A cross-national comparative study exploring formative assessment enactment in Ireland and Scotland

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List of Acronyms

AiFL:	Assessment is For Learning
BERA:	British Educational Research Association
CBA:	Classroom-based assessment
CERI:	Centre for Educational Research
CfE:	Curriculum for Excellence
CHAT:	Cultural Historical Activity Theory
CPD:	Continual Professional Development
DOL:	Division of Labour
ESRI:	Economic and Social Research Institute
FaSMEd:	Formative Assessment In Science and Maths Education
JCT:	Junior Cycle for Teachers
KLAs:	Key Learning Areas
KMOFAP:	Kings College Medway Oxford Formative Assessment Project
LHTL:	Learning How to Learn
MAXQDA:	Max Weber Qualitative Data Analysis
NCCA:	National Council for Curriculum and Assessment
OECD:	Organisation for Economic Co-operation and Development
PCK:	Pedagogical Content Knowledge
SERA:	Scottish Educational Research Association
SIMD:	Scottish Index of Multiple Deprivation
ZDP:	Zone of Proximal Development

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Abstract

How formative assessment is enacted is not fully understood. This thesis explored formative assessment enactment in Ireland and Scotland with a specific focus on the factors that promote or inhibit enactment. The literature review revealed a gap in the research on how formative assessment is enacted in second level science classrooms, particularly in Ireland. The study employed a multi-site case study methodology with activity theory providing the theoretical lens. A sample of four second level schools (two in Ireland and two in Scotland), four school leaders, and eight science teachers with their lower second level science classes were recruited to the study. Data were gathered using interview, observation, video data, desk research, and the Q methodology. Qualitative data were coded using themes relating to formative assessment (Wiliam and Thompson, 2007) and activity theory (Engeström, 1987). Q data were analysed quantitively using PQ Method software (Schmolck & Atkinson, 2002). Findings from this thesis illustrated that in Ireland there is a strong focus on tools for formative assessment without consideration of its true purpose: improved learning and responsive teaching. While teachers plan to enact formative assessment, they were not using it to inform teaching and learning. The cultural context of high stakes examinations in Ireland was also undermining formative assessment enactment. Scotland had a longer time with formative assessment in their Curriculum for Excellence (Scottish Executive, 2004). However the data showed teachers were still not enacting formative assessment effectively. The findings add new knowledge to the scholarship on formative assessment. Most notably a pair of factors for effective formative assessment enactment are presented: cultural context and assessment literacy. In addition, this thesis uncovered a variety of other factors that were influencing formative assessment enactment including curriculum, whole school initiatives, professional development, school community, teacher professional identity, and teacher student relationships.

1. Introduction

What is formative assessment? Being both a teacher and researcher I had a curiosity about how teachers enact formative assessment. I started thinking about second level teachers in Ireland. I had a feeling that teachers misunderstood the purpose of formative assessment, which is improved learning and responsive teaching. From previous research I conducted in Ireland (FaSMEd, 2015), I noted a superficial enactment of formative assessment in science classes, with a strong focus on tool use (for example: traffic light cups and mini whiteboards) without any follow up to enhance student learning. I was curious as to why there was this superficial adaption. I thought about how teachers encounter formative assessment through professional development. Being a teacher, I felt that professional development in Ireland on formative assessment was disjointed. Some schools took it upon themselves to teach their interpretation of formative assessment, while some external agencies offered training on assessment. All these thoughts and feelings combined to form the research problem of this thesis: how formative assessment is enacted is not fully understood.

At this point I will explain the research problem in more detail, why is formative assessment misunderstood? This can be related to how formative assessment is interpreted in theory, policy, and practice. Beginning with theory, since the 1960s when formative assessment began, it has been understood through many different learning theories including behaviourism, cognitivism, constructivism, and sociocultural theory. Because of this, the underlying principles of formative assessment have changed since its emergence in the 1960s. As a result, I argue that it has been theorised and interpreted differently, which has added to the misunderstanding of what exactly formative assessment is. Moving next to looking at policy, this thesis collected data in Ireland and Scotland where both have their own separate definitions for formative assessment. In Ireland formative assessment policy focuses on what the teacher can do to get feedback from students to improve their learning (Department of Education and Skills, 2015a), whereas in Scotland, formative assessment is not treated as a standalone entity, it is considered as part of assessment in general, and includes key features such as supporting learning, informing improvement, and planning the next stages in learning (Scottish Government, 2011).

The misunderstanding continues when we look at how formative assessment is enacted in classrooms. To begin, empirical research on formative assessment in Ireland, is scarce. The

data we have suggest that teachers' approaches to formative assessment are sporadic, teacher led and lack student active engagement (Lysaght & O'Leary, 2013). In Scotland where there is a larger body of research on formative assessment, there is a lack of clear understanding as to how formative assessment should be implemented with contradictions arising amongst teachers' intended and enacted practices (Hayward, 2015).

At the time of research, Ireland was undergoing curriculum reform at lower second level. I was curious about how teachers were going to enact the new Junior Cycle Framework (Department of Education and Skills, 2015a), the revised curriculum for lower second level education. I wanted to observe classroom practice where the new curriculum was enacted. The new curriculum is less focused on a terminal exam and brings in continuous assessment practices such as classroom-based assessments and assessment tasks into the classroom. Because of the new focus on continuous assessment (with some focus on formative assessment) I needed to know how the Junior Cycle Framework was developed. This led me to looking at Scotland as its Curriculum for Excellence (Scottish Executive, 2004) which informed the development of the Junior Cycle Framework in Ireland. This had me thinking about how policy borrowing worked and what formative assessment enactment looked like in Scotland. Since they had been implementing the Curriculum for Excellence in Scotland from 2010, I asked: was formative assessment enacted effectively to improve student learning? This is where the rationale for the comparative study came into play. If I could observe formative assessment in practice in Scotland, could I possibly determine the factors that were helping it to be enacted? Then it might be possible to consider these factors in the Irish system so that curriculum reform could be at its most beneficial to student learning.

Aim, Objectives, and Research Questions

The aim of this research was to examine formative assessment enactment in lower second level science classes and identify what factors can influence teaching, learning, and assessment practices. Formative assessment was the focus of this research and the definition used in this thesis is as follows:

> "Practice in a classroom is formative to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better

> founded, than the decisions they would have taken in the absence of the evidence that was elicited." (Black & Wiliam, 2009, p. 9)

In the previous definition, teaching is seen as a dynamic process involving various actors: the teacher; the learner; and peers, where evidence of student learning takes centre stage. This definition considers moments of contingency, a fundamental aspect of formative assessment overlooked in previous definitions (see for example Black, Harrison, Lee, Marshall, & Wiliam, 2004; Black & Wiliam, 1998; Cowie & Bell, 1999). These moments of contingency will be discussed further in the literature review chapter.

Central to this research were two main questions, these questions had yet to be answered in the literature with a specific paucity on the factors[1] that promote or inhibit formative assessment practice.

1. How is formative assessment understood and enacted in lower second level classes in Ireland and Scotland?
2. What are the factors that shape formative assessment enactment in science classes in these countries?

The first question was concerned with the how teachers intended to enact formative assessment in their classrooms and then what enactment looked like. The second question was more exploratory. Although a sample of factors are cited in a footnote, this was not an exhaustive list. Other factors emerged from the data, and these were examined in relation to their influence on classroom practices.

The five main objectives of the research were as follows:

1. Observe assessment practices in science lessons to determine if formative assessment is embedded in practice.
2. Determine teachers' understanding of formative assessment and identify what they believe to be the significant influences on their teaching practices.
3. Ascertain the influence of cultural context on teaching, learning, and assessment practices within schools.
4. Examine students' beliefs about the teaching, learning, and assessment practices enacted in their school and science classes.

[1] *Factors* in this case refer to influences on teaching, learning, and assessment such as classroom culture, teacher professional identity, relationships, and curriculum policy.

5. Investigate the influence of curriculum policy on a school's approach to formative assessment.

The first objective was concerned with how teachers practice formative assessment in science lessons. What strategies were prevalent, what ones were lacking? Were there commonalities or differences among teachers? Were practices being enacted effectively to improve student learning? The main method used to gather data to address this objective was through classroom observation. During observations detailed field notes were penned and lessons were videoed so that they could be revisited during the analysis process.

The second objective concerned teachers and their practices. What was making them teach in a certain way? Where and how did they learn these practices? Were the teachers internally motivated or was there an external source promoting these practices in their classroom? This objective provided a link between the observed teaching practices and the wider influences on teaching practice. This objective was realised through teacher interviews and was backed up with observational data. For example, when an interesting practice arose during an observation it was noted and discussed during the teacher interview to understand the nuances of the practice.

The third objective widened the lens on teaching practice and focused on the whole school and country context. What was going on in the school that promoted or inhibited formative assessment? Were there whole school initiatives that were directed at improving teaching and learning? Were external factors such as curriculum or community influencing the quality of teaching and learning in a school? Data on this objective were gathered through interviews with school leaders with consideration given to policy documentation at lower second level in Ireland and Scotland.

The fourth objective considered the student voice in terms of teaching, learning and assessment. What do they have to say about how they are taught? How do they like to learn? How do cultural and contextual factors to the school influence their learning? This was the only objective that used quantitative methods in gathering the data. A mixed methods approach using the Q methodology was employed. In addition, the data in this objective were triangulated with the observation data.

Finally, the fifth objective stepped away from the research participants and focused on review of cross-national policy. It aimed to identify the challenges and possibilities for policy learning and sharing in relation to second level education across Scotland and Ireland. What aspects of policy did the countries have in common? What were their differences in policy? How did the countries compare in their enactment of formative assessment? For the most part this objective was achieved through policy and curriculum review however, in some cases data arose from interviews.

Theoretical Framework

Activity theory was the theoretical framework of choice for this research. It is a sociocultural theory of learning and is often represented through an activity system diagram (Figure 2) that is best viewed as "complex formations in which equilibrium is an exception and tensions, disturbances and local innovations are the rule and engine of change" (Salomon, 1993, pp. 8–9). It provided for a subject's[2] activity system (Engeström, 1987) to be analysed in detail while helping to explain how cultural and contextual factors can influence day to day classroom life. Thus, the unit of analysis (and therefore the subject) in this study was the teacher and their lower second level science class. Activity theory was the best fit for this research as it drew together my epistemological and ontological beliefs about teaching, learning and assessment. The ontological foundations of this thesis lay within social constructivism where reality is produced through social interaction and along with knowledge is indeterminant and in a constant state of revision (Bryman, 2008). My epistemological position is that knowledge is socially constructed as there are no absolute truths emerging from research and research is not devoid of underlying theoretical assumptions. Therefore, this research was situated in interpretivist paradigm.

Scope of the Study

The aim of this research was to examine formative assessment enactment in lower second level science classes and identify the cultural and contextual factors that can influence teaching, learning, and assessment practices. The reason for this being that formative assessment should improve student learning (Black, Harrison, Lee, Marshall, & Wiliam, 2003; Black & Wiliam,

[2] The subject is the actor/participant in an activity system. The subject is not to be thought of as a single entity but as an individual entwined in society that is affected by the context in which he or she is situated. The subject can be more than one participant, for example, in this thesis the subject was the teacher and their science class.

2005, 2012). The research design for this study was based on multi-site case studies utilising a mixed methods approach to data collection. In addition, this research sought to investigate the influence of education policy on an education system, therefore it was deemed necessary to add a cross-national comparative aspect to data collection and analysis. Data were collected in both Ireland and Scotland.

Data collection began in June 2017 and continued until March 2018. Within this time four schools were involved in the research, two in Scotland and two in Ireland. The schools in Scotland were located within the East Renfrewshire and Angus local authorities, in Glasgow and Dundee respectively. Both schools in Ireland were in the east of the country, one in Dublin and one in Meath. Within each school two science teachers were observed and interviewed, and school leaders were also interviewed. In total eight science teachers (two male and six female) were observed in their lower second level classes. In Ireland lower second level classes comprised of first year students; in Scotland it was second year (S2) students. All students were between the ages of 12 and 14. Of those students, six from each class took part in the Q methodology (n=48, 23 male and 25 female) comprising of an individual card sort activity and interview. In total, just over 25 hours of lessons were observed, equating to approximately one week of science lessons per school. Each class was observed for three hours of lessons on average.

To summarise, the research followed a mixed methods approach to data collection comprising of:

- 4 school leaders interviews
- 8 science teacher interviews
- 48 student Q methodologies (card sort and interview)
- 25 hours of classroom observation and video data. Field notes were penned during observations.
- Desk research of policy documentation

For the most part data were analysed qualitatively, with the Q methodology adding a quantitative aspect. Interview transcripts and video data were coded using themes relating to formative assessment and activity theory discussed later in the methodology chapter. Q data were analysed quantitively using PQ Method software (Schmolck & Atkinson, 2002), again this process is discussed later in the thesis.

Overview of Main Findings

This thesis advances the scholarship on formative assessment by adding two main findings to the field:

1. ***Cultural context*** *plays a significant role in deciding what teaching, learning, and assessment practices are given value within an education system.*
2. *Teachers'* ***assessment literacy*** *is underdeveloped therefore it is difficult for them to enact formative assessment effectively.*

These emergent findings are considered as a pair of factors that are significant in explaining how formative assessment is enacted in schools. Each of these findings contributed to the teaching, learning, and assessment norms of the participant schools. This is discussed in more detail in Chapter 10.

