade with me and in the company of their team members.

10.3.1.1 Self-Assessment Challenging and Difficult

Students experienced that the self-assessment aspect of the assessment process itself to be very challenging because 'we were assessing ourselves within the group, which was difficult because we were trying to work as a team, not individually' (Anne, Interview 4, 15th March 2017). They found reflecting on and writing-up their self-assessment, using the provided assessment criteria, to be time-consuming due to the desire to 'write a sentence … that will be understood the way I want it to be understood' (Anne, Interview 4, 15th March 2017).

In writing their self-assessments, students had a number of difficulties with the actual format and structure of the Assessment Criteria sheets (Appendices O to S) employed during Semester 2. Students felt that these 'self-assessments, they were long-winded' (David, Interview 4, 15th March 2017) and repetitive because there was an overlap between what was being asked of them within the Learning Log Template and the self-assessment Criteria Sheets. 'Sometimes, it was very repetitive. You were tracking back on what you were saying' (Peter, Interview 1, 14th March 2017). It was suggested that I make both 'one thing. The [self-assessment] justification is the same as the

learning logs, every week, so I actually wrote what I had written [in] the previous weeks' (Emma, Interview 1, 14th March 2017).

Students struggled to relate to the questions asked within the self-assessment criteria sheets in the belief that the criteria were not clear, tedious and demanding to answer

> because you… sort of say to yourself, 'Did you achieve that in your groups?' We did, but there were hiccups along the way. We still finished it at the end of the day, and you have evidence to back it up, sort of. Of course, on the other hand, there's evidence to take it down too. So, you're sort of between both the whole time….With regard to what had been done, in my opinion, it was some of the points are unclear on the self-assessment. You delivered. You did deliver. You achieved it well, if you delivered it on time. But, they could have been clearer, but they weren't. Were well delivered, but to get that delivery, was the question. They weren't awfully clear in that end. …Just the criteria wasn't well written. It could have been a little bit clearer. (Jack, Interview 1, 14th March 2017)

10.3.1.2 A "Honest Mark Out of 10"

Students accepted that the starting point in negotiating grades with me was that each student must have completed the relevant self-assessment criteria sheets before any discussion with me. Within this context, students queried their own ability to self-assess particularly when there were grades at stake. They questioned if they had the skill-level required to undertake self-assessment itself and if they could be honest in that process:

> [f]rom the point of view for the amount of work you put in, I think it's good that you grade yourself, but on the other hand, it's not a fair reflection because I could have done X, Y, and Z and it could have been arse-ways…If you've done a job, and you think you've done it correctly, even though it could be wrong, do you mark yourself 10 out of 10? More thinking went into that one. You over-think it and you want to be honest, but you also want to be great, do you know what I mean. (David, Interview 4, 15th March 2017)

Every time students had to engage in self-assessment, they constantly struggled to award themselves a 'honest mark out of 10 [because] you always think you did better than maybe you really did. Finding that level of honesty is a difficult process' (John, Interview 2, 14th March 2017). Throughout the self-assessment process, students

continually grappled with this idea of a "honest mark out of 10" because 'you're very conscious of not being overly honest to lose marks, even though we shouldn't be mark-orientated, but we are. Because we all want to get over the threshold' (Mark, Interview 3, 15th March 2017).

Another aspect which worried students was, if they were overly honest in grading themselves, how could they be sure that their team members would 'honestly grade themselves. I think they're always going to put that bit more onto it' (Ronan, Interview 3, 15th March 2017). This concern was driven by the fear that when all team members were assessing the same aspect of the work undertaken 'you might put "barely achieved" … they might say oh, it's actually "well achieved". Then it's clash there. It's kind of like thinking are they feeling the same way as I do but also trying to put that in an honest way (Anne, Interview 4, 15th March 2017).

However, the students' experience of negotiating grades and their concern over their ability to be honest with themselves was alleviated in the discussion with me because they observed that I 'can honestly tell if we had doubts ourselves' (Sam, Interview 2, 20th April 2018). Over time, due to the nature of the assessment process and how it evolved, the students felt that 'there wasn't much focus on the mark' (Amy, Interview, 20th April 2018) in the negotiation and the grade became a secondary concern because

- 'everyone was consumed by that work. Group work. So much that no one really cared [about] marks (Dillion, Interview 1, 20th April 2018),
- they observed that 'my group, we wanted to make it work. We knew at the end of the day, if we could get things ready and be done, then we should get a good score' (Bernard, Interview, 20th April 2018), and
- they encountered that 'there was more frustration when the product didn't work. We weren't worried that we're not getting the marks, but more of why is the product isn't working. So there wasn't much focus on the mark' (Amy, Interview, 20th April 2018).

For students, the mark became just one more element within the assessment process and was considered by students to be a form of feedback to be reflected upon because

they discussed with me where 'we lost our marks [and] that was where we looked to improve for the next [part of the assessment]' (Jacob, Interview 2, 20th April 2018). In receiving feedback the students accepted that 'the mark worked because a lot of it's conceptual … it's not just static answers, it's not like math or something where it's either right or wrong. Just a lot of grey area' (Sam, Interview 2, 20th April 2018).

10.3.1.3 The "Hitch-Hiker" Dilemma

Students felt they had received clear direction from me in relation to the "hitch-hiker" dilemma that could occur within teams. Students acknowledged that I would not tolerate hitch-hikers and that I made this position clear to them when I introduced the 'self-assessments at the start of this semester, [you said you] would know from the self-assessments who the hitchhikers were. So that made people think then' (Ronan, Interview 3, 15th March 2017). 'I have to do the work. I have to do the work now' (Denis, Interview 3, 15th March 2017).

However, '[t]here was still hitchhiking being done, but- not as much. Not as much. But it was still done. …' (Denis, Interview 3, 15th March 2017). Some students would have liked to have seen the hitch-hiker's

> learning logs and their reflections to sort of see what they'd written. Just because one, I'm nosy, I'd just like to see how they've covered their tracks. But again, I think the meetings that we had every Tuesday where you would come round and talk to every group, whether we had learning logs, self-assessments, reflections, even from that, you can gauge who's [not participating]… people… talk, and they'll talk knowledgeable. Others will just shuffle their feet. (Mark, Interview 3, 15th March 2017)

Some students tolerated hitch-hiking in order to compete the work because 'I did have to carry people sometimes and we never said anything about it…we done what needed to be done and that was it' (Sam, Interview 2, 20th April 2018). These students reckoned that the hitch-hikers 'probably did not learn as much' (Jacob, Interview 2, 20th April 2018).

10.3.2 My Experiences on Developing My Assessment Methods

I now describe and reflect on my experiences on developing my assessment methods during this inquiry.

10.3.2.1 Addressing the Issue of Task Stability within Assessment

To assess the software engineering problems that I gave the students, I developed assessment practices to assess of the negotiation of meaning that 'encompass [the] shared understanding' (McCormick and Murphy, 2008, p.11) created through group-work as students learned together. This assessment approach required learners to develop their *metacognition* through some element of *self-assessment*. Within this context, I identified that the task 'stability' (McCormick and Murphy, 2008, p.11) of the enacted assessment activities is an issue as students bring their own agency, identity and 'social, cultural and historical experiences' (Elwood, 2008, p.96) to assessment tasks, tasks requiring engagement with both participation and reification activities through which both explicit and tacit software engineering knowledge is created and used.

In this inquiry, I have transformed my assessment practice to address this issue of task stability. I have come to recognise that '[a]ssessment of learning' (Bloxham and Boyd, 2007, p.15) is not best suited to teaching and learning activities structured to negotiate meaning within a social context in a way that acknowledges and recognises knowledge as both 'dynamic and contextual in nature' (Murphy *et al.*, 2008, p.62) within the authentic software engineering problems that students must solve, problems which typically have more than one possible solution.

As students solve these real-world problems, I no longer constrain students' agency or identity by specifying major milestones as a road-map that must be met in order for the real-world problem to be solved in one particular way. This has resulted in students becoming focused on solving the problem rather than allowing their learning to be influenced by how I would solve the problem, assess and mark their work. I have learned to relinquish control in such situations and have learned to take my direction from students as they navigate through the problem based on their own experiences

and current knowledge of Agile Methodologies as they take responsibility for their own learning. This has encouraged students to no longer make strategic decisions about targeting marks in their activities at the expense of potential learning opportunities available. I consider that the introduction of formative and self-assessment has promoted this change in student behaviour.

10.3.2.2 Discussion of Grades

When meaning is negotiated, as it is in my practice, I have discovered that the experiences of each of the students are different. This observation has implications for assessment results, which 'will be essentially tentative in nature and provide only estimations of achievement' (Murphy *et al.*, 2008, p.103). To reduce, but not eliminate, tentativeness and estimation inaccuracy, I have learned that the students themselves must be utilised as a 'major source of evidence' (Murphy *et al.*, 2008, p.103) where they are required to describe their experiences which influenced their interpretation of the solutions they developed for the assessment tasks given.

To utilise students as a major source of evidence, I developed Assessment Methods consisting of many moving parts, particularly, in terms of the amount of assessment evidence collected. I employed my reflections and observations that I gathered as I facilitated the group-work as evidence to determine student and grades. Assessment evidence that students maintained included their learning logs and completed self-assessed Assessment Criteria that I provided for each project. All of this evidence provided the basis for the grading of student and group work when students, their groups, and I met to negotiate and agree the final mark.

With so much assessment evidence to consider, I found the discussion to finalise the grade to be a holistic process. While I intended that the assessment process was structured based on discussion of the assessment evidence gathered, the rest of the deliberation took on a life of its own as participants shared their own individual interpretations and experiences of the work and assessment criteria employed. This resulted in agreement on certain aspects of the project, differing opinions, perspectives on the project that I had never even considered, and the confidence amongst the students to articulate their stance even if it was contrary to the perspectives of their

other team members and even me. The final part of the process was to firstly agree a grade for the quality of the Work Product produced. Then, within this context, the conversation turned to the individual contributions made to the project resulting in a discussion to determine if all in the group were happy that all had learned and contributed equally and, if so, whether a group mark should apply rather than different individual marks.

I found it difficult after such meetings to record within my research diary the dynamics of the actual analysis and discussion that occurred. However, I do want to share with the reader an account from my Research Diary, where I reflect on what was achieved and the output from a set of meetings that I had with each group in the 2017-18 Academic Year as we jointly assessed their work for Sprint One, a project deliverable in Semester 2. This diary entry speaks for itself and provides some evidence for the effectiveness of the negotiation and assessment process. However, to really appreciate the benefit this process, I feel that it must be actually experienced.

On the 6th March 2018, within class-time, I met with each group to finalise their grade for Sprint One. Before class I had gathered my thoughts based on the evidence I had collected and made notes on my assessment of each group/individual and the marks that I would award them. In class, I discussed with each group the criteria that they employed for the assessment, their justification of the criteria, and the marks that they would award the group and themselves as individuals. After class, in my diary, I summarised and reflected on my thoughts on the discussion with each group:

> Group A1:
>
> This group is very fortunate to have a member with real-world software engineering experience. I believe this has benefited the group and individual members during their engagement in sprint one. This has resulted in a very functional and well tested demo at the end of sprint one. It is clear to me that every member of the group has learned during sprint one. The importance of test driven development, I believe, is clear to each member of the group and in particular the benefit of test driven development when it comes to creating code from scratch. It is also clear that this is the first time that this team has encountered a project of this complexity, not just from a product perspective, but also from a process perspective requiring planning, estimation, organisation, integration skills, and communication between five members to deliver a product requiring

test, Java programming, and database knowledge. However, I would recommend for sprint two and sprint three that members of the team come out of their comfort zone and maybe take responsibility for something that they haven't tried before (e.g. leading the integration effort). Maybe, the team member with real world experience might lead from behind rather than in front.

Group A2:

This group provided a very honest assessment of their activities, both process or product, for Sprint one. I agree with this assessment and would reiterate the comments that are made by the group during Sprint one. I find this group to be well organised, communicating well with each other, demonstrating the appropriate technical skills, having a clear plan of what needs to be done but more importantly each of them individually have demonstrated the capability of critically reflecting upon the work that they are engaged with. This ability to critically reflect has benefited the team and this was demonstrated through the Sprint one demo.