Looking next to answering each of the research questions:

1. *How is formative assessment understood and enacted in lower second level classes in Ireland and Scotland?*

This research found that in Ireland formative assessment is understood by schools and teachers as a tool-based approach to assist student learning. The focus in science lessons was often on the specific tool used for formative assessment (for example technology), without using the information gained from the tool to improve student learning. This was common among the teachers from Ireland where contradictions arose between their intended (what they discussed in interview) and enacted (what was observed) practice.

Scotland was used as a comparative for examining formative assessment enactment in this research. Scotland had formative assessment engrained in the curriculum for a number of years through Assessment is for Learning (Scottish Government, 2005) and the Curriculum for Excellence (Scottish Executive, 2004). These initiatives predated Ireland's Junior Cycle Framework and it was envisaged that there would be a deeper level of formative assessment understanding in Scotland, and this would provide insight into how Ireland could engage more with formative assessment. This preconception was confirmed with one Scottish teacher only. Whereas, with the rest of the teachers from Scotland similarities were drawn to the teachers from Ireland, whereby the intentions for enactment were there but the follow through was lacking due to constraining factors, such as school community and the provision for professional development.

2. *What are the factors that shape formative assessment enactment in science classes in these countries?*

The second question looked at the different factors that shaped enactment and in particular what factors were promoting or inhibiting formative assessment. Drawing from the data chapters, Figure 1 depicts the various factors that were considered to influence formative assessment enactment in both Ireland and Scotland. These factors are explored in the data chapters (Chapter 5 to 9) and discussed in detail in Chapter 10.

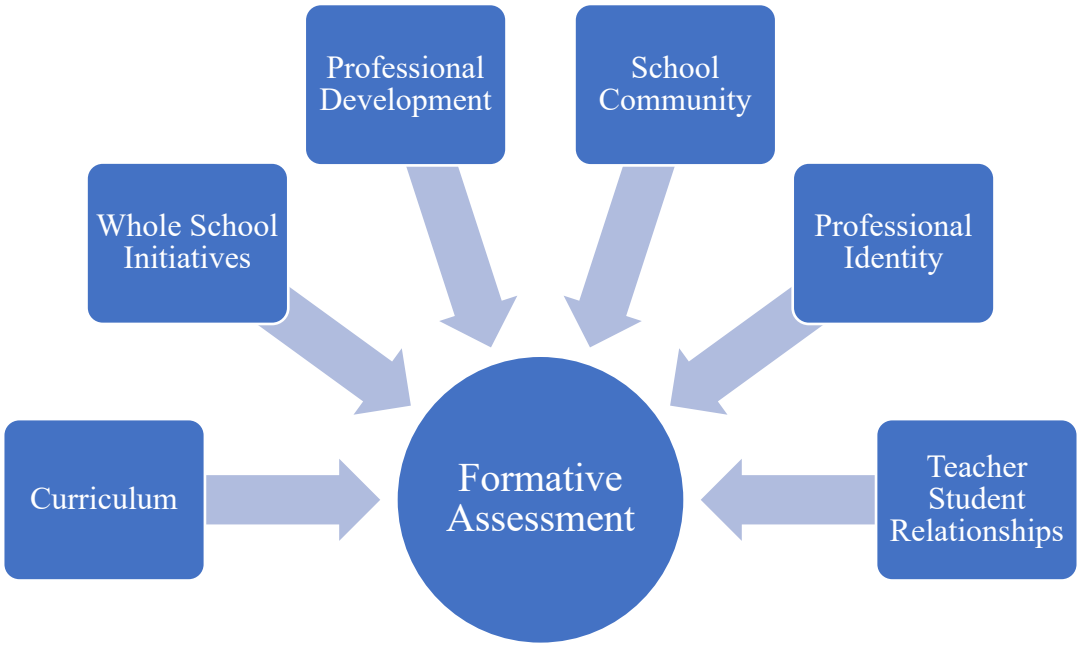

Figure 1: Emerging factors effecting formative assessment enactment in this research

Layout

This thesis is presented in ten chapters, this being the first. The second chapter is concerned with the theoretical development of formative assessment and presents the theoretical framework for this thesis. The third chapter explores literature on teaching, learning, and assessment, and is broken down into the following sections: policy context of classroom assessment in Ireland and Scotland, empirical research on teaching, learning, and assessment from Ireland and Scotland, and formative assessment empirical research. The fourth chapter focuses on the research methodology and justifies the methods chosen. It also outlines the validity and reliability of the research instruments while considering the limitations and positionality of this research.

Chapters 5 through 8 present data analysis using evaluative *episodes* (Hardman, 2007) of four case study teachers participating in this research: Dylan, Matthew, Nora, and Amy. In addition, factors external to these teachers' evaluative episodes were analysed to determine their influence on teaching, learning, and assessment. Chapter 9 presents both qualitative and quantitative data from the Q methodology. This chapter focuses on students' beliefs about the teaching, learning, and assessment practices occurring in their schools and science lessons. The final chapter, Chapter 10 presents the discussion and conclusion of this thesis. Findings from both Ireland and Scotland are discussed, research questions are answered and implications for theory and practice are discussed. In addition, the recommendations for further research and the limitations of the study are presented.

2. From behaviourism to sociocultural theory: How is formative assessment conceptualised within theories of learning?

Introduction

Formative assessment first emerged in western scholarship in the 1960s. Searching for a definition of formative assessment is not difficult, a simple online search yields an array of definitions (see for example Cowie & Bell, 1999; Frey & Schmitt, 2007; Miller & Lavin, 2007). However, what is clear from examining the literature is that a uniform definition for formative assessment does not exist. This is not necessarily a limitation to those who study formative assessment, rather, it is presented as a multidimensional concept that needs to be explored from whichever learning theory one situates their research. This chapter is concerned with mapping the development of formative assessment within three main theories of learning: behaviourist, constructivist, and sociocultural theories. To do this a semi-chronological approach was undertaken to explore the growth of formative assessment from its inception in the 1960s, to the most recent relevant work. As the body of research on formative assessment extends geographic boundaries and overlaps at certain points in time, a completely chronological development was not possible. The chapter concludes by presenting the theoretical framework of this thesis.

Table 1 outlines the key contributions of scholars to formative assessment theory. Scholarship was chosen to be included in this chapter based on its relevance to the research questions. As this research took place in Ireland and Scotland the works of Black, Wiliam and their colleagues at Kings College London were reviewed in detail (Black, Harrison, Lee, Marshall, & Wiliam, 2004; Black & Wiliam, 1998b, 2003, 2006, 2012, 2018; Wiliam & Black, 1996). They cite how Scriven coined the term formative evaluation therefore, an examination of his work was necessary. Following this line of enquiry, other behaviour theorists who cite Scriven and his formative work were included to build a picture of what formative assessment first emerged as (Bloom, Hastings, & Madaus, 1971). Moving forward to the 1970's, Piaget (1971) and Vygotsky (1978) were fundamental in driving learning theory forward so their work was included to explore how formative assessment was understood through cognitive, constructivist and sociocultural lenses. Later this chapter discusses the theoretical framework of this thesis therefore literature on activity theory (Black & Wiliam, 2009, 2018; Engeström, 1987) was necessary to help frame how formative assessment is interpreted in this thesis.

Furthermore, formative assessment theorists cite how activity theory is fundamental in understanding how phenomena such as formative assessment come to be operationalised, thus it was included in this chapter. Finally, the works of Sadler (1989), Shepard (2000) and Pryor and Crossouard (2008), were included as they are often cited in formative assessment scholarship from Western culture and they each added a new facet to formative assessment theory by examining feedback, constructivism, and sociocultural theory respectively. Other theoretical work on formative assessment by authors such as Allal (1979, 1988) were not included in this chapter as English translations of this work were not available.

Year	Author	Country	Contribution to Formative Assessment	Learning Theory
1963/64[3]	Cronbach	USA	Distinguished between two types of evaluation: fluid and appraisal.	Behaviourism
1967	Scriven	USA	Coined the terms formative and summative evaluation in curriculum development.	Behaviourism
1971	Bloom, Hastings, Madaus	USA	Applied the terms formative and summative evaluation to teaching and learning.	Behaviourism
1971	Piaget	Switzerland	Theorised cognitive development stages in the child. Stressed the importance of active learning and self-regulation	Cognitivism Constructivism
1978	Vygotsky	Soviet Union	Zone of proximal development (ZDP)	Sociocultural theory
1987	Engeström	Finland	Activity theory presented to explore a subject classroom i.e., an activity system.	Sociocultural theory Activity theory
1989	Sadler	Australia	Focused on the role of the student in formative assessment.	Constructivism
2000	Shepard	USA	Importance placed on constructivist and sociocultural theories of learning in education systems.	Social constructivism
2006	Black and Wiliam	United Kingdom	Began to develop a theory of formative assessment.	Sociocultural theory Activity theory
2008	Pryor and Crossouard	United Kingdom	Development of a model for formative assessment based on sociocultural theory	Sociocultural theory Identity theory
2009	Black and Wiliam	United Kingdom	Condemned oversimplification of formative assessment, focus on moments of contingency in learning.	Sociocultural theory Activity theory
2018	Black and Wiliam	United Kingdom	Situated formative assessment within theories of pedagogy, instruction, and learning, and by the subject discipline, together with the wider context of education.	Activity theory

Table 1: Key scholarship in formative assessment theorisations presented chronologically.

[3] This article was originally published in 1963 but reprinted in 1964. Reference used in this thesis refers to the latter version of the article.

Early Days: Behaviourism in the USA

Formative assessment first emerged in the 1960's in North America. Behaviourism was a common theoretical standpoint for education scholarship in the USA at this time (Mota & Scott, 2014). Behaviourist theories are concerned with the rapid acquisition of new skills by deconstructing complex activities and focusing on individual stimulus response events. According to James:

> "the environment for learning is the determining factor. Learning is viewed as the conditioned response to external stimuli. Rewards and punishments, or at least the withholding of rewards, are powerful ways of forming or extinguishing habits. Praise may be part of such a reward system." (2006, p. 7)

Initially established in the 1920's by Watson, and added to by American psychologists such as Skinner and Thorndike, behaviourist theory suggested that if human behaviour is reinforced or rewarded it is likely to continue, whereas if it is not it is most likely to disappear (Merriam & Bierema, 2014). Utilising behaviourism in education research applies a tunnel vision of learning where learning occurs in homogeneous student groups according to skill level. James (2006, p. 4) provided a vignette as to how behaviourism may manifest itself in teaching, learning, and assessment. She presented the following scenario where an English teacher has just received a new student (whose first language is not English) into her class:

> "She sits him in a quiet room by himself and sets him a timed test that consists of short answer questions asking him, without recourse to reference material or access to other students, to identify parts of given sentences (nouns, verbs, articles, connectives); make a list of adjectives to describe nouns; punctuate sentences; spell a list of ten words in a hierarchy of difficulty; write three sentences describing a favourite animal or place; write the opening paragraph of a story. She then marks these using a marking scheme (scoring rubric), which enables her to identify incorrect answers or weaknesses and compare his performance with others in the class. As a result, she places him in a group with others at a similar level and then provides this group with additional exercises to practise performance in areas of weakness. When he shows improvement, she is liberal with her praise and then moves on to the next set of skills to be learnt. Learning by rote and practice are a dominant feature of this approach."

The fictitious account drew on some key features of behaviourism:

- Individualised work
- Importance of testing

- Use of premade marking schemes
- Praise for work mastered
- Rote learning

It was within this behaviourist theory that formative assessment first emerged and was initially known as formative evaluation. It is widely cited that Michael Scriven was the first to coin the term formative evaluation, however on closer inspection of his writings it appeared that he built his work upon the work of Lee Joseph Cronbach. In his writings Scriven described how Cronbach began the process of distinguishing between formative and summative evaluation by stating that:

> "Evaluation used to improve the course while it is still fluid, contributes more to improvement of education than evaluation used to appraise a product already placed on the market." (Cronbach, 1964, p. 236)

Scriven expanded Cronbach's work in his paper on curriculum evaluation (1967). Although his discussion of *formative* and *summative* assessment was very brief, he proposed using the terms formative and summative to describe what Cronbach referred to as *fluid* and *appraisal* evaluation (Cronbach, 1964, p. 236). Furthermore, Scriven suggested that both types of evaluation were inseparable as many stakeholders in education, such as schools or policymakers, viewed summative evaluation as an "inescapable obligation" and "desideratum" of an education system (Scriven, 1967, p. 44). However, he then considered formative evaluation as a "necessary part of any rational approach to producing good results on the summative evaluation" and that "its occurrence is to some degree guaranteed by the nature of the case" (pp. 44-45). Here Scriven set up a dyadic relationship between summative and formative evaluation with one presupposing the other.