Group A3:

Individually this group has provided a very honest assessment of their activities, both process and product, for Sprint one. I have observed that communication and organisation are key skills that this group have mastered. In addition, it is my observation that this group consists of highly motivated and like-minded individuals prepared to work together to ensure successful delivery of the Sprint one demo. It is also clear to me from the group's engagement in Sprint one that the team's technical skills in test driven development and integration have improved which will be further improved on during Sprints two and three. I note that the activities of planning and estimating need to be improved on in sprints two and three.

Group B1:

…I could not fault their assessment but would add that they are a well-functioning group, their skills complement each other, and more importantly there is excellent interaction between the team members. I have also observed, during sprint one, the learning that has happened particularly around integration skills, architecture, problem solving and planning.

Group B2:

This group provided a very honest assessment of their activities… I agree with their assessment and would reiterate my main concern about the work undertaken during sprint one. The main concern that I have is that the group, for whatever reason, did not tackle in a planned and meaningful way the integration work/process required not only for sprint one but also the remaining sprints. As I said in my last meeting with the group there

seems to be a reluctance to engage in trying to fully understand how integration works. Having said that, the group demonstrated that as individuals that they could deliver their individual user stories using test driven development and that the stories could be integrated together into a single project (even though the recommended integration approach employing Git/Bitbucket was not used).

Group B3:

This group provided a very honest assessment of their activities, both process and product, for sprint one. I agree with their assessment. One thing that particularly impressed me about this group was that they were very well organised and how they undertook the work for sprint one. This team divided into three "pair programming" teams. Each week when I came into the practical class I observed, particularly with this team, that each of the pair programming teams started work immediately at the start of class. While the team was well organised it still fell short of the proposed functionality to be delivered for sprint one. Part of the reason for this, the group identified in their reflection, was poor estimation. However, another reason they identified was poor communication among the pairs with regard to architectural interfaces between the subsystems (e.g. the try catch issue in the GUI). (Research Diary, 6th March 2018)

As I reflect on my diary entry above, I am struck by the amount of times that I refer to "honest assessment". When I designed this part of the process I had a concern how it might be received by students. Initially, I noticed that students had initial reservations about the process but over time they recognised the fairness of involving them in assessing their own work. I feel that this belief is justified based on my observation of the level of honest assessment of Sprint One that the students engaged with and the fact that each student and group were content with the grades negotiated.

10.3.2.3 There's Room for Improvement

I have learned that there is room for improvement in the assessment process that I enacted.

I have learned that students have found the self-assessment process to be both challenging and difficult. While students understood and agreed that they could and should be a major source of evidence in the assessment process, I feel this is an area of practice I need to revisit. I am concerned that the process of self-assessment that I enacted within this inquiry may have hindered students ability and focus to self-assess as they were side-tracked by the ambiguity they perceived within the given assessment

criteria as well as the amount of documentation that had to be completed to record their thoughts on the self-assessment. Students have clearly identified that there is an overlap between what was being asked of them in the Learning Log Template and the self-assessment Criteria Sheets to be completed after various project deliverables had being implemented and finished. They also struggled to relate to the questions asked within the self-assessment criteria sheets in the belief that the criteria were not clear, tedious, and demanding to answer.

Another potential improvement lies in a disagreement between students in relation to the structure and break-down of marks within both modules. The majority of students were content with the break-down of the assessment where the practical Continuous Assessment was marked out of 60% and the Summative Written Examination graded out of 40% because

> the way the marking scheme was structured and how it focused more [on the] marks in your [practical] work than the exam. I did like that ... There was stuff to get done and then get marks and see, unlike certain courses, where your mark focuses on the exam and most of the marks are on the exam, so it was like a one-off chance. You make it or you break it. (Bernard, Interview 1, 26th January 2018)

However, a small minority suggested that I should radically transform our shared practice by rethinking the approach I took to the assessment methods. They rejected 'assessment of learning' (Bloxham and Boyd, 2007, p.14) as a means to evaluate the curriculum for Agile Methodologies 4.1 and 4.2 - 'If it was up to me, I would have no final written exam. I would make it just 100% project because [it is] practical learning' (Amy, Interview 2, 26th January 2018).

Finally, I have learned that as I strive to take further actions to improve my assessment practices, I must continue to embrace the interactions that exist between assessment of, for, and as learning where there is

1. an overlap between Assessment AS and OF Learning when students get the opportunity to receive a grade for their self-review (often called 'self-assessment') or to negotiate a grade on their work with staff (summative co-assessment), and

2. an overlap between Assessment FOR and AS Learning when students have had an opportunity to self-monitor and, based on this, ask for 'specific' feedback on their next assessment.

<div align="right">(adapted from National Forum, 2017, p.3)</div>

Section 5 – What have I learned?

Section 5, *What have I learned?*, consists of two chapters.

In chapter 11, *The Significance of the Research*, I reflect on the significance of my research for educational theory, for me, for my professional knowledge of practice, and for the education of social formations.

In chapter 12, *My Final Thoughts*, I conclude by reflecting on the type of lecturer I am now as I ask you, the reader, to test the validity of this thesis.

Chapter 11 – The Significance of the Research

11.1 Introduction

Action research has taught me to speak with a confident voice, critique and problematise my role, and change how I teach (Kincheloe, 2012). In finding my voice, I have been able to speak about my experiences and my 'ability to learn from that experience' (Winter, 1998, p.53). In this chapter I discuss what I consider to be the potential significance of my research where I have learned about my practice and myself, have realised my educational values within my practice, and have developed dialogic problem-posing pedagogies that have contributed to the software engineering knowledge learned by students becoming software engineering professionals.

11.2 The Significance of my Living Educational Theory

Within this study, I positioned myself as a practitioner-researcher committed to inquiring into and developing a living educational theory (Whitehead, 1989; McNiff and Whitehead, 2011), which privileges tacit knowledge within a Software Engineering curriculum.

Prior to this inquiry, I would have unquestionably accepted the notion that educational theory is only 'produced by a group of "intellectuals" or experts who claim the right to generate valid knowledge' (O'Hanlon, 2002, p.117). However, as I carried out this action research inquiry into my practice, I have come to understand that I too can generate theory as a practitioner-researcher. My engagement in this inquiry has taught me that in 'educational research a wide range of techniques, methods and procedures are used, which allows researchers to define their own forms of valid knowledge, and present them as educational theories' (O'Hanlon, 2002, p.117). In developing my living educational theory, I have become committed to the idea that practitioner-researchers

> [c]an improve [their] learning in order to improve workplace practices [and …] can advance knowledge and theory, that is, new ideas about how things can be done and why. (McNiff and Whitehead, 2011, p.1)

As a practitioner-researcher, who has adopted a Living Educational Theory approach, I now do not perceive research and practice as two separate entities. Instead I see theory and practice as closely related and integrated components throughout this research in that '[t]heory informs practice, which generates new theory that in turn feeds back into practice, in a cyclical manner' (Sullivan, 2006, p.292). The significance of this perspective is that, like me, any lecturer committed to inquiring into and improving their practice can become a practitioner-researcher to learn about and transform their practice for the better as they generate their own living educational theories of practice.

The significance of my living educational theory itself lies in its potential as a framework for privileging tacit knowledge, alongside explicit knowledge, within a Software Engineering curriculum through re-imaging the teacher-student relationship within the classroom, where I encourage students to think critically for themselves and become knowers in their own right. What I have achieved is to create and enact a learning environment that provided students with a sense of their worth as unique individuals capable of becoming software engineers. In creating and enacting such learning spaces, I have demonstrated that values of justice, democracy, and care can be incorporated into and drive transformation of living social practices. I suggest that the values that I cherish, incorporated within my transformed practice, 'by their very nature, cannot be applied sporadically or haphazardly, but must constitute a solid and constant framework for equality of treatment of all groups in society' (Sullivan, 2006, p.287). In that regard, I suggest that my living educational theory has the potential to inform other educational researchers and practitioners, who are interested in understanding how their values can impact for the better in practice on the lives of real students, who themselves are interested in pursuing knowledge of their chosen discipline.

In particular, the dialogic pedagogies that I have enacted can be characterised 'by the verb "knowing" rather than the noun "knowledge"' (Murphy *et al.*, 2008, p.197) in a learning environment where I have consistently observed students busily engaged on their assigned projects, as they co-created knowledge through dialogue with each other or reflecting on their own thoughts. I enacted a learning environment which requires students to think for themselves in a manner which does not always necessitate relying

on knowledge from textbooks. This led students to discover that learning can be problematic, where making a mistake is viewed as a learning opportunity, and that situations occur for which no correct answers can be found. The enacted pedagogies required students to both question explicit disciplinary knowledge and encouraged them to investigate their own learning processes and tacit knowledge, where 'their main subject knowledge became knowledge of their own capacity to learn and to think critically' (Roche, 2007, p.254), as they engage in becoming software engineers.

11.3 The Significance of the Research for Me

I have learned through this study that theorising one's practice reflects the fundamental principles of a new scholarship of inquiry that has been conducive in producing new knowledge about what I do as a lecturer (Whitehead, 1999). By adopting an action research methodology, I have chosen a way of knowing which recognises educational research as a way for me to help students learn to become competent as Software Engineers. My living educational theory has emerged as I inquired into and theorised my practice to take action to improve what I do where

> [a]ction research is not only about learning: it is about knowledge production and about a commitment to improve practice [where] the principles and practices of action research can play a significant part in helping us all to establish, sustain and nourish more meaningful work environments. (Ghayne and Ghaye, 1998, p.69)

I have located and developed my living educational theory within my pedagogical practice (my meaningful work environment) and, in doing so, this has led to the generation and implementation of new practices described and explained in this thesis, where I have

- relinquished the role of knowledge expert within the classroom in favour of being a facilitator alongside students,
- developed meaningful relationships with students,
- engaged in formal lesson planning,
- introduced dialogical pedagogical practices to enact meaningful learning experiences,

- implemented group-work as a means to solve authentic Software Engineering problems,
- helped students to reflect, and
- added formative and self-assessment practices.

I now appreciate that learning to generate and implement these new practices is new and valid knowledge that can be presented as an educational theory. In doing so, I have learned how to employ action research to enable a practitioner-researcher like me to develop a living educational theory as I seek to account for the professional practices and actions that I take. The significance of this approach is that it has allowed me to develop my own way of knowing, as a form of professional development, as I demonstrate a capacity to critically engage with my own learning as I transform my pedagogical practice (McNiff, 2002; McNiff and Whitehead, 2011).

Through action research, I have learned that the knowledge and awareness of the work practices that I developed emerged from my analysis of and reflections on the data that I collected during the course of this inquiry. I suggest that development of such self-awareness is an integral part of a living educational theory as the 'data analysis aspect of critical teacher research must always be directed towards an understanding of self' (Kincheloe, 2012, p.109) through reflection. 'I suggest that an understanding of the self should, where possible, lead to improvement of the self' (Sullivan, 2006, p.298).

Such understanding and improvement requires self-reflective conversations with one-self. These conversations have made me, as a practitioner-researcher, more accountable for and have encouraged me to reconceptualise my practice. By reflecting on the experiences of the actions that I took within this inquiry, I have been empowered to reconceptualise my identity as a practitioner-researcher who is capable of developing the kind of dialogical problem-posing pedagogy described and explained within this thesis, where I have learned to relate to students as thinking human beings who are capable of making meaning for themselves. In taking such a reflective stance in examining and transforming my practice, I have changed as a person and a lecturer because

> [i]t is through reflective conversations that a greater sense of self and professional identity can be brought about. Reflective conversations that are empowering enable teachers to name, define and construct their own 'realities': they enable teachers to sustain themselves. (Ghayne and Ghaye, 1998, p22-23)

As I reconceptualised and built my identity as a practitioner-researcher, I became aware that '[p]roblem-posing education affirms men and women as beings in the process of *becoming* - as unfinished, uncompleted beings in and with a likewise unfinished reality' (Freire, 1970, p.57, original italics) where I and each person can only take responsibility for improving themselves as a person. I have discovered that I needed to learn how to improve as a lecturer and become a facilitator in the classroom so that I could encourage and support students to help them to become the competent software engineers they wish to be. Due to this study, I now realise that the focus of my pedagogical practice, and education in general, must be about students and teachers constantly engaged in a process of becoming as they learn together.