While Scriven focused on curriculum evaluation in formative and summative evaluation (although he did suggest his ideas may be applied to other areas of educational evaluation), it was Bloom, Hastings, and Madaus (1971) who used the term *formative* in the area of teaching and learning specifically to describe improving student learning. This was a step forward from Scriven's thinking where he applied formative evaluation to curriculum only. In the opening pages of their *Handbook on Formative and Summative Evaluation* (1971*)*, Bloom, Hastings, and Madaus suggested that it is the responsibility of schools to "seek learning conditions which will enable each individual to reach the highest level of learning possible for him" (p.6). For

improvements to occur in the individual learner they believed that it was the responsibility of a school to make effective use of summative and formative evaluation. They linked formative and summative evaluation to their concept of *mastery learning* where instruction in a classroom is modified to the different needs of students (p.48). Having a variety of instructional materials (referred to as tools in this thesis) could help overcome passivity in learning and enable a student to become more independent in their learning. Additionally, rewarding student effort where frequent feedback was an important factor in students persevering at a task. Moreover, teachers and students must be aware of achievement criteria and secure evidence of progress in these criteria, competition should be removed from learning, and students should be able to work co-operatively on tasks.

The ideas that Bloom, Hastings, and Madaus (1971) depicted, edge closer to a contemporary understanding of formative assessment where feedback, achievement criteria, self-assessment, and co-operative learning are all fundamental in improving student learning (see for example Black and Wiliam, 1998a). Considering these ideas on formative evaluation (feedback, criteria, active learning) it could be assumed they were laying the groundwork for a social constructivist approach to education where knowledge develops from social interaction and the student is actively involved in their own learning. However, on closer inspection, these scholars actually presented a neo-behaviourist[4] view of formative evaluation (Allal, 1979)[5] where they suggested that formative evaluation should take the form of brief diagnostic tests at the end of a unit of learning to provide rewards in learning to students i.e. a stimulus-response behaviour. They considered a constructivist approach to learning later in their work by suggesting that these tests should not be graded. However, to view formative evaluation as short-term summative evaluation blurred the lines between the stimulus-response approach and more constructivist epistemologies. This caused confusion on the theoretical nature of formative assessment at this time.

Cognitivism: The Bridge between Behaviourism and Constructivism

Following the dominance of behaviourist theories of learning, a "cognitive revolution" occurred where learning was not only thought of as a stimulus response process, but as

[4] Neo-behaviourism differs from behaviourism in that a person's consciousness and mental events can be explanatory in terms of their behaviour.
[5] Published in French, information gathered from Allal and Lopez (2005)

"involving the acquisition or reorganisation of the cognitive structures through which we process and store information" (Good & Brophy, 1995, p. 179). The underlying assumption of cognitive theory is about understanding what happens in the mind between stimulus and response. Cognitivism considers the internal processes of learning where the emphasis is on conceptual understanding and thinking ability. It differs from behaviourism as it works in the space between stimulus and response. Cognitivist theorists including John Dewey and Jean Piaget guided learning theory away from the simplistic views of the behaviourists, towards more social and constructivist ideas of learning. For example, social constructivism can be considered as a subgroup of cognitivism where cognition is shared and collaboration is important (Gage & Berliner, 1998).

Cognitivism provides an important theoretical lens through which formative assessment can be explored. Cognitivism is about meaningful learning where learners take an active role in acquiring and assimilating knowledge. This marries closely with the ideals of formative assessment where students act as owners of their own learning. Cognitive views on assessment are in favour of approaches such as essays, reports, and projects that require active involvement from the learner (Gage & Berliner, 1998). Formative assessments also stress the need for more continuous types of assessments where conceptual understanding can be revealed and used to improve learning.

Emergence of Constructivism

It wasn't until the 1980's that a constructivist approach to theorising formative assessment began to emerge in Australia to build on the cognitive scholarship. It was also at this time that the term *evaluation* was replaced with *assessment* (Grant & Gareis, 2014). An exact reason for this terminology exchange is unknown, however Sadler (1989) suggested its etymology was geographical, where North American scholars preferred the term *evaluation* while other academics made use of the term *assessment*. It could also be deduced that those taking a behaviourist approach to formative methods considered the term *evaluation* more in line with their theoretical standpoints, while constructivists preferred the broader term of *assessment*. A constructivist approach to learning holds its roots with Piaget (1896-1980) and illustrates the picture of knowledge and understanding being constructed step by step (Piaget, 1971). In constructivism, learning is individual and requires active participation from the learner (James, 2006). For example, two learners exposed to the same lesson may have an entirely different

educational experience, based on their level of involvement and their prior knowledge of the topic at hand. This furthered Bloom and colleagues' (1971) views on assessment, where they believed that summative and formative evaluations should be designed to help each individual student improve.

Exploring contextualised learning and active involvement in learning processes further, Sadler (1989) emphasised the importance of the individual student being at the centre of the learning process. From reviewing the theoretical scholarship, this was something the American scholars fell short of in their work on formative evaluation. Based in Australia, Sadler (1989) was influential in adding to the under theorised concept of formative assessment. As described below, he focused on the importance of the learner being at the centre of the formative assessment process and argued that useful and timely feedback was essential to improve student learning. He agreed with the earlier American scholars about grades being unproductive and suggested that "for students to be able to improve, they must develop the capacity to monitor the quality of their own work during actual production" (1989, p. 119). Sadler linked his work to one of the outcomes of formative assessment: improved learning but took it further by theorising how a feedback loop involving the active participation of students could achieve this outcome. He put forth three conditions for improved learning:

1. The learner must know the criterion or goal being aimed for.
2. The learner should compare their current level of performance with this criterion or goal.
3. The learner needs to engage in action that closed the gap between current and desired levels of knowledge acquisition.

(Sadler, 1989)

These steps were fundamental in improving learning as goals can often be rejected by students if they do not possess the skills to act on feedback. Sadler commented on how *"*students often show little or no growth or development despite regular, accurate feedback*"* (p.119). For him, the self-monitoring aspect of feedback was essential if it was to be of use to students, this was an aspect previously unexplored in formative assessment.

A constructivist approach to teaching, learning, and assessment implies that the learner has an active role in learning where education "should be child directed not teacher directed" (Matthews, 2003, p. 57). Teaching therefore should be adapted to the learning needs of the student and should also be contextualised for them, i.e., taught in a manner that is interesting

and relevant to them. Differing from behaviourist approaches, constructivism notes intrinsic motivation as a key determinant of improved learning, rather than an extrinsic reward/punishment system. Constructivist approaches are often incorporated into science lessons as this theory lends itself to inquiry based learning, a key facet of science teaching, learning, and assessment (Minner, Levy, & Century, 2010). Looking at studies on constructivist science classrooms, the focus is often on helping learners to identify the strengths and weaknesses in their prior knowledge, using teacher questioning to identify prior knowledge, and giving learners opportunities to participate actively in the teaching and learning process (Goloi & Osman, 2018; Qarareh, 2016). These key ideas of constructivism helped to shape formative assessment practices where active involvement in learning is paramount to developing self-regulation skills (Jones, 2010; Leitch et al., 2007; Minner et al., 2010), and identifying prior knowledge helps the teacher to adequately plan for lessons using formative approaches such as pre-assessments (Guskey, 2018).

Social Constructivism

Social constructivism is a sub theory of constructivism concerned with the social aspect of learning. While constructivism focuses on individual learning, social constructivism places importance on the social interactions of learners with more knowledgeable members of a community where culture and context play a significant role (Pritchard & Woollard, 2010). In relation to its influence on formative assessment, social constructivism focuses on knowledge and learning being socially situated and this is a key premise of formative assessment where there is an emphasis on the dynamic relationship between the teacher and student(s). Vygotsky was a key theorist in social constructivism with his core construct of the zone of proximal development (ZDP) rationalising how knowledge is created in social settings (Vygotsky, 1978)

Vygotsky was a soviet psychologist who focused on the learning development of children. His work took place in the early twentieth centenary however much was not translated into English until the 1970's. Vygotsky died young in 1924 aged 37 and therefore his contributions to learning theory were not necessarily complete at the time of his death. He considered language as the foundation for all cognitive processes (Berk, 2006) and developed what he referred to as the zone of proximal development (ZDP). He described it as:

> "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem

solving under adult guidance or in collaboration with more capable peers"

(Vygotsky, 1978, p. 86)

The above definition described how subjects (e.g., teachers and students) inside the ZDP are working on tasks too difficult for the less abled participant to do alone, however made possible by the help of an adult, teacher, or more skilled peer. This is a very common interpretation of the ZDP among teachers (Dann, 2018) however, this basic interpretation of the ZDP falls short of explaining how the ZDP is conceptualised in in relation to formative assessment.

The ZDP can be broken down into two main areas: interpsychological and intrapsychological processes. Firstly, the interpsychological aspect of the ZDP is concerned with interactions between people i.e., the relationship between the learner and the adult/more capable peer. According to Dann (2018) these relationships can be explained in two ways:

1. Imitation: whereby the child can interact with another to do more than they can do alone.
2. Activity: how the ZDP accounts for what students can do while considering factors including culture, history, and social relations. This aspect of the ZDP is concerned with the sociocultural theorisation of learning, discussed later in this chapter.

Secondly, the intrapsychological aspect considers how the learner internalises what they have experienced within the ZDP. Vygotsky referred to this as "speech for oneself" (1962, p. 131), the connection between thoughts and words. Dann's interpretation of the ZDP makes the case that language and speech are fundamental in how a student engages in the ZDP. This is linked to how students engage with feedback, a core strategy for formative assessment (Wiliam & Thompson, 2007). Considering this, Dann presents a list of implications that frame feedback in a way that is more suited to the social constructivist view of formative assessment:

- The language of feedback must be shared and interpreted together (pupil and teacher/more capable other).
- Each participant has a role in forming, shaping, and assimilating feedback.
- Feedback about an activity and/or imitation not only comments on the past but projects into the future - highlighting a relationship between time frames.
- There should be recognition that understanding of the structures and systems of the learning environment, including tools and signs, will not be seen in the same way by the teacher and pupil – this should be explored and revealed not suppressed.
- Feedback contains language that is social and shared - a *language for others*.

- Feedback needs to feed into inner speech, which will enable new thinking and connections - indicating a relationship of shared speech with inner speech.
- Even at the point when feedback is being internalised (through inner speech) different voices (perspectives) may remain.
- Feedback is a part of the teaching/learning relationship rather than an isolated one-directional judgment or set of instructions.
- Action, resulting from feedback, is also part of the continued process of mediated action, not a passive process of reading or hearing.

(2018, p. 78)

Dann's interpretation of the ZDP and its implications for feedback are relevant to this research as this thesis advocates for a sociocultural approach to looking at formative assessment. The theoretical framework for this thesis is activity theory (discussed in detail later in this chapter), a theory that is steeped in the sociocultural field. In addition, Dann breaks down the ZDP in a way that social learning can be explored in more minute detail, this was relevant during the data analysis stage of the research.

In terms of what working in the ZPD looks like in the classroom, it often takes the form of scaffolding and/or co-operative learning. Scaffolding (Bruner, 1976) occurs when a teacher or peer adjusts the "support offered during a teaching session to fit the child's current level of performance" (Berk, 2006, p. 260). Examples of scaffolding include breaking a task down into manageable pieces and withdrawing support as the learner's competencies increase. Co-operative learning (Johnson, Johnson, & Smith, 1989) consists of using more expert peers situated in mixed ability groups to aid in the learning of both weaker and stronger students. Vygotsky regarded discussion with peers as more valuable than conversations with adults (Berk, 2006) as due to the nature of the adult and child relationship, learning may not be optimal as children may consider what is said by adults to always be correct. The key affordance of the ZPD is in the regulation of learning: through scaffolding the learner has agency over their learning and they begin to self-regulate. These assumptions have been integrated into the formative assessment literature where activating students as instructional resources for one another and as owners of their own learning contribute to the process of self-regulation (Leahy, Lyon, Thompson, & Wiliam, 2005; Wiliam & Thompson, 2007)

Now that the roots of social constructivism have been summarised, the discussion will continue with how it has influenced the development of formative assessment. Ten years following

Sadler's writing on the importance of feedback in teaching, learning, and assessment, the work of Shepard (2000) emerged that highlighted the need for a social constructivist paradigm in assessment. Shepard is an American academic whose area of expertise is in assessment and classroom instruction. In her 2000 work she put forth key concepts that would aid novice teachers in moving away from behaviourist models of assessment toward more social constructivist techniques. She presents the reader with a list of factors to help teachers motivate students to learn:

1. *Dynamic assessment:* this concept is concerned with moving assessment from the end of the unit and including it as an ongoing part of teaching and learning. It links strongly to Vygotsky's ZPD and is considered by Shepard as an interactive form of assessment where guidance is provided throughout the learning, not just summarised at the end of a unit.
2. *Assessment of prior knowledge:* Shepard specified the importance of open classroom discussions among the teacher and students where the teacher can "elicit a more coherent version of students' reasoning and relevant experiences" (p.11). Additionally, Shepard made the social aspect of prior learning more explicit.
3. *Use of feedback:* Shepard notes how literature on feedback up to the 21st century was approached from a behaviourist perspective and more work was needed to theorise it in a constructivist way. She believed that feedback studies at the time were of limited value, and more research in effective feedback would be needed so that students would know how to use it to improve their learning and self-regulatory skills.
4. *Teaching for transfer:* She disagreed with the earlier behaviourists that each learning outcome should be taught separately and memorised, she considered true understanding of concepts "flexible, connected, and generalizable" (p.11). What this means for assessment is that it should account for learning in different situations and allow for students to apply their learning to a variety of contexts.
5. *Use of explicit criteria for success:* This component was based on the concept of fairness in assessment through transparency of what would be assessed. It provides students the opportunity to "get good" at what is expected of them in learning (p.12).
6. *Student self-assessment:* Through self-assessment students can increase their responsibility in learning and make their relationships with their teachers more collaborative and conducive to their learning. This occurs when teachers share the responsibility for learning with their students. When responsibility is shared, students

take more ownership of their learning and trust that their teacher is providing them with appropriate learning guidance (Gipps, 1999).

7. *Evaluation of teaching:* This component moves beyond looking at the learning of the student alone and considers the improvement of teaching practices. Shepard discussed the use of student understanding (through the other components above) so that learning processes can be adapted to the needs of individual students and/or classes. This is a concept that can often be overshadowed in studies based on formative assessment enactment where the focus is often on the tool for implementation (e.g., success criteria) and not how the teacher can use the tool to adapt teaching and improve learning.

The seven components listed above were aimed to counteract the strong behaviourist view of assessment engrained in American culture however, they present a problematic paradox in terms of teacher professionalism. Shepard advocates for teachers gathering data from students to create an overview of the learner to include observations, interviews, reflective journals, projects, demonstrations, collections of student work, and evidence of student evaluation. Although social constructivist in nature, she does not aptly consider the cultural context of teachers in relation to professional identity and education system i.e., would this be achievable in different education systems and countries where the role of the teacher may be fundamentally different?

Furthermore, while the components listed above draw similarities to strategies for formative assessment, Shepard was quite narrow in her views on how components should be enacted. For example, she puts down the notion of conducting a written pre-assessment task with students in favour of classroom discussion however does not consider the effect this may have on the variety of student needs in the classroom and their willingness to engage in conversations with the teacher. However, her work was seminal in promoting the need for a social constructivist approach to assessment and therefore was a step toward a sociocultural approach to assessment more appropriate for effective learning. She stressed that that students are not passive vessels ready to take in knowledge from their teacher but should be actively engaged in learning processes. Shepard considered the various subjects at play in the classroom (e.g., teacher, students) and how the relationships between them can be used to enhance learning through assessment. Her ideas on the role of assessment in learning cultures was very comprehensive in furthering the theory on formative assessment as it considered a myriad of social constructivist-based concepts that can help improve student learning. This furthers the idea that formative assessment is a multidimensional concept that cannot be attributed to one body of

scholarship alone but should be understood as a range of processes developed over time that work together to improve learning and self-regulation among students.

In terms of teaching, learning, and assessment, in social constructivist classrooms the focus is on the dynamic relationships in the classroom. These relationships can be between the teacher and their students, peers learning together, and between the student and themselves. Managing these relationships in the classroom can proceed through a variety of different assessment processes that link to both Shepard and Vygotsky's social constructivist work. For example, teachers can co-construct success criteria for a topic with their students so that a shared understanding of what knowledge is important is transparent and the responsibility for learning is shared among all in the classroom. This can also be expanded through Shepard's component of self-assessment where the co-constructed success criteria can aid students in assessing their own work as they have clarity in what was expected of them. Leahy and colleagues (2005) applied these social constructivist measures with teachers and students and commented on how student self-assessment helped them understand material in a new way, while their teachers cited that the student self-assessments were generally accurate.

The activities discussed above only consider a small aspect of social constructivist teaching, learning, and assessment. There are other ways social constructivist methods can manifest in teaching, learning, and assessment, many of which are explicitly linked to formative assessment techniques proposed by Black and Wiliam (1998a, 1998b) who are considered to be the fathers of formative assessment. Their work is discussed under the umbrella of sociocultural theories.

Sociocultural Theory and Formative Assessment

So far, the links between early theories of learning and the development of formative assessment has depicted a chronological path towards a theory of formative assessment. On this path, sociocultural theories of learning played important role in formative assessment theorisation (Pryor & Crossouard, 2008). Sociocultural theories are concerned with how cultural and historical factors can influence an individual's learning. These factors include the learning environment and culturally situated tools such as relationships and teacher professional identity. Social constructivism focused mainly on the relationship between the actors in the classroom: teacher, students, peers, while sociocultural theory expands these

relationships into the surrounding community. While social constructivist and sociocultural theories share similar beliefs about assessment in that they both view assessment as a social process stemming from the work of Vygotsky (1978), sociocultural theory expands theory to include the influence of culturally and historically situated tools and/or artefacts for learning. In other words, it recognises that "different historical and cultural circumstances may encourage different developmental routes to any given developmental endpoint" depending on particular social or physical circumstances and tools available (Miller, 2011, p. 198). A focused sociocultural theorisation of formative assessment first began with Black and Wiliam (2006), was expanded upon by Pryor and Crossouard (2008), with Black and Wiliam adding to their theorisation of formative assessment in 2009 and 2018.

Black and Wiliam have written extensively in the area of formative assessment (see for example Black, Harrison, Lee, Marshall, & Wiliam, 2004; Black & Wiliam, 1998, 2018; Wiliam, 2014; Wiliam & Black, 1996) . Even though their work began in 1996, it wasn't until ten years later that they began to theorise formative assessment within larger theories of learning (Black & Wiliam, 2006). They considered their early work on strategies for formative assessment (success criteria, questioning, comment-only marking, peer and self-assessments, and formative use of summative tests, 1998a, 1998b) as underarticulated, leaving room for a surface level interpretation of formative assessment devoid of a theoretical standpoint. In 2006 they situated formative assessment as part of the wider sociocultural theory of activity theory (Engeström, 1987) with the intention of setting out the basic criteria needed for a study on formative assessment. The rationale for this stemmed from the empirical findings from their KMOFAP project[6] (Black & Wiliam, 2005) that illustrated how the culture, context, and historicity of education influences formative assessment enactment. When applied in the context of teaching, learning and assessment, activity theory puts forward the important relationship between the individual (subject) and their environment. This is to understand how practices such as formative assessment come to be enacted among those involved in learning. Activity theory is the theoretical framework of this thesis and will be presented in greater detail later in this chapter, however for now, a brief synopsis of the theory will be provided to conceptualise the theory to the reader. Activity theory is a sociocultural theory of learning and is often represented through an activity system diagram (Figure 2). The activity system is best

[6] The *Kings College Medway Oxford Formative Assessment Project* (KMOFAP) This project followed the review of formative assessment research by Black and Wiliam (1998a, 1998b) and aimed to improve teachers' formative assessment practices through professional development. It is discussed in more detail in Chapter 3.

viewed as "complex formations in which equilibrium is an exception and tensions, disturbances and local innovations are the rule and engine of change" (Salomon, 1993, pp. 8–9).

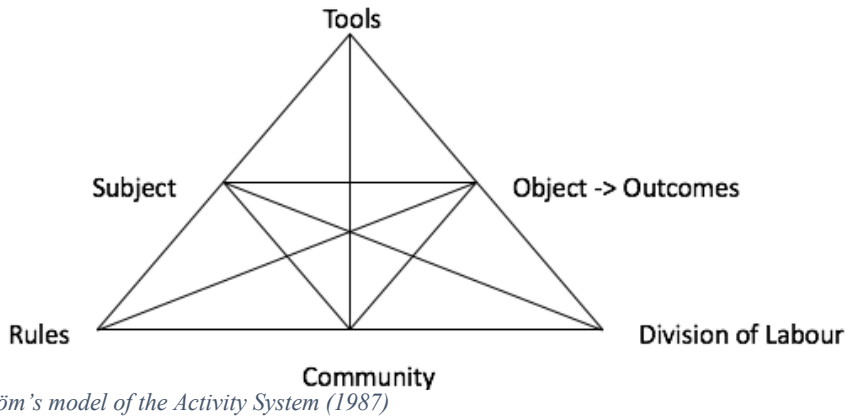

Figure 2: Engeström's model of the Activity System (1987)

According to Engeström, the elements of the activity system can be broken down as follows:

> "The subject refers to the individual or subgroup whose agency is chosen as the point of view in the analysis. The object refers to the 'raw material' or 'problem space' at which the activity is directed, and which is moulded or transformed into outcomes with the help of physical and symbolic, external, and internal tools (mediating instruments and signs). The community comprises multiple individuals and/or subgroups who share the same object. The division of labour refers to both the horizontal division of tasks between the members of the community and to the vertical division of power and status. Finally the rules refer to the explicit and implicit regulations, norms and conventions that constrain actions and interactions within the activity system"
>
> (Engeström, 1993, p. 67)

Although Black and Wiliam (2006) cite the importance of activity theory in a study examining formative assessment, this work falls short of properly conceptualising the social, cultural, and historical aspects of this theory i.e., the bottom tier of the activity system triangle. They admit that their work overly focused on the top apex of the triangle: the relationships between the subject, tools, and object, as they wished to set out what they considered to be the minimum elements of a theory of formative assessment. These criteria were as follows:

1. *Teachers, learners, and the subject discipline*

A theory of formative assessment must consider the pedagogical content knowledge of the subject teacher as well as their ontological and epistemological interpretation of their subject discipline (Black and Wiliam, 2006). For example, they found feedback more prevalent in the music classroom than in the English classroom as music is a more hands on practical subject.

2. *The teacher's role in the regulation of learning*

Formative assessment theory needs to shift teachers' thinking from regulation of an activity to the regulation of learning. i.e., are teachers planning activities or are they planning learning?

3. *Feedback and student-teacher interactions*

The authors took into consideration Perrenoud's (1998) criticisms of their previous work (1998a, 1998b) that the complexity of feedback in formative assessment lacked an understanding of the regulatory effects of a feedback intervention i.e., does the student know what to do with the feedback to improve their learning? They admit that Sadler's work (2000) was not considered in great enough detail and a theory of formative assessment needed to look at Sadler's conditions for improved learning through feedback (1989).

4. *The student's role in their learning*

Learners need to be active participants in their learning to be engaged fully with formative assessment. In the 2006 theorisation of formative assessment, Black and Wiliam further emphasised the importance of students not being passive, feeling safe to make mistakes and learn from them, and having the ability to self and peer assess work, both at home and in the subject classroom. These criteria drew attention to the importance of agency and identity in conceptualising formative assessment. This importance was expanded upon by Pryor and Crossouard (2008) in their sociocultural theorisation of formative assessment.

In 2008 Pryor and Crossouard brought together the work of Engeström (1987), Torrance and Pryor (1998), Perrenoud (1998), Black and Wiliam (2006), and James (2006), to theorise formative assessment as a "discursive social practice, involving dialectical, sometimes conflictual processes" (2008, p.1). What they meant by this was that teacher and learner identities are implicated in the formative assessment process, and that knowledge is framed by institutional discourses and summative assessments. They commented that "nether as teachers nor as learners are we free to become who we want" (p.9). They explained how there are a variety of sociocultural factors at play when it comes to enacting formative assessment. For example, they cited that summative assessment is socially valued in western society, and policy with a focus on summative assessment mitigates against socially constructed formative assessment practices such as peer assessment. Therefore, in western society, summative assessment can be considered as a factor that impedes any paradigm shift towards formative assessment processes. From reviewing Pryor and Crossouard's 2008 work, built on a decade of interventionist empirical research, three key concepts emerged that were imperative in

conceptualising formative assessment as a sociocultural phenomenon: identity, agency, and division of labour. Hence, a brief delineation of these concepts is now provided.

Teacher Professional Identity

With teacher professional identity, scholarship has noted a precise definition is lacking (Beauchamp & Thomas, 2009). Following an extensive review of the literature in the area of teacher professional identity, Beijaard, Meijer, and Verloop (2004) describe it as an ongoing process, involving both a person and their context. In these contexts, teachers gain professional characteristics that they adopt in their own unique way. Sachs simplifies this concept by stating that teacher professional identity "provides a framework for teachers to construct their own ideas of 'how to be', 'how to act' and 'how to understand' their work and their place in society." (2005, p. 15). Research has found that a teacher's professional identity is linked to how they promote student autonomy and how they see themselves as educators (Correia & Harrison, 2020). If formative assessment is to be understood accurately and enacted thoroughly, it needs to become part of a teacher's professional identity. This can be accomplished by focusing on formative assessment within initial teacher education programmes and in continual professional development (Beauchamp & Thomas, 2009). Moreover, enactment becomes stronger when school leaders and teachers collaborate and share a strong sense of professional identity (Organisation for Economic Co-operation and Development, 2015). A more detailed discussion of teacher professional identity is provided in Chapter 3

Agency

When considering agency, a commonly cited definition considers it as:

> "The capacity of actors to make practical and normative judgements among alternative possible trajectories of action, in response to the emerging demands, dilemmas, and ambiguities of presently evolving situations"
>
> (Emirbayer & Mische, 1998, p. 971)

This means that the level of agency a subject (including teachers and students) has is dependent on their capacity to act independently and make their own choices in relation to learning. Research in education has demonstrated that this capacity is intrinsically linked to the subject's environment and the cultural norms they are emersed in (Biesta & Tedder, 2007) i.e. it is sociocultural. Understanding teacher agency is fundamental in a sociocultural theorisation of formative assessment as the level of enactment of formative assessment is dependent on a

teacher's capacity to implement formative assessment practices. Recent curriculum reform in many countries (including Ireland and Scotland) is moving toward putting the teacher at the centre of school-based curriculum development (Priestley, Biesta, & Robinson, 2013). For example, the reformed Junior Cycle Framework (Department of Education and Skills, 2015a) in Ireland "gives schools greater flexibility to design programmes that are suited to the needs of their junior cycle students and to the particular context of the school" (p.7). Therefore, for curriculum reform to be successful, with teachers at the centre of improvement and reform, they need to have a strong agentic capacity. The factors influencing agency were explored by Priestley, Biesta, and Robison (2015) in detail in Figure 3.