To enable a process of becoming within my pedagogical practice, I have learned that I needed to embrace the values of justice, democracy, and care within a learning environment which values dialogue, problems, the open-ended nature of knowledge, meaningful relationships between students and teachers, and the ability of individuals to be creative critical knowers. As I transformed my practice in this way, both students and I too have become more critical as thinkers where

> dialogue, including dialogue with the self through reflection, is crucial to the development of critical awareness, because dialogue, as I understand it, honours the other as an equal knower who can think and speak for herself. (Roche, 2007, p.33)

In becoming a more critical thinker, I have learned that didactic approaches to education do not promote values of justice, democracy, and care. As a result, I have come to reject this approach to education as it does not recognise students as knowers, favours transmission of knowledge to passive learners, and privileges standardised assessment methods to determine how much of the transmitted knowledge has been retained (Freire, 1970; Kincheloe, 2008, 2012).

Instead, in *becoming* a Software Engineering lecturer, I have learned to equally privilege tacit and explicit software engineering knowledge. In particular, I have come to understand that tacit software engineering knowledge is an important element 'present in the activity of practice and made available ...through participation' (Murphy *et al.*, 2008, p.218) in authentic software professional activities. I have used the lens of tacit knowledge to analyse and direct the actions that I have undertaken within this inquiry to develop as a software engineering lecturer and improve my practice to support students becoming competent software engineers. I now understand that I need to equally value knowledge reproduction alongside knowledge creation as a prerequisite for engaging with the process of becoming within my practice. In doing so, I have learned to believe in my own ability to develop dialogical ways of knowing that enable students and myself to become aware of how we learn to think for ourselves.

Because of this study, I know now that I can support students in such knowledge creation by requiring them to 'reflect on the relevance of what they learn' (Murphy *et al.*, 2008, p.242) and relate it to any 'personal position' (Murphy *et al.*, 2008, p.244) that they hold. Such reflective practices encourage students to make explicit or at least develop their 'experience-based (tacit) knowledge' (Matthew and Sternberg, 2009, p.530) as a means to cultivate their software engineering knowledge and help them learn to become competent software engineers through 'engagement in a set of tasks relevant to the development of expertise' (Sternberg, 2008, p.25). This development of expertise is demonstrated by Jacob who reflected:

> So now that I am at the end of the agile process I think the big question is "did it help me to become a better software engineer?". A software engineer should be able to deal with group work, engage in new practices, apply their knowledge constructively, improve on their learning, [be] consistent and anticipate change. I would say that I improved greatly on all these criteria, maybe not evenly, but to a much faster degree than if I was working alone or was not working as part of a scrum group. I can confidently say this because I know from prior experiences and from never engaging with a process this thoroughly that I have become a better software engineer. It's hard to pinpoint the exact moments that I saw these changes but reflection and clear examples of where I am lacking make getting better a lot easier. Not only does it give you a team goal to work towards but a personal one, motivation to not let down your team is a

powerful way to realise self-improvement is key. (Jacob, Semester 2 2017-18, Learning Log).

Sternberg (2008, p.15) is correct when he considers such 'expertise … as a process of continual development'. In this respect, Hall's (2008, p.103) observed link between 'the taking up of new and the relinquishing of old identities' with agency has implications for my practice in that my just, democratic, and caring pedagogical activities must recognise that identity development (becoming) is on-going for both students and me. The implications for my current and future practice are that, while I have a role in structuring the learning environment, I must recognise that all members of my community including myself are on different trajectories and that I also must remain open to learning (developing my expertise) through participation with students as they learn (developing their expertise) through participation with me. This has had and will have implications for my pedagogy in the future – I must learn to accept that a just, democratic, and caring approach to learning means that I must also be prepared to learn "from" the students as we negotiate meaning together and become the professionals we wish to be.

11.4 The Significance of the Research for my Professional Knowledge of Practice

I have learned that tacit knowledge constitutes part of a teacher's 'professional knowledge of practice' (Loughran, 2010, p. ix). However, at the very beginning of this inquiry, I focused only on the notion of tacit knowledge and professional knowledge within the context of the Software Engineering Profession and particularly with respect to the Software Engineering knowledge valued within the curriculum I taught. I had not yet made the connection that the concept of tacit knowledge was also relevant to me directly in the development of my professional knowledge as a lecturer. However, in transforming my practice, it occurred to me that I was drawing on my experiences, expertise, and competency which constitute part of my professional knowledge that I had developed over the previous 25 years or so as both an engineer and lecturer. This thinking led me to relate my own experiences as both a software engineer and educator to the concept of tacit knowledge and professional competence:

> Both S/W engineering and teaching professions are similar in that they involve projects in one-off situations e.g. no two projects are the same, no two classes are the same. Both disciplines require an individual's experience to complement explicit knowledge in order to get the work done. This experience or tacit knowledge develops over time and is part of the person themselves. Sometimes individuals do not recognise that they possess this tacit knowledge and/or don't know how to identify or use the tacit knowledge. For me, experience is a recognition that there are many ways to engage with practice and solve problems. (Research Diary, 19/10/2015)

I have contemplated the fact that my professional practice straddles two professions: education and software engineering. Each of these professions has its own discipline-specific body of professional knowledge which underpins the competence and expertise of individuals working within these different fields of employment. As my practice straddles two professions, this inquiry evolved in a way where the actions that I took within this study, to privilege tacit knowledge within a Software Engineering curriculum, contributed to my tacit understanding and knowledge of my pedagogical practice. I have reflected that the idea of "taking action" is common to all professions and where there is a willingness amongst practitioners to engage through action with their practice, then such action contributes to and helps develop practitioners' professional knowledge and competence. I have learned that while I was taking action and encouraging students to value software engineering professional knowledge within the curriculum, I grappled with and developed the explicit and tacit components of my 'teacher knowledge' (Loughran, 2010, p.180).

This observation made me reflect that the relationship between the concept of knowledge and the notion of expertise is complex within the context of any profession. I have determined that how professional knowledge, such as teacher knowledge or software engineering knowledge, is itself viewed is very much context dependent, particularly its tacit dimension (Schön, 1983; Polanyi, 1962). While writing this thesis, I further reflected that

> [t]o build competence, skill, and expertise as a teacher or s/w eng or any [type of] professional requires the continuous development of professional knowledge. I have discovered that professional knowledge cannot be quantified and is not finite. Instead. I have learned that it develops over

> time, is context dependent, and is built upon both propositional and personal (tacit) knowledge. (Research Diary, 17/08/20)

This is not the position that I had adopted within my past practice. Prior to this inquiry, I would have positioned myself and students within an epistemology of practice situated on the

> the high, hard ground overlooking the swamp [, where on] the high ground, manageable problems lend themselves to solution through the application of research-based theory and technique. In the swampy lowland, messy, confusing problems defy technical solution. The irony of this situation is that the problems of the high ground tend to be relatively unimportant to individuals or society at large, however great their technical interest may be, while in the swamp lie the problems of greatest human concern. The practitioner must choose. Shall he remain on the high ground where he can solve relatively unimportant problems according to prevailing standards or rigor, or shall he descend into the swamp of important problems and non-rigorous inquiry? (Schön, 1987, p.1)

By adopting such a position, I had embraced an epistemology of practice that emphasised the value of technical rationality over

> the type of knowing that practitioners need in order to respond to the problems of everyday practice that defy technical solution, where the practitioner faces issues of distress and conflict within the unique human-human encounter on a daily basis. (Johns, 2009, p.4)

Although Schön (1983) states that a practitioner must choose where to reside within their epistemology of practice and suggests 'that swampy lowland knowing is more significant than technical rationality because it is knowledge practitioners need to practice' (Johns, 2009, p.4, p.5), I have come to learn through this inquiry that becoming a competent practitioner requires that, while my main residence is in the swampy lowlands, I must be prepared to travel to the high hard ground to acquire and incorporate relevant research and theory into my practice as I develop my professional knowledge.

11.5 The Significance of the Research for the Education of Social Formations

The term "*field*" is used to denote the various settings and contexts, such as education, sport, or politics, in which social agents or people come together to constitute society (Bourdieu, 1990). From Bourdieu's perspective my professional practice is an example of a field which can be described and represented by the framework for analysing educational practice (see Figure 1.1). Such fields, in which social agents participate, consist of 'discourses, institutions, values, rules and regulations' (Webb, Schirato, and Danaher, 2002, p.21). Every field or social formation has its own set of rules which influence the way that individuals behave and interact as they compete for the field's resources (Bourdieu, 1990). These rules are often unspoken, unquestioned, unrecognised, and unchallenged resulting in people coming to 'serve the rules, rather than have the rules serve them' (McNiff and Whitehead, 2011, p.174).

When Whitehead (2018, p.2) speaks of the education or 'learning of social formations' he is speaking about how to influence people to challenge the normative assumptions and behaviours within fields, and where necessary to change them. He suggests that this is achieved by identifying taken-for-granted assumptions about the social formations, making them explicit, and determining if they are appropriate or must be changed. For example, authority and position within social formations play an important role within a person's habitus, or 'network of understanding that is acquired, often early in life, which predisposes members of a [field] to interact in ways consistent with the specific societal norms [or rules] of their group' (Gill, 2003, p.8).

Throughout this thesis, I have questioned my taken-for-granted habitus. In doing so, my living educational theory has challenged some of the assumptions about the ways things are done in both educational inquiry and my professional practice and has redefined the 'rules of the game' (Lareau, Adia Evans and Yee, 2016, p.279) for the social formations that I participate within. In particular, I have re-imagined the role of authority and position, within the fields of educational inquiry and pedagogical practice, as I have positioned myself as a practitioner-researcher within the inquiry and re-positioned myself as a facilitator within the classroom.

As a practitioner-researcher I have contributed to the creation of 'good social orders' (McNiff and Whitehead, 2011, p.38). By developing pedagogical practices to encourage students to think independently and critically, engage in dialogue with others, and co-create knowledge, I have made a contribution to society by changing the way that I relate to students within the classroom. I do so, for example, by enacting group-work and reflective practice activities that provide students with greater freedom and opportunity for learning. Also, my living educational theory promotes interactions within the curriculum which question the 'power relations in the classroom, in the institution, in the formation of standard canons of knowledge, and in society at large' (Shor, 1992, p.31). I have learned that by designing appropriate teaching, learning, and assessment strategies that I have put in place a foundation that provide students with the opportunity and freedom to engage with and choose their own ways of knowing within the curriculum. I have ensured that such opportunity and freedom was encouraged within my pedagogical activities through

> true dialogue [where I and students] engage in critical thinking - thinking which discerns an indivisible solidarity between the world and the people and admits of no dichotomy between them - thinking which perceives reality as a process, as transformation, rather than as a static entity - thinking which does not separate itself from action, but constantly immerses itself in temporality without the fear of the risks involved. …Only dialogue, which requires critical thinking, is also capable of generating critical thinking. (Freire, 1970, p.65)

I have learned to see dialogue as a key component within my learning environment to encourage and support students to question their experiences and taken-for-granted assumptions in the classroom as they engage in a challenging learning process 'as thinkers, communicators, and citizens' (Shor, 1992, p.10) who experiment with and develop their own ways of knowing as they learn to become competent software engineers. I took such a stance, in designing the curriculum, to empower students to perceive and appreciate 'the complex and diverse forms of knowing' (Kincheloe, 2012, p.10) that they shall need to navigate through the problems they encounter in both their educational and software engineering practices, respectfully. I have re-designed the curriculum to 'challenge and call forth in students their own act of knowing' (Freire, 1987, p.213) as means for students to engage with and question the "rules of the game" that they participate in. Learning to engage in such activities has

'the potential to influence wider social change' (McNiff and Whitehead, 2011, p.38) as students bring their thinking and knowledge creation skills into the wider society, particularly after graduation from Higher Education.

11.6 The Significance of the Research within my Institute of Higher Education

This inquiry has impacted significantly on my professional practice as a lecturer. I have come to recognise that my Living Educational Theory of practice is a valid contribution to educational knowledge (Whitehead, 1989). Although the focus of my Living Educational Theory is limited to me and my perspective of transforming my practice, I have reflected that I should be able to employ my Living Educational Theory to inform the practice of whole programme curriculum development within my institute alongside my teaching colleagues.

I have identified that this can happen in one of two ways. One approach is that I can share my thesis findings with like-minded colleagues who wish to improve their practice. In doing so, I could encourage and support my colleagues to inquire into their own practice, preferably using a Living Educational Theory approach, in order to transform what they do as lecturers. While this approach has the potential to transform the specification and enactment of individual modules within a whole programme, and by default the whole programme itself, I would be concerned that this approach would endorse the 'silos in education' (Zahradnik, 2018) mentality that tends to prevail in the minds of educators who see themselves as knowledge experts within the modules that they teach.