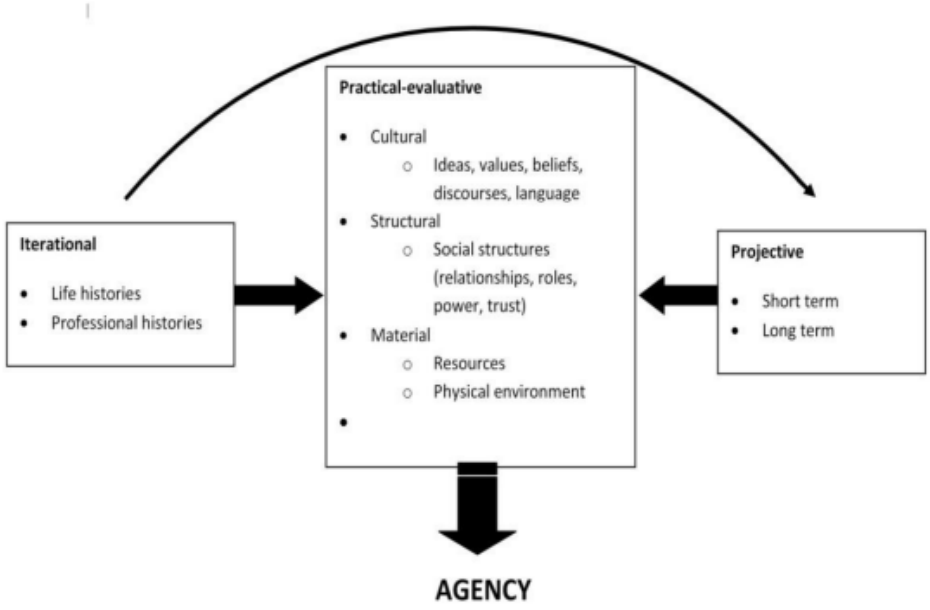

Figure 3: An ecological model for understanding teacher agency (Priestley & Biesta, 2013)

Priestley, Biesta, and Robinson built on Emirbayer and Mische's work and presented teacher agency as an amalgamation of "influences from the past, orientations towards the future and engagement with the present." (2015, p. 3), These dimensions were conceptualised by categorising them as iterational (the past), projective (the future), and practical-evaluative (the present) see Figure 3. The iterational dimension is rooted in past experiences where a teacher's skills, knowledge, personal values, and professional values influence their teaching practice. The projective dimension relates to a teacher's aspiration for their work in both the long and short term. The practical-evaluative dimension is the biggest influence on teacher agency. It is made up of three aspects: the cultural, structural, and material. These aspects can both encourage or inhibit agency and thus promote or constrain certain teaching practices such as formative assessment. For example, research from Ireland has demonstrated that teachers are

aware of what formative practices are most effective in improving student learning (such as groupwork and effective questioning), however they are constrained by the cultural context of senior cycle education in Ireland where teaching to the test is more in line with the high stakes nature of the Leaving Certificate (O'Grady, Simmie, & Kennedy, 2014). The importance of these cultural and contextual factors needs to be taken seriously by policymakers as certain educational contexts may disable a teacher's agentic capacity (Priestley et al., 2015). Therefore, a sociocultural theorisation of teacher agency in formative assessment is necessary to understand how formative assessment is enacted in schools and the factors that can promote or inhibit enactment.

Division of Labour

It is widely accepted that the division of labour in formative assessment should be shared between the teacher, peer groups, and individual students (Black & Wiliam, 2006; Leahy et al., 2005; Wiliam & Thompson, 2007). Pryor and Crossouard discussed the division of labour in assessment by classifying formative assessment processes on a continuum from convergent to divergent. Convergent processes are behaviourist in nature where the teacher is in control and learning is "done to" learners (Pryor & Crossouard, 2008, p. 13). Whereas divergent practices are more constructivist, establishing what learners know and involving them in the conversations about their learning. In their opinion (Pryor and Crossouard, 2008), both convergent and divergent methods are considered as formative, however from reviewing the theoretical literature on formative assessment, most modern scholars (see for example Black and Wiliam, 2009) would align formative assessment on the divergent end of the formative assessment scale. This suggests that more research is needed to clarify how formative assessment is conceptualised through a sociocultural lens.

Key Theory from Kings College London

Black and Wiliam furthered their theoretical work from 2006 with *Developing the Theory of Formative Assessment* (2009). The authors considered criticism from themselves (1998a, 1998b), Pryor and Crossouard (2008), and Perrenoud (1998) on their oversimplification of formative assessment and its lack of a theoretical foundation. This oversimplification was manifested by presenting formative assessment as five different teaching techniques:

1. *Success criteria:*

Involves teachers making their learning objectives and criteria for success transparent to students.

2. *Questioning:*

Asking students questions that either prompt students to think or provide teachers with information that can be used to adjust instruction and meet leaming needs.

3. *Comment-only marking:*

Comments that address what a student needs to do to improve and links to rubrics where appropriate can cause deeper thinking for students.

4. *Peer and self-assessment:*

When students assess the work of a peer, they are forced to engage in understanding the rubric, but in the context of someone else's work, which is less emotionally charged. Moreover, when students assess their own work, they are generally accurate about their level of learning, and it helps them to understand material in a new way.

5. *Formative use of summative tests*

Any assessment can be used formatively, for example a teacher may not grade a test but give it to a group of students to review and open a plenary discussion on how to optimise success.

(summarised from Leahy et al., 2005; Wiliam, 2013)

Black and Wiliam's 2009 work suggested that the links between the five approaches were still unclear and because of this they were concerned about the oversimplification of formative assessment to a surface level interpretation. They were correct about forecasting the oversimplification of formative assessment, for example, research has found that a lack of understanding of assessment terminology and approaches to formative assessment by teachers results in sporadic implementation of formative assessment strategies (Lysaght & O'Leary, 2013). One of the purposes of Black and Wiliam's 2009 work to was to unify the diverse set of practices considered as formative and present an updated definition of it built on the work of the many formative assessment scholars before them:

> "Practice in a classroom is formative to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited."
>
> (Black & Wiliam, 2009, p. 9)

This revised definition brought focus on contingency as an integral formative assessment process. The authors suggested that capitalising on moments of contingency would help to truly embed formative assessment into teaching, learning, and assessment. This revised definition was founded from Thompson and Wiliam's framework for formative assessment (2007), see Table 2. This framework was built on empirical literature from Leahy et al. (2005) who discussed moments of contingency by referring to them as "on-the-fly decisions" (p.23) made by teachers about how learning should progress. They commented on how this principle can bind the five strategies together. Additionally, the teachers who adapted these processes into their teaching enjoyed it more than traditional methods. These moments of contingency can be seen as short-term adaption where "taking appropriate remedial action is essential" in a learning situation (Wiliam, 2014, p. 1). This is also referred to by Allal (1988) as "interactive regulation" where formative assessment is used in real time to adjust instruction. Contingency has a foothold in social theories of learning including social constructivism and sociocultural theory. Black and Wiliam (2006) placed a specific importance on regulation and how teachers need to incorporate this more into their practices.

<table>
<tr><th></th><th>Where the Learner is Going</th><th>Where the Learner is Right Now</th><th>How to Get There</th></tr>
<tr><td>Teacher</td><td>Clarifying learning intentions and sharing criteria for success</td><td>Engineering effective classroom discussions and tasks that elicit evidence of learning</td><td>Providing feedback that moves learners forward</td></tr>
<tr><td>Peer</td><td rowspan="2">Understanding and sharing learning intentions and criteria for success</td><td colspan="2">Activating students as instructional resources for one another</td></tr>
<tr><td>Learner</td><td colspan="2">Activating students as the owners of their own learning</td></tr>
</table>

Table 2: Framework Relating Strategies of Formative Assessment to Instructional Processes (Wiliam and Thompson, 2007 p.63)

An important caveat at this time is to look at the *Framework Relating Strategies of Formative Assessment to Instructional Processes* (Wiliam & Thompson, 2007, p. 63). In this work (Table 2), the researchers synthesised the work of Ramaprasad (1983) with their earlier work on the five main types of formative assessment techniques to create a framework that links strategies for formative assessment with instructional processes. This table is simple to read and informative for both researchers and practitioners, however, a key focus is how Wiliam, and Thompson explain the "big idea" of formative assessment where "evidence about student

learning is used to adjust instruction to better meet student needs—in other words, that teaching is adaptive to the students' learning needs." (p.64). The literature of Chapter 3 will explain how this adaption or responsiveness of teachers can be overlooked in teaching practices due to a lack of understanding. Each of the strategies contained in Table 2 are discussed via the empirical literature in Chapter 3 and are important in this research as they helped to frame how formative assessment was interpreted.

Returning to Black and Wiliam's 2009 work, it can be summarised as explaining formative assessment rather than solidifying it in a specific theory. Although they make numerous claims within the paper about theorising formative assessment, this does not manifest fully. They drew on ideas of activity theory (Engeström, 1987), the regulation of learning (Perrenoud, 1991), the zone of proximal development (Vygotsky, 1978), and contingency (Allal, 1988; Leahy et al., 2005; Wiliam, 2014) to theorise formative assessment however from reviewing their literature this more so clarified the processes of formative assessment rather than developing it as a theory. This raised the question if a theory of formative assessment is necessary? As this chapter so far has demonstrated, formative assessment has interweaved among many theories of learning and as a result oversimplification and a lack of understanding appears to be the problem. Situating it within a particular theory would help to ease misunderstanding and move toward a shared enactment. More scholarship is needed on cementing formative assessment within sociocultural theory: building it on activity theory combined with Thompson and Wiliam's framework (2007) so that understanding, and in turn enactment can improve.

As their literature demonstrates, theoretical scholarship by Black and Wiliam was concerned with developing formative assessment as a theory, and although their theorisation contained elements that were sociocultural, at this point (2009) formative assessment was back to being theoretically undefined. From the extensive review this chapter has presented, a sociocultural theorisation of formative assessment is how it is understood in this thesis. This is because the literature suggests that it does not occur in isolation and there is a myriad of factors that can influence its enactment that are outside of the five strategies (Wiliam and Thompson 2007, Table 2). These factors are largely sociocultural and bringing in concepts such as division of labour and identity add to a richer theorisation of formative assessment. Scholarship has furthered its link between formative assessment and sociocultural theory, most notably the work of Sach (2012), Torrance (2012), Asghar (2013), Pham, (2015) and once again Black and Wiliam (2018). A principal argument of Black and Wiliams 2018 work was that:

> "assessment cannot be understood without a consideration of the wider context within which that assessment takes place. Teachers and schools are constrained, at least in the short term, by the cultural traditions, the political and public expectations of education, and the norms of the various institutions within which they operate.
>
> (2018, p. 570)

Once again Black and Wiliam returned to a sociocultural perspective of formative assessment enactment by considering the wider context of education, something they drifted from in 2009. The focus of the 2018 study and the others cited in the sociocultural section of this chapter was on investigating formative assessment with activity theory. The theoretical framework of this thesis explores this relationship and therefore will now be forwarded.

Theoretical Framework

Activity theory provides the lens for this research study. After consideration of different theories of learning, activity theory was the best fit for this study. When applied in the context of teaching, learning and assessment, activity theory puts forward the nuanced relationship between the individual and their environment to understand how practices such as formative assessment come to be enacted. It is essentially sociocultural in nature however there are some discrepancies between the hallmarks of sociocultural theory and how activity theory is perceived in educational research. Activity theory is the product of several theories: the scholarship of Marx, the dialectical traditions of Hegel, and the cultural-historical school of psychology including Vygotsky and his protégé Leont'ev.

Historical Foundations

Hegel's Dialectics

Activity theory is largely concerned with relationships: among all its elements, between pairs of elements, or within individual elements of an activity system. Most importantly, dialectical relationships are a focus; the theory suggests that elements presuppose one another, are mutually exclusive, and neither element can be used as a starting point for explaining the other (Roth & Lee, 2007). Activity theory draws upon Hegel's dialectic tradition as it views the world in constant movement through time and this movement can produce evolution in an activity system (Engeström, 1987).

Hegel (translated in 1969) suggested that dialectics leads to an evolution or development from less sophisticated views or definitions of the subject at hand, to more sophisticated ones later. Hegel's growth of logic of the subject occurs in three stages. Firstly, there is a moment of understanding of the present condition of the subject matter. At this point concepts have a seemingly stable definition. Then, by studying the subject there is a dialectical moment, the instable moment where the subject matter is questioned. This is a process of self-sublation where initial ideas have a double meaning; ideas are both cancelled out and preserved simultaneously. Finally, the third moment is a speculative moment where new knowledge arises from the previous two moments. Hegel discusses these moment as a journey to the *Absolute* which is the final and completely all-encompassing form of the subject matter under scrutiny (Maybee, 2019). Journeying through Hegel's three moments of logic would not be possible, fruitful, or even worthwhile if it wasn't for contradictions that exist within the subject matter and among the subject and its relationship with other elements of its activity system. Therefore, Hegel's dialectics is a starting point for an activity system in flux as it introduces the idea of contradictions among its elements.