My preferred approach would be to build on the research presented in this thesis and involve like-minded colleagues in a shared inquiry when we next work together as a team to transform both the development and enactment of a whole programme curriculum that we would be jointly responsible for. Although Whitehead's (1989) original conception of living educational theories focused on the self and individual knowledge, I believe that it is possible for both my colleagues and I to inquire into how to transform the specification and enactment of a whole programme curriculum to develop our 'shared living [educational] theories' (Smith, 2002, p. 157). I would

even go as far as to suggest that we, my colleagues and I, already have a shared concern and initial research question to start the inquiry process:

- How can we, as a team of Software Engineering lecturers, break-down the use of silos in the specification and enactment of a Software Engineering programme?

Chapter 12 - My Final Thoughts

12.1 Introduction

I have been formally on this PhD journey since February 2014, but in reality I had been subconsciously planning for it after I decided in 2008 to stay in education and actively question who I was as an educator (Chapter 1). It has been a long journey undertaken without a detailed map because, although I had identified my starting point, I had only a vague notion of my destination and no clue how to get there. This resulted in me, at times, losing my way and reaching dead-ends within my study. Although, I lost my way many times, I persevered and eventually I mapped out my route to this point in my journey - the completion of my written thesis containing my descriptions and explanations of my living educational theory of my practice.

Emotions, I have had many - sense of being not good enough to be a practitioner-researcher, sense of frustration with elements beyond my control, sense of being energised by the students who trusted me enough to engage as participants in this inquiry as I undertook transforming actions, sense of being lost, and a sense of achievement that I have arrived at this point in my doctoral journey. I have lived through these emotions while being driven by an internal determination to know myself better, to know my practice better, to know the students better, and to know myself as a practitioner-researcher better.

12.2 So Many Colours in the Rainbow

Flowers are Red

Little boy on the first day of school
Got some crayons and started to draw
He drew colours all over the paper
For colours was what he saw
And the teacher said. "What you doin' young man?"
"I'm paintin' flowers" he said
"It's not the time for art, young man
And anyway flowers are green and red...
There's a time for everything young man
And a way it should be done

You've got to show concern for everyone else
For you're not the only one
And she said...
Flowers are red young man and
Green leaves are green
There's no need to see flowers any other way
Than the way they always have been seen

But the little boy said...
There are so many colours in the rainbow
So many colours in the morning sun
So many colours in a flower and I see every one

The teacher said. You're sassy
There's ways that things should be
And you'll paint flowers the way they are
So repeat after me...

And she said...
Flowers are red young man and
Green leaves are green
There's no need to see flowers any other way
Than they way they always have been seen

But the little boy said...
There are so many colours in the rainbow
So many colours in the morning sun
So many colours in a flower and I see every one

The teacher put him in a corner
She said. It's for your own good.
And you won't come out 'til you get it right
And are responding like you should
Well finally he got lonely
Frightened thoughts filled his head
And that little boy went up to the teacher
And this is what he said. and he said

Flowers are red, green leaves are green
There's no need to see flowers any other way
Than the way they always have been seen

Time went by like it always does
And they moved to another town
And the little boy went to another school
And this is what he found
The teacher there was smilin'
She said... Painting should be fun
And there are so many colors in a flower
So let's use every one

But that little boy painted flowers
In neat rows of green and red
And when the teacher asked him why
This is what he said. and he said

Flowers are red, and green leaves are green
There's no need to see flowers any other way
Than the way they always have been seen.

(Chapin, 1977)

I am no longer that teacher who only believes that *"flowers are red…and green leaves are green"*. Through this inquiry, I have transformed into that teacher who both embraces that little boy who every day sees *"so many colours in the rainbow"* and the new learning opportunities each time I now enter a classroom to teach a Software Engineering curriculum alongside the students in my care as together we 'practice co-intentional education' (Freire, 1970, p.43) where

- Both teachers and students are agentive problem solvers,
- Both teachers and students act with the environment,
- Perception and action arise together and co-construct each other,
- Problems emerge in activity when a dilemma has to be resolved,
- Problems are perceived and solutions are arrived at through action,
- Knowledge relates to action and is created as the result of social transactions/interactions,
- There is no separation between the knower and the known,
- Efficient practice precedes the theory of it, and
- Individual change is not separated from social change.
  (adapted from Freire, 1970; Bruner, 1996; Murphy *et al.*, 2008)

12.3 Asking the Reader to Test the Validity of my Living Educational Theory

I established the Standards of Judgement (Chapter 4) that I employ to evaluate the validity of my living educational theory. In doing so, I have chosen to follow a two-step process, consisting of 'internal [and] external validity' (McNiff and Whitehead, 2011, p.133, pp.161-2) to validate my claim to knowledge.

Internal validity is concerned with me demonstrating to myself that I have produced validated evidence to justify my claim to knowledge. I submit that I have done so by critically reflecting on what I have written within this thesis. I have reflected on my

practice and research in terms of my values because my values reflect my commitment to who I am and how I perceive myself in the world (McNiff and Whitehead, 2011). I have thought about my place as a lecturer, which is both defined by and dependent on the nature and quality of the relationship between my values and my practice, where I am in relation with students. I have endeavoured to make meaning of this relationship as I try to hold myself accountable for my actions. I have addressed the questions asked in relation to the Standards of Judgement that I created (Chapter 4). I judge my descriptions and explanations of my practice to be legitimate and trustworthy.

To address the issue of external validity requires that I invite other people to assess my claims to validity and to agree that my claims are satisfactory and credible. In doing so, I suggest the following questions for use, by you the reader, to ask:

- Is my account comprehensible? Do you understand what I am saying? Have I expressed myself in a form of language you understand?
- Does my account come across as truthful? Have I provided enough evidence for you to believe that what I have written are true accounts and not made up or interpreted inaccurately?
- Does my account come across as sincere? By this I mean, do you see me living my values in my practice [to privilege tacit knowledge]?
- Have I expressed the normative contexts in which I work clearly?

(Jones, 2019, p.239)

I suggest that this thesis, my living educational theory, is comprehensible, truthful, sincere, and describes clearly my practice. I hope that you, the reader, are in agreement.

12.4 Conclusion

Asking and inquiring into the question *"How can I, as a lecturer, improve my pedagogical practice to value tacit Software Engineering knowledge?"* has provided me with a considerable amount of insight into my practice. However, I acknowledge that my thesis is my attempt

> to do justice to the always frustrating relationship between the linear sequence of words on a page, the infinite complexities of experience, and the desire to elucidate a wider significance from particular events (Winter, 1996, p.25).

I have found it a challenge to document the living evolving organism that is my practice, but a necessary challenge to be overcome which has equally contributed, alongside carrying out the actual research, to my learning as a practitioner-researcher.

As a practitioner-researcher, I have gained confidence that the personal practical knowledge that I have gathered as a lecturer during my many years of teaching and this study is both important and valid knowledge. I present my living educational theory, which has been developed from my practice, for both approval by the academy and as a resource for my colleagues as I place my 'personal experiences of practice into "public" knowledge' (Snow, 2001, p.9). I do so in the hope that other lecturers or practitioners might learn from my personal experiences and adapt them in a way that are of use to them.

Although I have reached the end of my PhD journey, I do not see this as the end of my journey as a practitioner-researcher but rather a milestone in my continuing adventure to further develop and transform my practice in a way that I continue to live my values of justice, democracy, and care with the students I have yet to meet and have the pleasure to teach.

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Appendix A: Participant Information Sheet

PARTICIPANT INFORMATION SHEET
(Valuing Tacit Knowledge within Software Engineering's Agile Methodology)

Part 1: Introduction

The purpose of this Participant Information Sheet is to ensure that potential research participants have sufficient information to make an informed decision about whether to take part in this research project or not.

I am currently undertaking a Ph.D. in Education to improve my professional practice as an educator. The title of my research project is 'Valuing Tacit Knowledge within Software Engineering's Agile Methodology'. Software engineering is seen as a knowledge-driven industry employing a knowledge-intensive process, where knowledge is created and shared, when different aspects of a software development process (concepts, products, tools, process, people, etc.) interact with each other. Software engineers working as a team, engaged in such a development process, employ their expert knowledge to create a finished product. It is believed that such expert knowledge is tacit in nature and that the acquisition and transmission of [such] tacit knowledge is significant in the development process. The Agile Methodology is one example of a software development process. It is against this background that the objective of this study is to find a better way to teach, learn, and assess Software Engineering's Agile Methodology tacit knowledge.

Part 2: Invitation to take part in the study

You are being invited to take part in this research study. Before you decide, it is important for you to understand why this research is being done and what it will involve. This Participant Information Sheet will tell you about the purpose, risks and benefits of this research study.

If you agree to take part, I will ask you to sign a Consent Form. If there is anything that you are not clear about, I will be happy to explain it to you. Please take as much time as you need to read this Participant Information Sheet. You should only consent to participate in this research study when you feel that you understand what is being asked of you, and you have had enough time to think about your decision.

Thank you for taking the time to read this Information Sheet.

Part 3: Purpose of the Study

As an educational researcher, who also participates in this study, I am interested in the concept of tacit knowledge as it relates to Agile Methodologies. In that context, my research question for this study is 'How do I structure my professional practice to recognise, generate, share, capture, and assess the tacit knowledge required in the context of Software Engineering's Agile Methodology?' My study examines my professional practice where I structure my teaching, learning, and assessment activities around the concept of joint enterprise, where a group or team of students work together on an authentic software problem employing an Agile Methodology. The findings from the research should theorise and identify ways of teaching, learning, and assessing tacit knowledge within an Agile Methodology. You have been asked to participate in this research project as you are a student in Year 4 on the B.Eng. in Software Engineering.

Part 4: Taking part – what it involves

This section identifies and discusses what taking part in this study will involve for you as a participant.

Do I have to take part?
It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision not to take part, will not affect your rights in any way.

What will happen to me if I take part?
As a participant in the project you will engage with the teaching, learning, and assessment activities put in place by me in my role as your lecturer. In addition, as a participant, you will be interviewed and observed to allow me as a researcher to inquire into how you engage with my teaching, learning, and assessment practices. You shall also have the opportunity to review the audio transcripts of your interviews for accuracy and to ensure that you may not be identified in the recording/transcript.

How long will my part in the study last?
You shall be required to participate during the 2016/2017 Academic Year.

What do I have to do?
You will be required to attend and participate in your Agile Methodologies 4.1 and 4.2 modules as normal throughout the academic year.

What are the possible benefits in taking part?
Engaging with this study shall benefit you, the participant, in that you should be able to better recognise, generate, share, capture and assess tacit knowledge within your learning environment in preparation of doing the same when you graduate as a qualified Software Engineers.

What are the possible disadvantages and risks of taking part?
There are no foreseeable disadvantages or risks attached to taking part.

What happens at the end of the study?
Your participation in the study is tracked through interviews and observation. The information collected through interviews and observation shall be analysed to understand how participants in the study made sense of, how they acted within, and how they experienced the teaching, learning, and assessment activities they encountered. Findings from the analysis shall form part of my Ph.D. thesis, due for publication in 2020. Participants shall not be identified in my thesis. A copy of my thesis shall be available to anybody from the library in Maynooth University after the completion of my Ph.D.

What happens if I change my mind during the study?
As a participant you are entitled to change your mind about participation at any time. You can withdraw at any point during the course of this study. There is no disadvantage or penalty to participants who withdraw.

What if I have a complaint during my participation in the study?
If during your participation in this study you feel the information and guidelines that you were given have been neglected or disregarded in any way, or if you are unhappy about the process please contact me, Mr. Michael Russell (mrussell@ait.ie), School of Engineering. Please be assured that you concerns will be dealt with in a sensitive manner.

Whom do I contact for more information or if I have further concerns?
If you wish to have more information in relation to participation on this study please contact me, Mr. Michael Russell (mrussell@ait.ie), School of Engineering.

If you have any concerns about this study and wish to contact someone independent and in confidence, you may contact the Chairperson of the AIT Research Ethics Committee, c/o Office of the Vice President for Research, AIT (ethics@ait.ie).

Part 5: Confidentiality

All information that is collected about you during the course of this research will be kept strictly confidential and will not be shared with anyone else. The information collected in this research study will be stored in a way that protects your identity. Results from the study will be reported as group data and will not identify you in any way.