Vygotsky and Leont'ev

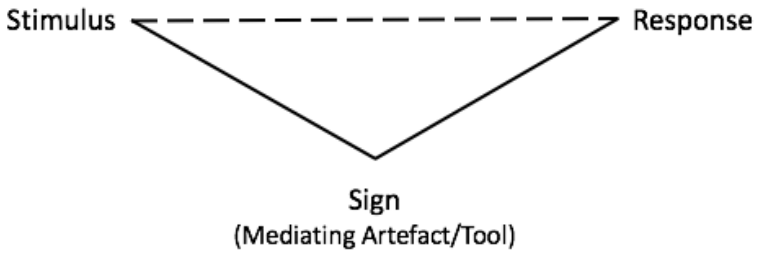

Figure 4: Vygotsky's mediation model (1978, p.40)

It is accepted that there are three generations of activity theory, each building on the last. The second and third generations are particularly relevant in this research. The collective works of Vygotsky, Luria, Leont'ev, and Engeström all contribute to the understanding of activity theory. Vygotsky's concept of mediation laid the foundations for first generation activity theory. His ideas surrounding mediation and the interaction between the individual (stimulus), mediating artefact (sign), and object (response) were first framed in his triangular model of a "complex, mediated act" (1978, p.40) depicted in Figure 4.

In this model Vygotsky explains how:

> "The direct impulse to react is inhibited, and an auxiliary stimulus that facilitates the completion of the operation by indirect means is incorporated…The use of signs leads humans to a specific structure of behaviour that breaks away from biological

development and creates new forms of a culturally-based psychological process."

(1978, p.40)

According to Engeström this work was revolutionary as the "individual could no longer be understood without his or her cultural means; and the society could no longer be understood without the agency of individuals who use and produce artefacts" (1987, p. 5). This theory was the first of its kind to purposefully link the subject to its object via an external mediating object, demonstrating that contextual artefacts or tools are fundamental in converting external stimuli into internal mental functioning. However, in his complex mediated act, Vygotsky concentrated largely on mental signs and what they meant without considering the physical tools that can mediate between the subject and object (Engeström, 1987). Therefore, more emphasis was needed on physiological tools to include physical tools and mental signs. This paved the way for second generation activity theory.

Second generation activity theory considers inter-relationships between the individual and the community, history, and context. It is the most popular generation of the theory in educational research (Nussbaumer, 2012). A disciple of Vygotsky, Leont'ev, expanded Vygotsky's thinking on mediation and began to think about what activity is. According to Engeström, Leont'ev concluded the following:

1. Objects distinguish activities from one another.
2. There is a strong link between activity and motive.
3. Activity controls the participating individual rather than an individual controlling activity. (1987, p. 54)

Engeström

Building on Leont'ev's ideas, further activity theories tried to conceptualise what activity looks like. Although there have been different representations of activity theory in the past (see for example Roth and Lee's thread, string, and fibre analogy, 2007), it is Engeström's depiction of the *Elements of Activity Systems* (1987) that clearly illustrates the second generation of this theory, see Figure 2. This generation has been discussed briefly in Chapter 2 but will be expanded on now. Many studies citing activity theory as a theoretical or analytical framework turn to second generation activity theory and Engeström's depiction of the activity system to help guide their research (see for example Asghar, 2013; Plakitsi, 2013; Sundberg et al., 2016). The language used in his diagram (illustrated in Figure 2) depicts the various elements

necessary to achieve the desired outcome by transforming the *Object* into its intended *Outcomes*.

Top tier: subject, tools, object|outcome

The primary focus of any activity system is the top triangle consisting of the *Tools*, the material or physiological artefacts that are used in the transformation process, the *Subject*, the individual or group of agents being transformed, the *Object*, being the physical or mental product sought acted upon by the subject, and the *Outcomes* consisting of the desired goal (for example a learning or behavioural goal). The *Object* is the aspect of the activity system that connects the individual actions of the subject to the collective activity of the whole system, as both the individual subject and the external societal factors (*Rules, Community*, and *Division of Labour*) have a part to play in achieving the *Outcome(s)* of the *Object*. Engeström focused attention on the object of the activity system as more than just a goal or product. He explained that they are "generators and foci of attention, volition, effort, and meaning", they are changed and created by people and they can carry with them foundational contradictions based on previous iterations of an activity system (2015, p. xvi). From reviewing the literature on formative assessment, it was concluded that the outcome of any formative assessment activity system is improved learning for students and responsive teaching. The term *responsive* is considered in this research as the process by which a teacher considers the information provided by one or more of the strategies for formative assessment and uses this informative to respond to the learning by changing the lesson or continuing with the lesson as planned. The term *responsive* was chosen over the more common term *adaptive* as adaption or response may not always be needed but must always be considered by the teacher.

The movement from *Object* to *Outcome* functions as the motive of an activity giving a broader meaning to actions (Engeström, 1999). It is interesting to consider how the object can exist more than once in an activity system. According to Marx and Engels (1978) an object can be understood as both a physical (German: *objekt*) and mental (German: *genestand*) process (Roth, 2004). For example, a teacher may have an idea of what formative assessment is in their mind (*genestand*) but how it enacted in their classroom (*objekt*) may be different. This is the beginning of contradictions that arise between a teacher's intended and enacted practices. Activity is achieved (after examining these contradictions) when the *objekt* and *genestand* coincide. The discrepancies between intended and enacted practices are specifically relevant

to this thesis, Chapter 3 cites problems with formative assessment enactment due to a mismatch between teachers' intended and enacted practices (Albergaria-Almeida, 2010; Crichton & McDaid, 2016; Hayward, 2015; Priestley & Sime, 2005).

Bottom tier: rules, community, division of labour

Further to the top tier, the activity system focuses on factors beyond the subject|object dichotomy so that the societal *Rules*, the wider *Community,* and the *Division of Labour* in an activity system can be analysed and explored to determine the contextual and cultural influences on a subject's activity. The relationship between the subject and their environment is considered through the element of *Community* (Hashim & Jones, 2007). The community at the bottom tier of the triangle are the group that share a common set of social meanings (Jonassen & Rohrer-Murphy, 1999) who are concerned with achieving the same object within the activity system (Plakitsi, 2013a). *Rules* mediate the relationship between the object and the community (Hashim & Jones, 2007). In other words, the implicit or explicit rules set forth by a community will either promote or inhibit the effectiveness of the object. Looking at the rules of an activity system, it is interpreted that they refer to the explicit and implicit norms that influence the activity within the system (Engeström, 1993). Within an activity system, the power and tasks of the system are divided among the different members of the community; this is referred to as the *Division of Labour* in the activity system. Daniels explains that the "division of labour refers to both the division of tasks and the status relations between actors" within an activity system (2004, p. 123). Applying activity theory to this thesis meant that the power dynamics between the subjects in the classroom could be explored in detail to ascertain who is involved in formative assessment practices.

The elements within an activity system are not fixed and may switch position depending on the activity. Roth and Lee (2007, p.208) provide the example of language as an interchangeable element of an activity system. At the level of activity, language can be interpreted as a tool (e.g., to reflect on action or represent situations), a sign, or as an object of an activity system. Reflecting on this, and applying it in a learning context, formative assessment can appear as the object of a system, providing for reflective teaching and improved learning. However, it may also be conceived as a tool within a system, comprising of strategies for effective teaching and learning. Therefore, having a clear definition of formative assessment is important, so that an activity system can be clearly constructed to determine its contradictions and in turn provide

for better teaching and learning. The definition for formative assessment in this thesis was provided by Black and Wiliam (2009) cited on page 11.

The third generation of activity theory combines the ideas of the first and second generations into an interconnected network of activity systems. The need for this generation arose from the previous generations insensitivity to cultural diversity i.e., only looking at one system meant that other culturally important factors could be overlooked in research. Networked activity systems can potentially share an outcome and are part of a larger web of activity systems that makes up human society (Roth & Lee, 2007). Engeström, who gave rise to this iteration of activity theory, posits that this generation:

> "refers to theorizing and empirical studies which expand the unit of analysis from a single activity system to multiple, minimally two, interacting activity systems. In such a framework, for example schooling is analysed as dynamics within and interplay between the activity systems of the student and the teacher, possibly also including other relevant activity systems." (2012, p. 516)

His explanation is depicted in Figure 5 where it can be clearly seen that the systems must share a common object or goal.

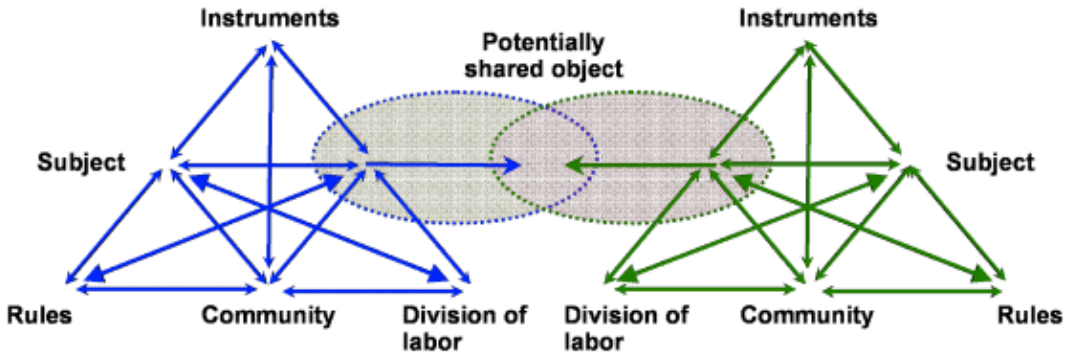

Figure 5: Two activity systems and a potentially shared object (Engeström, 2009, p.305)

Contradictions in an Activity System

Contradictions in an activity system are the drivers of change (Roth, 2004). Contradictions can arise within and among elements of an activity system and express a tension between culturally historical ways of being, and their alternative viewpoints. The most basic contradictions in an activity system arise from the division of labour when fundamental divisions such as age and sex are considered (Engeström, 1987). Looking at an example of where contradictions are explored in an activity system, Roth and Lee (2007) present a vignette into a science classroom where the teacher (Katherine) chose not to do a fun learning activity with her students as her

school had a strong culture of accountability. A contradiction arose here between Katherines professional identity and what her school expected of her. The authors comment that if Katherine had completed the fun activity with her students they would "become emotionally engaged in that learning" (p. 187) and would have been able to reach their learning goal in a way that met the needs of all students. However, because of the accountability culture of the school Katherine felt she had to "abandon this option and instead rely on direct teaching as the method of choice, given its economy of instructional time and assurances of mastery learning and higher achievement scores" (p. 187). This example demonstrates a contradiction within an element of the activity system: the subject, Katherine. She was in turmoil about how students should achieve and meet learning goals efficiently.

When researchers aim to alleviate the contradictions within an activity system, the theory moves into the empirical. Studies that adopt an interventionalist approach often make use cultural historical activity theory or CHAT for short. Much research uses the terms *CHAT* and *activity theory* interchangeably as the same theory however CHAT research is largely concerned with editing the activity system to improve it for the subject. According to Daniels (2004) CHAT has the capacity to uncover interventions and hidden relationships within the activity system as it clarifies complex phenomenon through the exploration of the activity system. CHAT has been used in education research especially in the areas of policy, higher education, childcare, and system wide initiatives (Nussbaumer, 2012). This thesis considered CHAT as the guiding theoretical framework but made use of activity theory instead as tackling the historical influences on formative assessment is big undertaking and went beyond the scope of a PhD thesis. Therefore, activity theory as theorised by Engeström was the framework of choice for this study. An amalgamation of second and third generation activity theory was utilised as each activity system (from each science class; teacher and students) was looked at individually (common in second generation) however, contractions were the focal point of analysis (common in third generation). Therefore, an amalgamation of the two generations was deemed necessary to answer the research questions of the study.

Critique of Activity Theory

Although Engeström (1987) makes clear how activity can be interpreted as its own theory, not all scholars believe that activity merits as a standalone theory. Bakhurst (2009) suggests that the triangle depiction can fit any theory and although it is a useful diagram, it is not a separate

theory of learning. Conversely, Blunden (2010) discusses the complexness of analysing the activity system using its different elements however does not offer an alternative solution to his perceived complicatedness. There are many areas of critique when advocating for an activity-based approach to research. These critiques include the oversimplification of activity theory into a basic schema utilised mostly as an empirical approach to data analysis (Bakhurst, 2009), the true meaning of *activity* and how its roots in Russian psychology being misinterpreted or mistranslated (Mironenko, 2013), and how activity theory situates the subject of the activity system. The final critique is most relevant to this thesis so therefore will be explained now in more detail.

Earlier this chapter explored the various interpretations of formative assessment through different learning theories. The most recent theorisation of formative assessment is through a sociocultural lens with activity theory being prevalent (Black & Wiliam, 2006, 2009; Pryor & Crossouard, 2008). The extensive discussion on sociocultural theory earlier brought to light a variety of concepts that define sociocultural theory as a learning theory, most notably the importance of identity and agency in a sociocultural theorisation of teaching, learning, and assessment practices (Beauchamp & Thomas, 2009; Priestley, Biesta, & Robinson, 2015; Pryor & Crossouard, 2008). However, from reviewing the literature on formative assessment (Chapters 2 and 3) it appears that research is not engaging enough with the various characteristics that make up a person's identity and agentic capacity including (but not limited to) social class, life histories, relationships, values, and beliefs. To truly situate activity theory within the sociocultural family of theories, a stronger link needs to be made between the subject of the activity system and the different elements it is made up of including identity and agency. This thesis aims to explore these elements in relation to how formative assessment is enacted.