Part 6: Summary

You should contact me to clarify any points on which you remain unclear. My contact details are:

> Mr. Michael Russell,
> U302, Engineering Building,
> School of Engineering,
> Email: mrussell@ait.ie
> Phone: 090-6442541

You are free to refuse to take part in this study without any disadvantage or penalty. If you do decide to participate and agree to take part, you can change your mind at any point during the study and decide not to continue in the study without any disadvantage or penalty.

I wish to take this opportunity to thank you for taking the time to read this Participant Information Sheet and participating in the study.

A copy of this Participant Information Sheet and a copy of the signed consent form will be given to each participant to keep.

Appendix B: Participant Consent Form

PARTICIPANT CONSENT FORM

Title of Project: Valuing Tacit Knowledge in Software Engineering's Agile Methodology

Name of Researcher: Mr. Michael P. Russell

Participant Identification Number: ☐☐☐☐

Please initial box

1. I confirm that I have read the information sheet dated 1/12/2016   ☐
(Version 1.0.) for the above study and have had the opportunity to ask questions.

2. I am satisfied that I understand the information provided and have had enough time   ☐
to consider the information.

3. I understand that my participation is voluntary and that I am free to withdraw at any   ☐
time, without giving any reason, without my legal rights being affected.

4. I agree to take part in the above study.   ☐

_____   _____   _____
Name of Participant   Date   Signature

_____   _____   _____
Name of Person taking consent   Date   Signature
(if different from researcher)

_____   _____   _____
Researcher   Date   Signature

Appendix C: Module Descriptor Template Example

SFTW08037
Agile Methodologies 4.1

Transcript Title	Agile Methodologies 4.1

Full Title	Agile Methodologies 4.1

Attendance	75% Required	Award Area	Computer Software

Coordinator	Michael Russell	Department	Electronic Computer Software

Co Author(s)	Marcus Rahilly

Official Code	SFTW08037	NFQ Level	08	ECTS Credit	05

Module Description

This module introduces students to the concept of software engineering as well as describing the role of software engineers, including their ethical/professional responsibilities. It provides an introduction to the following different types of agile methodologies: Scrum, Extreme Programming, Feature Driven Development and Kanban by focusing on the key processes of
Requirements, Pair Programming, Testing, and Configuration Management.

Learning Outcomes

On completion of this module the learner will/should be able to

1.   Explain what Software Engineering is, why it is important, and the role of a software engineer.
2.   Identify and contrast different types of agile methodologies: Scrum, Extreme Programming, Feature Driven Development and Kanban.
3.   Employ User Stories to collect and document Requirements.
4.   Practice Pair Programming and Test-Driven Development.
5.   Discuss the role of Software Configuration Management (SCM) and demonstrate the use of an SCM Tool within assignments and projects.

Teaching and Learning Strategies

Face to face teaching and learning shall occur within in the context of both lectures and practical laboratories. Lectures shall focus on the knowledge to be applied on assignments and projects within the practical laboratories. For assignments and projects, the lecturer shall facilitate the learning process in which students shall be required to work in groups to solve problems. This teaching and learning approach positions students as active participants in their own learning where learning from and with others is fundamental. This approach also acknowledges relationships between individual modules and encourages students to make the knowledge connections between the different modules.

Assessment Strategies

Assessments shall be exam-based, assignment and project-based. Assessments shall be summative (assessment of learning), formative and diagnostic (assessment for learning) and/or involve students in assessment (assessment as learning).

Repeat Assessment Procedures

Students shall be required to sit a repeat exam and/or submit outstanding assignments/projects.

Assessment Facilities

Computer Laboratory.

Module Dependencies

Indicative Syllabus

Definitions of Software, Software Engineering, Software Process, Software Process Model. Attributes of 'Good' Software. Ethical and Professional responsibility. System versus Software Engineering.

History and value of Agile Development including the Agile Manifesto. Introduction to Agile Methodologies: Scrum, Extreme Programming, Feature Driven Development and Kanban. Roles and Teamwork. Comparison of Agile Methodologies.

Requirements within agile methodologies. Format of User Stories used within Scrum including epics and acceptance criteria. Explore how user stories are broken down from epics to child user stories and how acceptance criteria add important details to the story. Identify how other agile methodologies differ from Scrum in their requirements terminology and practices. Examine how requirements can be enhanced by using personas or engaging user experience designers to better understand potential system users.

Pair Programming. Introduction to Clean Code. Introduction to the Test Process. What is agile testing? Acceptance Test-Driven Development. Test-Driven Development (Unit Testing). Test design and measurement techniques. Unit Test Frameworks. Static Analysis. Code Coverage.

Introduction to Configuration Management. Configuration Management Planning. Version Control. Continuous Integration. Software Configuration Management Tools.

CourseWork / Assessment Breakdown	

CourseWork / Continuous Assessment	60 %

End of Semester / Year Formal Examination	40 %

Coursework Assessment Breakdown

Description	Outcome Assessed	% of Total	Assessment Week
Develop User Stories for a small project.	3	25	Week 2
Employ Pair Programming and Test-Driven Development in the development of Java Classes for the User Stories defined above.	4	25	Week 7
Employ basic SCM planning and version control on all assessments.	5	10	Week 4

End Exam Assessment Breakdown

Description	Outcome Assessed	% of Total	Assessment Week
Written Exam	1,2,5	40	Week 14

Appendix D: Bloom's Taxonomy of Educational Objectives within Cognitive Domain

Level of Expertise	Description of the Level	Typical Action Verbs
1. Knowledge	People focus on acquiring information that can be recalled at a later date when a person is thinking. This level recognises that a person may have the ability to recall information without necessarily knowing them.	Arrange, Collect, Define, Describe, Examine, Identify, List, Name, Order, Present, Quote, Recall, Recognise, Reproduce, Select, Show, Write
2. Comprehension	This level focuses on people being able to show an understanding of the facts they know. Typically, these facts consist of learned information which a person can remember.	Associate, Change, Clarify, Classify, Construct, Contrast, Decode, Describe, Discuss, Estimate, Explain, Generalise, Interpret, Predict, Recognise, Review, Select, Solve, Summarise
3. Application	Application is concerned with how a person can take their knowledge and understanding of learned material to use it in new and novel concrete situations. For example, employ ideas and concepts in solving problems.	Add, Apply, Calculate, Change, Classify, Collect, Compute, Construct, Demonstrate, Develop, Discover, Employ, Examine, Experiment, Illustrate, Interpret, Manipulate, Modify, Practice, Predict, Where, Select, Show, Transfer
4. Analysis	Separation of a complex idea into its constituent parts and an understanding of organization and relationship between the parts. Includes realizing the distinction between hypothesis and fact as well as between relevant and extraneous variables.	Analyse, Praise, Calculate, Classify, Compare, Connect, Contrast, Criticise, Detect, Determine, Develop, Distinguish, Examine, Experiment, Identify, Illustrate, Inspect, Question, Recognise, Separate
5. Synthesis (/Create)	Creative, mental construction of ideas and concepts from multiple sources to form complex ideas into a new, integrated, and meaningful pattern subject to given constraints.	Argue, Arrange, Collect, Compile, Construct, Create, Design, Develop, Establish, Explain, Integrate, Invent, Make, Modify, Organise, Plan, Prepare, Propose, Reconstruct, Reorganise, Revise, Rewrite, Summarise, Synthesise
6. Evaluation	To make a judgment of ideas or methods using external evidence or self-selected criteria substantiated by observations or informed rationalizations.	Appraise, Ascertain, Argue, Choose, Compare, Conclude, Consider, Convince, Criticise, Critique, Side, Defend, Determine, Estimate, Explain, Evaluate, Interpret, Justify, Predict, Resolve, Revise, Standardise, Summarise, Validate, Value, Verify

(adapted from The Center for Teaching and Learning, 2018)

Appendix E: Specified Curriculum Design and Alignment Decisions for Agile Methodologies 4.1 and 4.2

Specified Curriculum Design and Alignment Decisions

For Agile Methodologies 4.1

Module Learning Outcome	Strand of Learning Outcome(s) - NFQ	Teaching & Learning Strategy	Assessment Strategy	Assessment Activity
1. Explain what Software Engineering is, why it is important, and the role of a software engineer.	1. Knowledge	1. Face-to-face lecture	1. Assessment of Learning (Summative)	1. Written Exam Question
2. Identify and contrast different types of agile methodologies: Scrum, Extreme Programming, Feature Driven Development and Kanban.	1. Knowledge	1. Face-to-face lecture	1. Assessment of Learning (Summative)	1. Written Exam Question
3. Employ User Stories to collect and document Requirements.	1. Knowledge, 2. Know-How & Skill, 3. Competence	1. Face-to-face lecture, 2. Computer Laboratory, 3. Groupwork	1. Assessment for Learning 2. Assessment as Learning	1. Develop [as a group] User Stories for a small project.
4. Practice Pair Programming and Test-Driven Development.	1. Knowledge, 2. Know-How & Skill, 3. Competence	1. Face-to-face lecture, 2. Computer Laboratory, 3. Groupwork	1. Assessment for Learning 2. Assessment as Learning	1. Employ Pair Programming and Test-Driven Development in the development of Java Classes for the User Stories

				developed for LO 3 above.
5. Discuss the role of Software Configuration Management (SCM) and demonstrate the use of an SCM Tool within assignments and projects.	1. Knowledge, 2. Know-How & Skill, 3. Competence	1. Face-to-face lecture, 2. Computer Laboratory, 3. Groupwork	1. Assessment of Learning (Summative) 2. Assessment for Learning 3. Assessment as Learning	1. Written Exam Question 2. Employ [as a group] basic SCM planning and version control on all assessments.

Specified Curriculum Design and Alignment Decisions

For Agile Methodologies 4.2

Module Learning Outcome	Strand of Learning Outcome(s) -NFQ	Teaching & Learning Strategy	Assessment Strategy	Assessment Activity
1. Discuss and compare the approaches to Planning, Tracking, and Reporting within Agile Methodologies	1. Knowledge	1. Face-to-face lecture	1. Summative	1. Written Exam Question
2. Evaluate and Practice Test-Driven Development.	1. Knowledge, 2. Know-How & Skill, 3. Competence	1. Face-to-face lecture, 2. Computer Laboratory, 3. Groupwork	1. Assessment for Learning 2. Assessment as Learning	1. Employ [as a group] Test-Driven Development on a Java Project.
3. Explain the role of Software Configuration Management for Agile projects	1 Knowledge	1. Face-to-face lecture	1. Summative	1. Written Exam Question
4. Employ SCRUM for managing and implementing a Group Project.	1. Knowledge, 2. Know-How & Skill, 3. Competence	1. Face-to-face lecture, 2. Computer Laboratory, 3. Groupwork	1. Assessment for Learning 2. Assessment as Learning	1. Employ SCRUM for managing and implementing a Group Project.
5. Demonstrate the use of a SCM Tool within projects and assignments.	1. Knowledge, 2. Know-How & Skill, 3. Competence	1. Face-to-face lecture, 2. Computer Laboratory, 3. Groupwork	1. Assessment for Learning 2. Assessment as Learning	1. Employ Software Configuration Management on all assignments and Group Project.

Appendix F: Moodle Page Example

WEEK 2 (Lecture Notes):

Learning Outcome 1 (MLO 1): Explain what Software Engineering is, why it is important, and the role of a software.

Class Learning Objectives:

> a. *Describe what Software Engineering is.*
> b. *Differentiate between customised and generic products.*
> c. *Identify the main activities within a Software Engineering (Development) Lifecycle.*
> d. *Discuss the ACM/IEEE Code of Ethics.*

Introduction to Software Engineering

Frequently asked questions about software engineering (Handout)

Ethics - Class Assignment

Working in groups, discuss the ethics of a company releasing software without disclosing known defects. In the discussion, refer to the ACM/IEEE Code of Ethics (see Handout).

Week 2 (Practical Notes):

MLO5: Discuss the role of Software Configuration Management (SCM) and demonstrate the use of an SCM Tool within assignments and projects.

Class Learning Objectives:

1. Describe and explain the concept of Version Control.

2. Compare and contrast Local, Centralised, and Distributed Version Control Systems.

3. Describe the basic GIT Project Structure and Workflow.

4. Create a BitBucket Account (using your AIT student email address)

5. Describe and use the basic GIT operations: Clone, Add, Commit, Push, and Pull using SourceTree and your BitBucket account.