Why Activity Theory?

After various elements of activity theory, its foundations, contradictions, and problems have been explored it was important to explicitly link why this theory was chosen for this research. Specifically, a hybrid of second and third generation activity theory was utilised as it presented the clearest framework to analyse classrooms in different jurisdictions. To begin, this research looked at country-based education systems: Ireland and Scotland. These education systems are steeped in contextual, and culturally influenced traditions. Activity theory put an emphasis on including these traditions when exploring what was happening to the subject of an activity

system, in this case the subject being the science teacher and their students. Moving to the objectives of the study which were to:

1. Observe assessment practices in science lessons to determine if formative assessment is embedded in practice.
2. Determine teachers' understanding of formative assessment and identify what they believe to be the significant influences on their teaching practices.
3. Ascertain the influence of cultural context on teaching, learning, and assessment practices within schools.
4. Examine students' beliefs about the teaching, learning, and assessment practices enacted in their school and science classes.
5. Investigate the influence of curriculum policy on a school's approach to formative assessment.

Activity theory was applied to help meet these objectives. Looking at some examples, the second objective was open-ended, what teachers believe to be influential on their practice was a vast myriad of different factors. Activity theory helped to categorise these influences into elements of activity systems, making analysis clearer. This in turn helped to generalise these influences so that conclusions could be drawn from the data. This logic also applied to objective three and five of the research.

To recap, the research questions of this study were to explore:

1. How is formative assessment understood and enacted in lower second level classes in Ireland and Scotland?
2. What are the factors that shape formative assessment enactment in science classes in these countries?

The first question was focused on how teachers and students interact with tools in the classroom to carry out teaching and learning. Using the lens of activity, these tools (physical or mental) were examined in detail to ascertain which ones were promoting or inhibiting formative assessment. If inhibitors were present, contradictions were explored. The second question looked beyond what was happening in the classroom alone so a theoretical framework that moved beyond examining the classroom alone was needed. Because of activity theory practices could be explained in relation to cultural and historical influences. In a final advocation for activity theory, problems exist with understanding the nature of formative assessment. Activity theory had the ability to explore these problems by approaching the data from inside and outside the classroom.

Conclusion

It was necessary for a chapter in this thesis to explore the development of formative assessment from its inception to current conceptualisation to determine how formative assessment is theoretically understood. There has been a shift in thinking about formative assessment from a behaviourist approach, through constructivism, to a sociocultural understanding. Among these theorisations was an attempt to theorise formative assessment as its own theory, however as this chapter demonstrated this led to further misunderstanding of what formative assessment is. While the theoretical journey of formative assessment is long, its inclusion as part of various learning theories suggests that not one clear understanding is possible. It is a multidimensional concept not without complications. As it has shifted paradigm over the past number of years, the empirical research can be misunderstood when it comes to theorising formative assessment, this is evident in the literature review of Chapter 3.

There are a variety of ways to think about formative assessment, all of which are similar but differ in relation to theoretical focus and detail. For example, Shepard (2000) provides a comprehensive constructivist model for improved learning in the classroom but does not explicitly term it *formative assessment*. Black and Wiliam focused for many years on their *famous five* model that until recently lacked a theoretical basis but now their work is situated within a sociocultural theory of learning (Black & Wiliam, 1998a, 2009). Of note in the literature now is the focus on activity theory with formative assessment, however some problems still exist among these two concepts in relation to how the subject is understood in a sociocultural manner. For this thesis the definition of formative assessment put forth by Black and Wiliam in 2009 (page 11, Chapter 1) was the most appropriate following the theoretical literature review. Furthermore, from reviewing the literature, formative assessment functions in improving student learning and includes responsive teaching techniques where appropriate. This thesis sought to add to existing scholarship that adopts a sociocultural analysis of formative assessment by examining the influence of cultural context on teaching, learning, and assessment practices within schools.

3. Literature Review

Introduction

The previous chapter focused on situating formative assessment among larger theories of learning to conceptualise how it is understood. Chapter 2 concluded by situating formative assessment as a part of sociocultural theory where social and community factors are important in the enactment of formative assessment. The aim of this chapter is to expand on Chapter 2 to examine the policy and empirical research related to formative assessment. Moreover, this chapter rationalises the research problem that formative assessment is not fully understood. The chapter begins by examining the policy context of classroom assessment in Ireland and Scotland as well as an insight into international policy on formative assessment. This leads into an exploration of the empirical research on teaching, learning, and assessment coming out of Ireland and Scotland including an exploration of teacher professional identity and assessment literacy. Following this, empirical research with a specific focus on formative assessment was investigated, studies involving intervention and those focused on the strategies for formative assessment were given due consideration. The chapter ceases with a summary of its main findings.

Scholarship on teaching, learning, and assessment is vast therefore the empirical research included in this chapter needed to be carefully chosen to reflect the research questions and objectives of this thesis. The process of the literature review began by exploring the empirical work of Black and Wiliam (1998) widely cited in formative assessment scholarship. This opened other key areas of research including exploring formative assessment in the science classroom and examining the individual strategies of formative assessment in detail. As the research took place between two countries, policy literature was included from both Ireland and Scotland, as well as other countries that had formative assessment at the heart of education policy. Finally, after theorising formative assessment in Chapter 2, empirical research on teacher professional identity and assessment literacy needed to be included to reflect the theoretical framework of this thesis. It was decided early in the research that the literature review would not expand into other jurisdictions such as America and Asia as the cultural context of formative assessment (cited in Chapter 2) is fundamental in how it is enacted. Therefore, more emphasis was placed on research coming out of Ireland and the United Kingdom. However, some international research and policy including New Zealand, Australia,

and Norway was included due to the fact that policy borrowing is common among western countries (Steiner-Khamsi, 2006).

Policy Context of Classroom Assessment in Ireland and Scotland

This chapter begins with a review of policy documentation Ireland and Scotland. For this research, educational policies were considered as:

> "representations which are encoded in complex ways (via struggles, compromises, authoritative public interpretations and reinterpretations) and decoded in complex ways (via actors' interpretations and meanings in relation to their history, experiences, skills, resources and context)." (Ball, 1993, p. 11)

Ball's interpretation of policy took into consideration how policy is not enacted in isolation and how there are a myriad of contextual factors that affect how policy is enacted. This interpretation was chosen for this thesis as there was a strong focus on the cultural context of teaching, learning, and assessment in education. This thesis needed a definition that looked beyond policy as just prescribed text, to consider it as a representation that is given to schools and interpreted differently depending on the cultural context of a school. This research was conducted in the lower second level science classroom in Ireland and Scotland, therefore what follows is a review of the policy literature in this area, beginning with policy from Ireland.

Ireland

This section maps the development of the Framework for Junior Cycle (Department of Education and Skills, 2015a). When this research began, the 2015 framework had not yet been published. When data collection started (2017) the framework was in its second year of enactment, with the new science specification (Department of Education and Skills, 2015b) for Junior Cycle beginning implementation in the 2016-2017 academic year. Part of this thesis sought to investigate the influence of policy on a school's approach to formative assessment therefore looking at how policy developed in each country was merited. The Framework for Junior Cycle came into effect in 2015 with sixteen years of development prior to enactment. The following key policy documents were influential in developing this framework:

- The Junior Cycle Review – Progress Report: Issues and Options for Development (National Council for Curriculum and Assessment, 1999)
- Innovation and Identity: Ideas for a new Junior Cycle (National Council for Curriculum and Assessment, 2010)

- Towards a Framework for Junior Cycle – Innovation and Identity (National Council for Curriculum and Assessment, 2011)
- A Framework for Junior Cycle (Department of Education and Skills, 2012)

These documents were reviewed and the interpretation of formative assessment in each explored.

The National Council for Curriculum and Assessment (NCCA) are responsible for advising the Minister for Education and Skills on curriculum and assessment for early childhood education, primary and post-primary schools, and assessment procedures used in schools and examinations in Ireland. Beginning in 1999, the NCCA published the report: *The Junior Cycle Review – Progress Report: Issues and Options for Development.* This report (1999) highlighted key areas for reform in the junior cycle with emphasis on the potential of formative assessment to support learning. *Innovation and Identity: Ideas for a new Junior Cycle* (2010) was the first of two documents published by the NCCA that provided a commentary on how a reformed Junior Cycle might develop. The report drew on international standards in curriculum as a blueprint for how lower second level education may be reformed to benefit student learning. Additionally the NCCA wished to address the problems arising from research conducted by the Economic and Social Research Institute (ESRI, summarised in Smyth, 2009) that rationalised the need for curriculum reform at lower second level education due to student disengagement in second year and the exam focused nature of the junior certificate. The international standards drawn upon for inspiration for the Junior Cycle included Scotland's Curriculum for Excellence (CfE, The Curriculum Review Group, 2004). The CfE was cited and interpreted as a benchmark for quality teaching, learning, and assessment. This was why Scotland was used as a comparative for this thesis. It is beneficial to take lessons on teaching, learning, and assessment from different countries, however, policymakers need to be mindful of policy borrowing and take into consideration culture context and the individuality of different countries when drafting policy (Ball, Maguire, & Braun, 2012; Sebba, 2012). To summarise *Innovation and Identity: Ideas for a new Junior Cycle* (2010), the document rationalised the need to move away from a narrow summative view of assessment, contain less prescriptive content, focus more on the learning outcomes of students, key skills, and the experiences and quality of learning for all students.

Towards a Framework for Junior Cycle – Innovation and Identity (2011) followed the 2010 report and was more prescriptive in its thinking around curriculum reform. It proposed that schools should be at the centre of curriculum planning and assessment. This policy document presented core curricular components that would form the basis of the 2015 framework including the statements of learning (p.15) and a breakdown of the subjects, potential short courses, priority learning units for students with additional education needs, and key skills of Junior Cycle (p.18). In terms of assessment, this piece of policy recommended two assessment components for each subject – a portfolio based on schoolwork completed during the junior cycle (with a weighting of 40% of the marks) and an examination. All subjects would be taken at a common level (apart from English, Irish, and mathematics) and the duration of examinations would be shorter. These recommendations were stepping away from the high stakes nature of assessment at second level in Ireland and the portfolio aspect was more in line with formative interpretations of assessment.

The ideas put forth in the two innovation and identity reports (2010, 2011) formed the basis for the 2012 Framework for Junior Cycle which was developed by the Department of Education and Skills. The framework kept the proposal that the school-work component of the Junior Cycle would account for 40 per cent of the students' overall grade with 60 per cent obtained from examinations created by schools in at the end of the third year of junior cycle. There was a strong focus on schools becoming autonomous in assessment practices as research found that reform in education can only succeed if teachers play a central role in the reform process (Black, Harrison, Hodgen, Marshall, & Serret, 2013). With more autonomy placed on schools, teachers would have more agency over how curriculum could be interpreted and enacted in their specific context to better meet the learning needs of students. However, this was met with controversy from teacher unions in Ireland. There were widespread debates among schools, teachers, unions, and the media about the implementation of the 2012 framework, resulting in many of the proposed changes being contested (Murchan, 2018). Stakeholders concerns grew around the pace of change, time allocated to reform, teacher professional development and quality assurance of in-school assessments (Department of Education and Skills, 2014). As a result secondary teacher unions in Ireland balloted to strike (Teachers' Union of Ireland, 2014) to express their concern about the new proposals. Responding to the dissatisfaction around the 2012 framework, the Department of Education and Skills published a revised Framework for Junior Cycle in 2015. The rejection of the 2012 framework suggested that schools and teachers did not want to become more autonomous in the assessment process and believed they lacked

the skills to interpret and enact a new curriculum in a relatively short space of time. Moreover, they were concerned about adequate upskilling of teachers to implement reform, a concern that carried through to the 2015 framework and presented itself in the data of this research.