Introduction to Configuration Management

Lecture Notes

Getting started with Git and Bitbucket

Lecture Notes / Instruction Guide

GIT Site

Git is a free and open source distributed version control system designed to handle everything from small to very large projects with speed and efficiency.
Goto the Download section.

Appendix G: Lesson Plan Template

TEACHING LESSON PLAN WEEK XX (Lecture/Lab)	
Module:	**Level / (Stage 6,7,8):**
Title of session / topic:	**Session Time:**

Module Learning Outcome
(What module learning outcome(s) is the class / session aligned to?)

Class / session Outcomes:
Upon completion of this session you should be able to:
(Write these class outcomes on board/overhead projector at beginning of class for students)

Select & Prioritise Your Content:
Since you only have 50 minutes you must decide what material is used in class and what material the students should study at home. To do this, think about the material and its relative importance and difficulty and list in the appropriate quadrant.

	Difficult	Not As Difficult
Important	1.	2.
Not As Important	3.	4.

Material in quadrants 1 and 3 typically become the focus during classes. Quadrants 2 and 4 represent material students could study at home.

Time	Lecturer Activity (what you will do during the class)	Student Activity (what students will do during the class)

REFLECTION

What worked?

What did not work?

What would I do differently next time?

Any other thoughts or observations?

Appendix H: Agile Roles - Lesson Plan

<table>
<tr>
<td colspan="2" align="center">TEACHING LESSON PLAN
WEEK 7 (Lectures x 2)</td>
</tr>
<tr>
<td>Module:
Agile Methodologies 4.1</td>
<td>Level / (Stage 6,7,8):
8</td>
</tr>
<tr>
<td>Title of session / topic:
Agile Roles and Teamwork</td>
<td>Session Time:
120 minutes (60 mins x 2) Lectures</td>
</tr>
<tr>
<td colspan="2">

Module Learning Outcome
(What module learning outcome(s) is the class / session aligned to?)

(MLO2): Identify and contrast different types of agile methodologies: Scrum, Extreme Programming, Feature Driven Development and Kanban.

Class / session Outcomes:
Upon completion of this session you should be able to:
(Write these class outcomes on board/overhead projector at beginning of class for students)

Lecture 1

1. Understand the roles in Scrum with their specific responsibilities—product owner, Scrum master, and team.

2. Identify the attributes and personality types that are most successful in the various roles.

Lecture 2

1. Understand the roles in Scrum with their specific responsibilities— the Scrum team.
2. Identify the attributes and personality types that are most successful in the various roles.
3. Explain the Agile definitions of "chickens" and "pigs".
4. See how extended team members interact with the team.

After Class
- Read Roles in Other Methodologies (Slides 77 to 91).

Refer to
- Agile Roles and Teamwork (PPT)

</td>
</tr>
</table>

Select & Prioritise Your Content:
Since you only have 50 minutes you must decide what material is used in class and what material the students should study at home. To do this, think about the material and its relative importance and difficulty and list in the appropriate quadrant.

	Difficult	**Not As Difficult**
Important	1. Agile Roles and Teamwork (PPT)	2.
Not As Important	3.	4.

Material in quadrants 1 and 3 typically become the focus during classes. Quadrants 2 and 4 represent material students could study at home.

Time	Lecturer Activity (what you will do during the class)	Student Activity (what students will do during the class)
Lecture 1 0–10 (10 mins)	**Recap on Week 6 Lectures** Ask Students to identify 1. One thing learned last week 2. One thing they struggled with. 3. One thing they would like more information on.	**Answer Questions and Class Discussion**
	Introduce Class Learning Outcomes	
	Lecture – Agile Roles and Teamwork (PPT): Encourage Questions and Initiate Discussion	**Listen, Discuss and Ask Questions**
11-30 (20 mins)	Scrum Roles (Slide 5) Product Owner (Slides 6 to 12, 14, 17, 20 to 21, 22, 25 to 26)	
31-55 (25 mins)	Scrum Master (Slides 29 – 45)	

Time	Lecturer Activity (what you will do during the class)	Student Activity (what students will do during the class)
Lecture 2 0-10 (10 mins)	**Recap on last lecture –** Recap on Product Owner and Scrum Master **Introduce Class Learning Outcomes**	**Listen and Ask Questions**
11-55 (45 mins)	**Lecture – Agile Roles and Teamwork (PPT): Encourage Questions and Initiate Discussion** Scrum Team (Slides 46 to 69) Extended Team Members (Slide 70) Project Sponsor (Slide 71) Stakeholders (Slide 72) Project Manager (Slides 73 to 76)	**Listen, Discuss, and Ask Questions**

Appendix I: Computer Laboratory Lesson Plan Example

TEACHING LESSON PLAN WEEK 7 PRACTICAL	
Module: Agile Methodologies 4.1	**Level / (Stage 6,7,8):** 8
Title of session / topic: Facilitation of Assignment 1	**Session Time** 90 minutes

Module Learning Outcome
(What module learning outcome(s) is the class / session aligned to?)

(MLO3): Employ User Stories to collect and document Requirements

Class / Session Outcomes:
Upon completion of this session you and your group should be able to:
(Write these class outcomes on board/overhead projector at beginning of class for students)

1. Present progress to date on Assignment 1 in context of Group/Individual Goals.
2. Identify what is currently being worked upon.
3. Identify and discuss, if applicable, any problems being experienced on Assignment 1.

Refer to

- Group Work (PPT)
- Assignment 1 – User Stories (DOC)
- Observation Record Form (DOC)

Select & Prioritise Your Content:
Since you only have 50 minutes you must decide what material is used in class and what material the students should study at home. To do this, think about the material and its relative importance and difficulty and list in the appropriate quadrant.

	Difficult	**Not As Difficult**
Important	1. Group Work (PPT) Assignment 1 – User Stories (DOC) Observation Record Form (DOC)	2.
Not As Important	3.	4.

Material in quadrants 1 and 3 typically become the focus during classes. Quadrants 2 and 4 represent material students could study at home.

Time	Lecturer Activity (what you will do during the class)	Student Activity (what students will do during the class)
0 -10 (10 mins)	**Recap on Week 5 Practical** Ask Students to identify 4. One thing learned last week 5. One thing they struggled with. 6. One thing they would like more information on.	**Listen and Ask Questions**
11-90 (80 mins)	**Practical – Facilitation Process** 1. Complete an Observation Form for Each Group. 2. Spend 15 minutes per Group. 3. Treat like a Stand-Up Meeting. Ask at the group level and individual level the following questions: 1. What have you achieved? 2. Any problems? 3. What you plan to do? 4. Additionally ask "What have you learned?"	**Listen, Discuss, and Answer Questions**

REFLECTION

What worked?

What did not work?

What would I do differently next time?

Any other thoughts or observations?

Appendix J: Group Work Presentation

Slide 1

Group Work

1

Slide 2

Introduction

- Groups are smart.

- Under the right circumstances, groups are remarkably intelligent, and are often smarter than the smartest people in them.

- All of us gain knowledge through peer interaction. It's part of daily life.

2

Slide 3

Introduction

- Group work
- requires face-to-face interaction,
- provokes interest and inquiry,
- requires that we present information, explain nuances, and infer.
- Requires we listen, debate, and negotiate.

- And as a result, we validate and extend our own understanding.

- We learn from one another.

3

Slide 4

Introduction

- Educators have understood the importance of **collaborative group learning** for decades.

- A large body of research shows that students involved in cooperative work demonstrate higher levels of academic learning and retention than their peers working individually.

- Equally impressive is that cooperative group work has been shown to result in increased self-esteem, improved relationships among students, and enhanced social and education skills.

4

Slide 5

Collaborative group learning / Cooperative Learning

- Cooperative learning is an instructional arrangement that allows two to six students the opportunity to work together on a shared task in order to jointly construct their knowledge and understanding of the content.

- There are five principles for making this arrangement successful— • *positive interdependence,*
- *face-to-face interaction,*
- *individual and group accountability,*
- *interpersonal and small-group skills,*
- and *group processing*

5

Slide 6

Positive Interdependence

- Positive interdependence within groups requires that the group task must be designed so that the participation of every member is necessary to its completion, and students must clearly understand their interdependence in accomplishing the task.

6

Face-to-Face Interaction

- To consolidate and build new understanding, groups need to have considerable face-to-face interaction.

- Importantly, these interactions should encourage the exchange of ideas and not just to work out the logistics of completing the assignment.

7

Individual and Group Accountability

- As a lecturer, my concern is that each student learn, and for this I will put in place an accountability system that provides feedback to the individual learner as well as to the group as the task progresses.

- I will assign both an individual and a group grade for the group task.

- The key to this accountability system is that the members of the group are aware that each individual will receive a grade and that each is a participant in the evaluation process.

- Each group member will provide feedback on his or her own performance but not the work of others.

8

Interpersonal and Small-Group Skills

- Group work will and should promote frequent use of interpersonal and small-group skills.

- These are some of the applied skills held in such high regard by employers, and they include the ability to resolve conflicts in a constructive manner, to communicate effectively, and to ably draw upon the strengths of others to solve problems.

9

Group Processing

- Frequent and regular group processing is the key to a group's future effectiveness.

- The opportunity for groups to talk to one another about what worked and what didn't is crucial to future success. It's not a matter of blaming individuals but, rather, of figuring out what should change and what should be retained.

- This gives learners an opportunity to notice what they did well and what got in the way.

10

Process vs Content Learning

- In collaborative work, there is always a tension between two types of learning - *process learning* and *content learning.*

- The process questions students pose to themselves include
- Who am I?
- Who am I with you?
- Who are we together?

- The content questions students ask themselves include
- What do we have to do?
- What do we need to do to accomplish our goals?

11

Process vs Content Learning

- In seeking out the answers to content questions, students have an opportunity to consolidate academic knowledge, but in working out process questions, they gain an understanding of themselves as learners and members of a team.

- Indeed, an important outcome of productive group work is that learners gain greater **metacognitive** awareness—that is, selfknowledge of how and when they learn something new.

12

- 267 -

Appendix K: Semester 1 Group Project Instructions

Agile 4.1 Assignment –
Develop User Stories (MLO3 – 25%, MLO5 – 5%)

A newspaper delivery system – brief description of what is required

This system is intended to manage the delivery of newspapers and magazines in some small town or area of a larger town. It is intended for use by newsagents who are only casual users of computer systems and should run on a PC or similar hardware.

Factors which should be taken into account in specifying and designing this system are:

- For each delivery person, the system must print, each day, the publications to be delivered to each address.

- The system should also print, for the newsagent, a summary of who received what publications each day.

- Whether the newspapers and magazines are in stock.

- Once a month, bills are delivered to customers along with their newspapers. These bills should be computed automatically by the system.

- Customers come and go and may be away temporarily on holiday or on business.

- Not all customers necessarily have a delivery every day.

- The system should be able to manage some simple geographic information so that it prints information for the delivery person in the order in which publications are delivered.

Assignment Details:

1. You shall work as part of a collaborative group to which you are assigned.
2. You and your group are required to develop the User Stories for the Newspaper Delivery System. The user stories are to be documented in the group's Product Backlog using easybacklog.com.
3. Your work and the group's work should be guided by the Process Learning Criteria Sheet (see below).
4. Development of the User Stories should be guided by the Content Learning Criteria Sheet (see below).
5. You are required to maintain and version control a Learning Log (see below).
6. You are required to self-assess using a Reflective Essay, the Process Learning Criteria Sheet (15%), and the Content Learning Criteria Sheet (15%) (see below).
7. Submission requirements are detailed below.

Process Learning Criteria (for Guidance and Assessment of Assignment)

Working/Learning as a Group and Individual - TOTAL MARK

Criteria Descriptor	Well Achieved (100)	Achieved (60)	Not Achieved (20)
Setting (Plan) Achievable Goals - Group	Group goals clearly achievable within planned timeframe. **10**	Group goals partially achievable within planned timeframe. **6**	Group goals not achievable within planned timeframe. **2**
Setting (Plan) Achievable Goals - Individual	Individual goals clearly achievable within planned timeframe. **10**	Individual goals partially achievable within planned timeframe. **6**	Individual goals not achievable within planned timeframe. **2**
Individual Role within Group (Interpersonal Skills)	Individual frequently prompts further discussion of a topic, taking a leadership role in the discussions. **20**	Individual actively engages in and contributes to group work, interacting with and encouraging other group members. **12**	Individual does not actively engage in and contribute to group work. **4**
Quality and content of contribution – (Group / Individual)	Content contribution demonstrates critical thinking to analyse and relate key points across the whole project. **20**	Content contribution demonstrates critical thinking to analyse and relate a particular aspect within the project itself. **12**	Content contribution does not demonstrate any evidence of higher-order thinking skills. **4**
Learning Log (Refer to guidelines below)	Learning Log Entry completed as per guidelines and versioned after each piece of work undertaken. **20**	Learning Log Entry completed as per guidelines and versioned the majority of time after each piece of work undertaken. **12**	Learning Log Entry rarely completed as per guidelines and rarely versioned after each piece of work undertaken. **4**
Reaching Achievable Goals - Group	Group goals clearly reached within planned timeframe. **10**	Group goals partially reached within planned timeframe. **6**	Group goals not reached within planned timeframe. **2**
Reaching Achievable Goals - Individual	Individual goals clearly reached within planned timeframe. **10**	Individual goals partially reached within planned timeframe. **6**	Individual goals not reached within planned timeframe. **2**

A Guide to Setting Achievable Goals

	What do I or the group need to do to accomplish this goal?
What does the group / individual want to accomplish in the big picture? Address the following questions	What smaller goals can I or the group set that will help me achieve this goal?
	What is the timeline (group/individual) for achieving this goal?
	What specific steps will I or the group take to accomplish this goal? (Break the goal down into a list of smaller steps.)
	How will I or the group be held accountable for each of these steps?
	What happens if I or the group don't reach the goals?
	How do these goals help me meet standards (process and content learning criteria)?
	What do I or the group want to accomplish in the big picture?

Learning Log – Guidelines

1. Learning Log must be a Word Document (MS-WORD).
2. Learning Log Entries should be made shortly after any piece of work on the project has been undertaken.
3. Each Learning Log Entry must be date and time stamped within the Word Document.
4. Learning Log should be versioned controlled after each entry is made.
5. Learning Log Entries should consider addressing the following items:
    a. The amount of time you spent on this piece of work,
    b. Your area or tasks of responsibilities in the context of the group's and your own goals for completing the assignment (e.g. what were you trying to achieve in this session),
    c. Your contribution (role and content) to the group-work,
    d. What did you learn,
    e. How did you learn (e.g. individually by referring to a text-box, or by asking group-members/lecturer, or by receiving feedback on work done from group-members/lecturer),
    f. Describe any feedback received and how you acted upon that feedback, and
    g. Identify and justify any Interpersonal Skills (see Table below) you employed.

Common Interpersonal Skills - Checklist

Skill	Definition
Leadership	• Offers guidance and organizational suggestions to help the group complete tasks • Allows others to voice opinions and assume responsibilities • Shares in successes and failures • Encourages the group to move toward their goal
Decision making	• Listens to the opinions of others and takes them into consideration • Identifies possible courses of action and accurately describes the costs and benefits of each • Is willing to make a choice when the group needs to come to a decision
Trust building	• Follows through on commitments to others • Contributes to a positive atmosphere • Disagrees respectfully • Accurately assesses his or her own competence
Turn taking	• Listens when others are talking and does not interrupt • Acknowledges others who have spoken • Makes sure all others are included • Offers supportive statements • Uses verbal and nonverbal signals to invite responses from others
Active listening	• Makes eye contact with the speaker • Uses an open posture • Stops other activities to listen • Paraphrases statements of others • Asks clarifying questions • Seeks and offers feedback
Conflict management	• Listens to the views of others • Avoids hurtful statements about others • States his or her own views without becoming defensive • Is able to identify personal concerns and the concerns of others • Accepts the group's decision graciously • Is able to resume the task

Content Learning Criteria (for Guidance and Assessment of Assignment)

User Story Characteristics (INVEST) + Who, What, and Why - TOTAL MARK

Criteria Descriptor	Well Achieved (100)	Achieved (60)	Not Achieved (20)
Independent	For all User Stories—The user story must be able to stand alone. It must be a feature or a component of a feature that can be tested and implemented as a unique element. To the extent possible, user stories should not be dependent on other activities. Ideally, they are written so that they can be delivered in any order. **20**	Minority of User Stories do not fulfil the **Independent** Criteria. **12**	Majority of User Stories do not fulfil the **Independent** Criteria. **4**
Negotiable	For all User Stories — A user story should invite collaboration and discussion about the best way to solve the business problem that is presented. The team, the Scrum master, and the product owner must be open to conversation about available options. **10**	Minority of User Stories do not fulfil the **Negotiable** Criteria. **6**	Majority of User Stories do not fulfil the **Negotiable** Criteria. **2**
Valuable	For all User Stories — Each story adds value. The reason why we do anything in Agile is to drive business value, and the more business value being delivered, the higher the priority of the story. If the story does not add business value, the team should not work on it (or maybe not consider it). **15**	Minority of User Stories do not fulfil the **Valuable** Criteria. **9**	Majority of User Stories do not fulfil the **Valuable** Criteria. **3**

Estimatable	For all User Stories –Each story is estimatable. The story is not too big or too vague. It is clear enough that the developers and testers can reasonably estimate the complexity and length of time to deliver. **10**	Minority of User Stories do not fulfil the **Estimatable** Criteria. **6**	Majority of User Stories do not fulfil the **Estimatable** Criteria. **2**
Small	For all User Stories —The story should be small enough to be completed within a single sprint or iteration. **15**	Minority of User Stories do not fulfil the **Small** Criteria. **9**	Majority of User Stories do not fulfil the **Small** Criteria. **3**
Testable	For all User Stories —Is it enough of a feature, and it is written in such a way that it can be tested to make sure it works as expected? **15**	Minority of User Stories do not fulfil the **Testable** Criteria. **9**	Majority of User Stories do not fulfil the **Testable** Criteria. **3**
Who, What, and Why	For all User Stories – The Who, What, and Why are clearly identifiable. Who: A user story incorporates the perspective of the person who will use or benefit from the requested feature. What: A user story is a description of the requested feature (or component of a feature) that is short and simple. Why: A user story incorporates the "value" of the feature so the team can understand what is driving this particular request. **15**	Minority of User Stories do not fulfil the **Who, What, and Why** Criteria. **9**	Majority of User Stories do not fulfil the **Who, What, and Why** Criteria. **3**

Reflective Essay Guidelines

Your reflection should be an essay written in MS-WORD. Your essay needs to address the following points:

What your reflection should include:

1. Restate in your own words what the assignment asked you to do.
2. Discuss your process for completing the task.
3. Individually justify each criteria and mark you awarded yourself for Process Learning by providing suitable evidence/examples from your Learning Journal.
4. Individually justify each criteria and mark you awarded yourself for Content Learning by providing suitable evidence/examples from your Product Backlog.
5. In addressing items 1 to 4 consider
    a. What did you learn?
    b. How did you overcome challenges?
    c. What would you do differently the next time?

What your reflection should NOT include:

6. Bad habits of other group members (focus on yourself).
7. Whether or not you liked the assignment (unless there is constructive feedback as well).
8. Just answers to the above questions without a narrative.

Submission Requirements

1. Your Learning Log.
2. Your Git History Listing of Learning Log submissions.
3. Your Product Backlog contributions.
4. Your completed Process Learning Criteria Sheet including Total Mark.
5. Your completed Content Learning Criteria Sheet including Total Mark.
6. Your Reflective Essay.

Appendix L: Newspaper Application Description

This system is intended to manage the delivery of newspapers and magazines in some small town or area of a larger town. It is intended for use by newsagents who are only casual users of computer systems and should run on a PC or similar hardware.

Factors which should be taken into account in specifying and designing this system are:

- For each delivery person, the system must print, each day, the publications to be delivered to each address.

- The system should also print, for the newsagent, a summary of who received what publications each day.

- Whether the newspapers and magazines are in stock.

- Once a month, bills are delivered to customers along with their newspapers. These bills should be computed automatically by the system.

- Customers come and go and may be away temporarily on holiday or on business.

- Not all customers necessarily have a delivery every day.

- The system should be able to manage some simple geographic information so that it prints information for the delivery person in the order in which publications are delivered.

Appendix M: Semester 2 Group Project Instructions

Newsagent Project:

For the Newsagent User Stories identified last semester, you and your group are required to design, implement, and test the Newspaper Application over 3 sprints. The project itself will be planned, tracked, and implemented using Scrum, with an emphasis on Test Driven Development and Acceptance Testing of each delivered sprint.

From an assessment perspective, the following deliverables will be required to be completed within the indicated timelines:

- **Deliverable 1 (Pass/Fail):** Working Agreement (Group) - Week 1 to 3. **Assessment:** Week 3 - Presentation of Working Agreement.

- **Deliverable 2 (Pass/Fail):** Basic Environment Setup (Group / Individual) - Week 1 to 3. **Assessment:** Week 3 - Presentation/Demo of Basic Environment Setup.

- **Deliverable 3 (Pass/Fail):** Revision/Update (if required) of Version Controlled User Stories and Story Point strategy agreed. (Group) - Week 1 to 3. **Assessment:** Week 3 - Sign off of User Stories by Customer.

- **Deliverable 4 (Pass/Fail):** Sprint 1 - User Stories Allocation/Estimation (Group/Individual) - Week 2 to 3. **Assessment:** Week 3 - Sign off of Requirements by Customer.

- **Deliverable 5 (20%):** Sprint 1 - Version Controlled Unit Tested End to End Stories (Group/Individual) - Week 4 to 6. **Assessment:** Week 6 - Sprint 1 Demo to Customer.

- **Deliverable 6 (Pass/Fail):** Sprint 2 - User Stories Allocation/Estimation (Group/Individual) - Week 6. **Assessment:** Week 6 - Sign off of Requirements by Customer.

- **Deliverable 7 (20%)**: Sprint 2 - Version Controlled Unit Tested End to End Stories (Group/Individual) - Week 7 to 9. **Assessment:** Week 9 - Sprint 2 Demo to Customer.

- **Deliverable 8 (Pass/Fail):** Sprint 3 - User Stories Allocation/Estimation (Group/Individual) - Week 9. **Assessment:** Week 9 - Sign off of Requirements by Customer.

- **Deliverable 9 (20%):** Sprint 2 - Version Controlled Unit Tested End to End Stories (Group/Individual) - Week 10 to 12. **Assessment:** Week 9 - Sprint 3 Demo to Customer.

- **Deliverable 10 (Pass/Fail):** Individual Learning Log / Reflections (Individual) - Week 1 to 12. Required to use Learning Log/Reflection template. **Assessment** Week 13 - Individual Interviews.

Note: Pass/Fail deliverables must be passed in order to qualify for the marks in Deliverables 5, 7, and 9. Groups/Students who fail a Pass/Fail deliverable will attend for interview and be given the opportunity to demonstrate competency in the failed deliverable in Week 13.

Note: Groups shall be required to complete a Group Assessment for each deliverable and submit a hard-copy to the lecturer.

Appendix N: Group Observation Record Form

Observation Record Form (V1.0)	Group Number:

Group Details: (Please PRINT name in CAPITAL LETTERS)

Member 1: _____ Member 2: _____

Member 3: _____ Member 4: _____

Member 5: _____ Member 6: _____

Date: _____   Begin Time:_____   End Time:_____

Description of Observed Task:

Group Observations:

Individual Member Observations:

Appendix O: Deliverable 1 (D1) - Working Environment Self-Assessment

Student Name: _____   Student Number: _____

Group Number: _____   Assessed Mark: PASS/FAIL

Well Achieved	Achieved	Not Achieved
Working Agreement Agreed and Signed by all Group Members (G).	Draft Working Agreement in place (G).	No Working Agreement in place (G).
Group planned and completed this deliverable within the estimated time and/or amended the planned task list required (G).	Group planned and completed this deliverable but exceeded estimated time and/or amended the planned task list required (G).	Group did not create a plan (estimate and/or identify the tasks needed) for this deliverable (G).

Justification:
- *Reflect on why <u>you</u> believe that your group are Well Achieved, Achieved, or Not Achieved in each of the criteria that you have selected in the above table.*
- *<u>Summarise your group's Working Agreement and how you believe it will benefit your group.</u>*
- *(G) indicates a group criteria.*

Committed Participation	Participation	No Participation
I actively engaged by providing direction, making suggestions, listening, taking action etc. to ensure completion of this deliverable (I).	I listened and accepted direction, suggestions, etc. from other group members to determine my actions for this deliverable (I).	I did not engage with the group (I).
I learned/acquired new knowledge through interaction with my group and on my own individual (I).	I learned/acquired new knowledge on my own without any interaction with my group (I).	I did not learn/acquire any new knowledge (I).
I worked more than 75% of my planned/allocated hours <u>and</u> fully planned at an individual level the activities assigned to me (I).	I worked 30% to 75% of my planned/allocated hours and/or partially planned at an individual level the activities assigned to me (I).	I worked less than 30% of my planned/allocated hours and/or did not plan at an individual level the activities assigned to me (I).
I fully completed my planned tasks to the required quality level for this deliverable (I).	I partially completed my planned tasks to the required quality level for this deliverable (I).	I did not complete any of my planned tasks and/or did not reach the required quality level for this deliverable (I).

<u>**Justification**</u>**:**
- *Reflect on your level of participation in this deliverable. Justify your choice of Committed Participation, Participation, or No Participation for each of the listed criteria.*
- *<u>Clearly identify the new knowledge that you acquired.</u>*
- *<u>How was the quality level for the deliverable defined and achieved?</u>*
- *(I) indicates an individual criteria.*

Appendix P: Deliverable 2 (D2) - Development Environment Self Assessment

Student Name: _____ Student Number: _____

Group Number: _____ Assessed Mark: PASS/FAIL

Well Achieved	Achieved	Not Achieved
All members of the group can accessed the team repository (G).	Some, but not all, members of the group can accessed the team repository (G).	No team repository created (G).
All members have cloned team repository locally employing EGit/Sourcetree (G).	Some, but not all, members have cloned team repository locally employing EGit/Sourcetree (G).	No local repositories cloned (G).
All members have agreed and have tested the team's merge/notification process (G).	Some, but not all, members have agreed and have tested the team's merge / notification process (G).	No merge/notification process in place (G).
Group planned and completed this deliverable within the estimated time and/or amended the planned task list required (G).	Group planned and completed this deliverable but exceeded estimated time and/or amended the planned task list required (G).	Group did not create a plan (estimate and/or identify the tasks needed) for this deliverable (G).
All team members took responsibility to ensure that this deliverable was completed (G).	Some, but not all team members, took responsibility to ensure that this deliverable was completed (G).	One team member took responsibility to ensure that this deliverable was completed (G).

Justification:
- *Reflect on why <u>you</u> believe that your group are Well Achieved, Achieved, or Not Achieved in each of the criteria that you have selected in the above table.*
- *<u>Summarise your group's Merge/Notification Process and how you believe it will benefit your group.</u>*
- *(G) indicates a group criteria.*

Committed Participation	Participation	No Participation
I actively engaged by providing direction, making suggestions, listening, taking action etc. to ensure completion of this deliverable (I).	I listened and accepted direction, suggestions, etc. from other group members to determine my actions for this deliverable (I).	I did not engage with the group (I).
I learned/acquired new knowledge through interaction with my group and on my own individual (I).	I learned/acquired new knowledge on my own without any interaction with my group (I).	I did not learn/acquire any new knowledge (I).
I worked more than 75% of my planned/allocated hours and fully planned at an individual level the activities assigned to me (I).	I worked 30% to 75% of my planned/allocated hours and/or partially planned at an individual level the activities assigned to me (I).	I worked less than 30% of my planned/allocated hours and/or did not plan at an individual level the activities assigned to me (I).
I fully completed my planned tasks to the required quality level for this deliverable (I).	I partially completed my planned tasks to the required quality level for this deliverable (I).	I did not complete any of my planned tasks and/or did not reach the required quality level for this deliverable (I).

Justification:
- *Reflect on your level of participation in this deliverable. Justify your choice of Committed Participation, Participation, or No Participation for each of the listed criteria.*
- *Clearly identify the new knowledge that you acquired.*
- *How was the quality level for the deliverable defined and achieved?*
- *(I) indicates an individual criteria.*

Appendix Q: Deliverable 3 (D3) - User Stories Self-Assessment

Student Name: _____   Student Number: _____

Group Number: _____   Assessed Mark: PASS/FAIL

Well Achieved	Achieved	Not Achieved
More than 75% of the User Stories meet the INVEST criteria (G).	30% to 75% of the User Stories meet the INVEST criteria (G).	Less than 30% of the User Stories meet the INVEST criteria (G)
Story Point strategy agreed <u>and</u> story point values assigned to User Stories (G).	Story Point strategy agreed but no story point value assigned to User Stories (G).	No Story Point strategy agreed (G).
User Stories reviewed in the context of a well-defined review strategy (G).	User Stories reviewed but no review strategy defined (G).	User Stories not reviewed (G).
Group planned and completed this deliverable within the estimated time and/or amended the planned task list required (G).	Group planned and completed this deliverable but exceeded estimated time and/or amended the planned task list required (G).	Group did not create a plan (estimate and/or identify the tasks needed) for this deliverable (G).
All team members took responsibility to ensure that this deliverable was completed (G).	Some, but not all team members, took responsibility to ensure that this deliverable was completed (G).	One team member took responsibility to ensure that this deliverable was completed (G).

<u>**Justification**</u>**:**
- *Reflect on why <u>you</u> believe that your group are Well Achieved, Achieved, or Not Achieved in each of the criteria that you have selected in the above table.*
- ***<u>Summarise how your group divided the tasks or work needed to create the User Stories. Justify the group's review strategy.</u>***
- *(G) indicates a group criteria.*

Committed Participation	Participation	No Participation
I actively engaged by providing direction, making suggestions, listening, taking action etc. to ensure completion of this deliverable (I).	I listened and accepted direction, suggestions, etc. from other group members to determine my actions for this deliverable (I).	I did not engage with the group (I).
I learned/acquired new knowledge through interaction with my group and on my own individual (I).	I learned/acquired new knowledge on my own without any interaction with my group (I).	I did not learn/acquire any new knowledge (I).
I worked more than 75% of my planned/allocated hours <u>and</u> fully planned at an individual level the activities assigned to me (I).	I worked 30% to 75% of my planned/allocated hours and/or partially planned at an individual level the activities assigned to me (I).	I worked less than 30% of my planned/allocated hours and/or did not plan at an individual level the activities assigned to me (I).
I fully completed my planned tasks to the required quality level for this deliverable (I).	I partially completed my planned tasks to the required quality level for this deliverable (I).	I did not complete any of my planned tasks and/or did not reach the required quality level for this deliverable (I).

Justification:
- *Reflect on your level of participation in this deliverable. Justify your choice of Committed Participation, Participation, or No Participation for each of the listed criteria.*
- *<u>Clearly identify the new knowledge that you acquired.</u>*
- *<u>How was the quality level for the deliverable defined and achieved?</u>*
- *(I) indicates an individual criteria.*

Appendix R: Deliverable 4 (D4) - Sprint 1 Planning Self-Assessment

Student Name: _____ **Student Number:** _____

Group Number: _____ **Assessed Mark: PASS/FAIL**

Well Achieved	Achieved	Not Achieved
User Stories prioritised for this Sprint using agreed prioritisation technique and some discussion on prioritisation for subsequent sprints (G).	User Stories prioritised for this Sprint using agreed prioritisation technique (G).	User Stories not prioritised for this Sprint (G).
Story Point strategy agreed <u>and</u> story point values assigned to User Stories (G).	Story Point strategy agreed but no story point value assigned to User Stories (G).	No Story Point strategy agreed (G).
Story Point ESTIMATION strategy agreed based on a well-defined rationale underpinning the estimation technique (G).	Story Point ESTIMATION strategy agreed but no rationale underpinning the estimation technique (G).	No Story Point ESTIMATION strategy agreed (G).
System architecture understood by all team members. Alternative architectures were discussed and considered (G).	System architecture understood by some, but not all, team members (G).	System architecture not agreed (G).
Definition of Done agreed by all relevant stakeholders (G).	Definition of Done agreed by the group only (G).	No Definition of Done agreed (G).
Group planned and completed this deliverable within the estimated time and/or amended the planned task list required (G).	Group planned and completed this deliverable but exceeded estimated time and/or amended the planned task list required (G).	Group did not create a plan (estimate and/or identify the tasks needed) for this deliverable (G).
All team members took responsibility to ensure that this deliverable was completed (G).	Some, but not all team members, took responsibility to ensure that this deliverable was completed (G).	One team member took responsibility to ensure that this deliverable was completed (G).

Justification:
- ***Reflect on why <u>you</u> believe that your group are Well Achieved, Achieved, or Not Achieved in each of the criteria that you have selected in the above table.***
- ***<u>Summarise and justify your group's prioritisation and estimation techniques.</u>***
- ***(G) indicates a group criteria.***

Committed Participation	Participation	No Participation
I actively engaged by providing direction, making suggestions, listening, taking action etc. to ensure completion of this deliverable (I).	I listened and accepted direction, suggestions, etc. from other group members to determine my actions for this deliverable (I).	I did not engage with the group (I).
I learned/acquired new knowledge through interaction with my group and on my own individual (I).	I learned/acquired new knowledge on my own without any interaction with my group (I).	I did not learn/acquire any new knowledge (I).
I worked more than 75% of my planned/allocated hours and fully planned at an individual level the activities assigned to me (I).	I worked 30% to 75% of my planned/allocated hours and/or partially planned at an individual level the activities assigned to me (I).	I worked less than 30% of my planned/allocated hours and/or did not plan at an individual level the activities assigned to me (I).
I fully completed my planned tasks to the required quality level for this deliverable (I).	I partially completed my planned tasks to the required quality level for this deliverable (I).	I did not complete any of my planned tasks and/or did not reach the required quality level for this deliverable (I).

Justification:
- *Reflect on your level of participation in this deliverable. Justify your choice of Committed Participation, Participation, or No Participation for each of the listed criteria.*
- *Clearly identify the new knowledge that you acquired.*
- *How was the quality level for the deliverable defined and achieved?*
- *(I) indicates an individual criteria.*

Appendix S: Deliverable 5 (D5) - Sprint 1 Self-Assessment

Student Name: _____ **Student Number:** _____

Group Number: _____ **Assessed Mark:** _____/ 10

Well Achieved	Achieved	Not Achieved
Definition of Done met (G).	Definition of Done partially met (G).	Definition of Done not met (G).
Group completed more than 80% of the deliverable within the Sprint duration (4 weeks) and the estimated group time (G).	Group completed more than 50% but less than 80% of the deliverable within the Sprint duration (4 weeks) and the estimated group time (G).	Group completed less than 50% of the deliverable within the Sprint duration (4 weeks) and the estimated group time (G).
All team members took responsibility to ensure that this deliverable was completed (G).	Some, but not all team members, took responsibility to ensure that this deliverable was completed (G).	One team member took responsibility to ensure that this deliverable was completed (G).

Justification:
- *Reflect on why <u>you</u> believe that your group are Well Achieved, Achieved, or Not Achieved in each of the criteria that you have selected in the above table.*
- *<u>Summarise how your work integrated with the work of the other team members. Discuss, in particular, any problems encountered.</u>*
- *(G) indicates a group criteria.*

Committed Participation	Participation	No Participation
I actively engaged by providing direction, making suggestions, listening, taking action etc. to ensure completion of this deliverable (I).	I listened and accepted direction, suggestions, etc. from other group members to determine my actions for this deliverable (I).	I did not engage with the group (I).
I learned/acquired new knowledge through interaction with my group and on my own individual (I).	I learned/acquired new knowledge on my own without any interaction with my group (I).	I did not learn/acquire any new knowledge (I).
I worked more than 75% of my planned/allocated hours <u>and</u> fully planned at an individual level the activities assigned to me (I).	I worked 30% to 75% of my planned/allocated hours and/or partially planned at an individual level the activities assigned to me (I).	I worked less than 30% of my planned/allocated hours and/or did not plan at an individual level the activities assigned to me (I).
I fully completed my planned tasks to the required quality level for this deliverable (I).	I partially completed my planned tasks to the required quality level for this deliverable (I).	I did not complete any of my planned tasks and/or did not reach the required quality level for this deliverable (I).

<u>**Justification**</u>:
- ***Reflect on your level of participation in this deliverable. Justify your choice of Committed Participation, Participation, or No Participation for each of the listed criteria.***
- ***<u>Clearly identify the new knowledge that you acquired.</u>***
- ***<u>How was the quality level for the deliverable defined and achieved?</u>***
- ***(I) indicates an individual criteria.***

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