At the time of research, the 2015 Framework for Junior Cycle was in its second phase of implementation. The first subject to engage with the new framework was English in 2014, followed by science and business studies in 2016. The science teachers participating in this research were in their first year of implementing the Junior Cycle Framework (Department of Education and Skills, 2015a) and the new science specification (Department of Education and Skills, 2015b). The 2015 framework kept the underlying concepts of the 2012 framework with major changes being made to how students were assessed. The 40% school-based assessment was reduced to 10% and takes the form of an *assessment task*, corrected by the State Exams Commission. The outline of the *assessment task* in the 2015 framework was vague: it was based on what students learned, and the skills and competences they developed through *classroom-based assessments*. *Classroom-based assessments* (CBAs) were described as "drawn from a variety of types of assessment, which might include project tasks, oral language tasks, investigations, practical or designing and making tasks, field studies and artistic performance." (p.8). The CBAs are reported on in the Junior Cycle Profile of Achievement, however they do not count towards a students' final grade in that subject. The framework states that the CBAs would build on the use of formative assessment in the classroom, with an interpretation for formative assessment following later in the document:

> "Formative assessment involves teachers and students reflecting on how learning is progressing and deciding next steps to ensure successful outcomes. A vital part of formative assessment is the feedback that teachers provide to their students. Through a range of assessment activities, the teacher helps the student to identify what has been achieved and where there is room for further learning and development. It involves a shift from focusing mainly on summative judgements to engaging in ongoing activities that can be used to support the next stages of learning."
>
> (Department of Education and Skills, 2015a, p. 29)

Further insight into how formative assessment was perceived in the 2015 framework stated that "formative assessment complemented by summative assessment will be a key feature of the new Junior Cycle" (p.35). This statement is repeated in the text and is given prominence by being presented in a green box to draw the reader's attention. In addition, details are provided as to how ongoing classroom assessment will be facilitated:

> "As part of their daily practice, teachers will continue to assess students' learning by observing and listening as students carry out tasks and by considering how they respond to questions. Teachers will use the learning intentions and success criteria as the basis for providing feedback to help students plan their next steps in learning. Students will also be encouraged to reflect on how they are progressing in their own learning and provide feedback to their teachers. In developing the capacity for self-management and self-awareness, students will approach their learning more confidently and will be better prepared to meet the challenges of life beyond school."
>
> (Department of Education and Skills, 2015a, p. 36)

The text above puts forth some key techniques for formative assessment including questioning, learning intentions, success criteria, feedback, and self-reflection. These techniques and are common in the literature on formative assessment (see for example Black & Wiliam, 1998; Leahy, Lyon, Thompson, & Wiliam, 2005; Wiliam & Thompson, 2007) . The 2015 framework stated that CBAs would be used to build formative assessment practices, however with the CBAs not counting towards a final grade, it is difficult to gauge if teachers and students if value these formative assessment practices when they did not contribute to their certification at the end of the three years. Therefore, as part of this research teacher and student views on the formative assessment practices enacted in schools were explored.

Another difference in assessment between the 2012 and the 2015 frameworks was the significance placed on summative assessment. Traditionally in Ireland preference is given to testing and examinations to report on student learning (Lyons, Lynch, Close, Sheerin, & Boland, 2003; Sheehan, 2003). In the policy and research documents that proceeded the 2012 framework (bullet pointed on page 50), it was noted that lower second level education needed to be revised so that teaching and learning would be more student centred and less exam focused. Although the 2015 framework cites formative assessment practices, the same formative emphasis from the 2012 framework does not exist. Without a strong emphasis on formative assessment in prescriptive policy it is difficult to see how teachers can place an emphasis on formative assessment enactment in their practice. Johnston and Murchan (2021) summarise these shortfalls in the 2015 framework by stating that:

> "against a backdrop of a fragmented system characterised by a multitude of agencies, a variety of school types operating within differing management structures, a rigid subject-based approach, and the prevalence of high stakes assessment that fosters a

> relatively didactic approach to teaching, curricular reform in favour of a more formative approach to assessment was going to be difficult to embed in schools."
>
> (p.256)

Next the Junior Cycle Science Specification (Department of Education and Skills, 2015b), is discussed. This policy document was created to:

> "develop students' evidence-based understanding of the natural world and their ability to gather and evaluate evidence: to consolidate and deepen their skills of working scientifically; to make them more self-aware as learners and become competent and confident in their ability to use and apply science in their everyday lives."
>
> (2015b, p. 5)

The science specification designated two *classroom-based assessments* and an *assessment task* to be completed by students. These assessment procedures would be new to practicing science teachers and their students. While continuous assessment was a feature of the new science specification and Junior Cycle Framework, in science the amount of continuous assessment fell from 35 percent (in the 2006 science curriculum) to ten percent in line with other subjects (Department of Education and Science, 2003; Department of Education and Skills, 2015b). This could be perceived as a shortfall of the revised science specification however according a 2013 report from the NCCA, students were not presenting original work for the continuous assessment aspect of the science curriculum and ten percent of their grade was awarded for practical work that was not assessed in any way (National Council for Curriculum and Assessment, 2013). Therefore revisions in assessment processes needed to be made and although continuous assessment now only counts for ten percent of their science grade, the new science specification has a greater focus on critical thinking and inquiry based learning rather than learning off scientific concepts and processes (Erduran & Dagher, 2014). Inquiry based learning has strong links to the formative assessment strategy of promoting student autonomy and the processes combined can engage and motivate students to learning science (Correia & Harrison, 2020). The revised specification also states directly that formative assessment is at the forefront of assessment practices in science, with key techniques such as feedback, modifying teaching and learning, higher order questioning, and promoting autonomy all cited. As part of the data collected in this thesis, participants opinions on the ideals of the science specification were gathered to explore how policy was affecting formative assessment understanding and enactment in Ireland.

Scotland

This section focuses on the Curriculum for Excellence (Education Scotland, 2006) in Scotland. It serves students from early childhood to upper second level education and has been widely acknowledged as "the most significant educational development in a generation" as it places learning at the heart of curriculum (Priestley & Humes, 2010, p. 345). To reiterate, this curriculum was used as benchmark for quality teaching, learning, and assessment for the Irish Framework for Junior Cycle (2012, 2015a), therefore an examination of its policy documentation was warranted. The Curriculum for Excellence (CfE) originated in 2004 and was predated by the Assessment is For Learning (AiFL) development programme (Scottish Government, 2005) initiated in Scotland in 2001 (Hayward, 2015). Drawing from Black and Wiliam's meta-analysis on formative assessment (1998a), and taking lessons from the King's-Medway-Oxfordshire Formative Assessment Project (Crossouard, 2011; Hayward, 2007), Scotland was one of the first countries in Europe to implement a national assessment policy (Hayward, 2015) where teachers were "active developers of curriculum" (Priestley, Biesta, & Robinson, 2015, p. 1). This signified a commitment to reforming curriculum with formative assessment and active involvement of teachers in curriculum making at the forefront. Following the success of AiFL, reform continued with the Curriculum for Excellence (CfE) being delivered in schools from 2010. The curriculum, designed for all children and young people aged three to 18, consists of a broad curricular framework that provides for a coherent approach to curriculum, assessment, and qualification. The curriculum aims to strengthen the lifelong learning skills of its students by developing four main capacities: being successful learners, confident individuals, responsible citizens, and effective contributors, both in and outside of school.

According to Education Scotland:

> "Curriculum for Excellence is about raising standards for all by actively engaging learners, improving pedagogy, promoting deep understanding and developing skills"
>
> (Scottish Government, 2011)

Like Ireland having a general framework policy that is complemented by subject specifications, Scotland has a range of policy guidelines available to support teachers in subjects like science. The policy is broken down into four main categories: Experiences and Outcomes, Principles and Practice, Benchmarks, and Curriculum Review (Scottish Executive, 2004). Experiences and Outcomes (Scottish Government, 2010) is similar to the Irish science specification as it outlines what students should be able to do on completion of their broad general education (beginning in early learning and ending at the third year of secondary school). It is written in

the first person i.e., I can, or I have, putting an emphasis on the learning of the student not the teaching of the teacher. The next document concerns the principles and practice of science (Education Scotland, n.d.). It outlines approaches to learning and teaching that include active learning, problem solving, investigation and inquiry, collaboration, and independent thinking, all while building on what was learned from the Assessment is For Learning programme. These approaches to learning can be actualised by using formative assessment strategies such as activating students as owners of their own learning by engaging with independent thinking or problem solving and activating students as instructional resources for one another when collaborating or investigating different phenomena.

The benchmarks document (Education Scotland, 2017) provides national standard expectations in the sciences at each level in the CfE. The document links the experiences and outcomes for science to benchmarks to support teachers' professional judgement. The final document pertaining to the science curriculum in Scotland concerns a curriculum review (Education Scotland, 2013). This review is made up of different elements of the curriculum including looking at the strengths and areas for improvement in science, exploring the student voice in relation to science, and good practice examples from a range of different education setting from early childhood up to lower second level education. This shows how the Scottish Government are invested in how science in the Curriculum for Excellence is being implemented and evaluated by teachers and students.

It is appropriate to be reminded at this point that a strong link exists between the Scottish Curriculum for Excellence and the Irish Junior Cycle Framework (2012 and 2015a). The concept of policy borrowing is not one that is new to comparative educational research. The term policy borrowing covers the whole range of issues relating to how a foreign example is used by policymakers at all stages of the processes of initiating and implementing educational change (Phillips & Ochs, 2003, p. 451). The NCCA in Ireland cites how ideas for the revised Junior Cycle Framework came about based on good international practices from other countries including Scotland's Curriculum for Excellence (National Council for Curriculum and Assessment, 2010, 2011). Additionally, the revised science specification in Ireland drew on the Curriculum for Excellence's Experiences and Outcomes document (Scottish Government, 2010) to help structure the learning outcomes of the new specification (National Council for Curriculum and Assessment, 2013). Policy borrowing was fundamental in the Junior Cycle development with policymakers drawing heavily from the Scottish Curriculum for Excellence,

especially in relation to revised assessment strategies. However, policy borrowing is not without its problems. Research suggests that policy makers need to be mindful of context and misunderstanding cultural differences within education systems (Burdett & O'Donnell, 2016). Considering this, the cultural context of teaching, learning, and assessment practices in Ireland will be explored to get a sense of how policy borrowing played out between the Curriculum for Excellence and the Junior Cycle Framework 2015.

International Research on Formative Assessment

The previous section focused on research from Ireland and Scotland, however it is important to be mindful of other international policy contexts that can influence policy borrowing and how research on formative assessment is undertaken. This section has a specific focus on the policy contexts of countries that have strong formative assessment initiatives in place including New Zealand, Australia, and Norway.

To begin, in 2005 the OECD in conjunction with their Centre for Educational Research and Innovation (CERI) published a large-scale study comparing formative assessment practices across eight countries (Organisation for Economic Co-operation and Development, 2005). To date, this cross-national research is the most comprehensive of its kind that examines formative assessment at second level across eight education systems namely Australia (Queensland), Canada, Denmark, England, Finland, Italy, New Zealand, and Scotland. In addition, the study included literature reviews from English, French, and German language educational literature. Moreover, much of the research from this report is presented in a case study format mirroring the methodology of this thesis. Therefore, the OECD study was included in the literature of this thesis due to its comprehensiveness and its similarities to the research methodology of this thesis. A quick overview of the report shows that aspects of formative assessment including the role of feedback, co-operative learning and self and peer assessment were common among the selected countries. What differed in each country was the emphasis put on different strategies due to the variety of cultural contexts at play in each region. This is an important point to consider because as seen in the previous section on Ireland and Scotland the implementation of formative assessment varied depending on the cultural contexts of each education system.

Case studies from the OECD research demonstrated that with regards to legislation, both Denmark and Italy had the strongest policy concerning formative assessment from the *Folkeskoler* in Denmark stressing that students need to be actively involved in the assessment process, to the legislation passed in Italy in 2003 aimed at promoting formative assessment and making learning more individualistic for students. With regards to teaching and assessment, England had a strong Assessment for Learning programme developed in 2000, which provided schools with teaching strategies, and tools that they could use based on a schools' specific need. The OECD report study also considered how countries invested in professional development for teachers on formative assessment and found that both New Zealand and Queensland invest heavily in teacher professional development in this area with a variety of in-service courses and assessment methods readily available to teachers. It is important to consider these international studies and practices to come to understand where Ireland and Scotland lie internationally on formative assessment and how policy may contribute to promoting effective assessment practices.

New Zealand can be considered as a country where formative assessment is embedded in practice (Olson, 2005). Extensive research in the area of formative assessment in science education from New Zealand demonstrates that formative assessment is responsive to student needs, builds from professional knowledge and experience, is carried out by both teachers and students and is contextualised to the nature of the classroom environment (Bell & Cowie, 2001). These findings suggest that the formative assessment practices in New Zealand are more advanced than other countries where formative assessment research is still in its infancy. Therefore, it is important to consider how these practices in New Zealand came about and how their research could influence other research in different countries.

In 1989 New Zealand reformed its education policy by introducing a new Education Act that gave more autonomy to schools regarding their school charter and finances. Moreover the Department of Education was replaced with a more comprehensive Ministry of Education who design and implement policy, make sure that education providers have the resources and support they need to deliver services to students, and support teachers' and principals' professional leadership, learning and teaching (Ministry of Education, 2002). As a result of this change, the newfound Ministry allocated funding for educational research where one project focused on cultural preconceptions and sharing the power in learning. It was called the *Maori Mainstream Programme*. Case study research stemming from this initiative demonstrated the

formative assessment practices that were given due consideration in the project including feeding forward (sharing learning intentions and success criteria), scaffolding learning, feedback (sharing exemplars of work) and group work (Organisation for Economic Co-operation and Development, 2005). The results of adapting these practices into teaching and learning demonstrated that students had increased information retention and attendance at school, they were more likely to share their ideas in class, ask and answer questions, while teachers could allocate more time to learning rather than focusing on behaviour. This meant that the division of labour in these classroom was shared among teacher and students where the students took on more responsibility of controlling the classroom environment.

The Maori Mainstream Programme demonstrated how formative assessment initiatives can improve student learning within the classroom, however it is also important to use a wider lens when examining formative assessment and look at those factors outside of the classroom that can influence what is happening inside the classroom. A second case study from the OECD looked at how teacher professional development and monetary resources can improve formative assessment practice.

At Rosehill College, where students pay tuition and there is a healthy discretionary budget, they took on a whole school initiative to engaging with formative assessment practice. Senior management in the school took it upon themselves to share with staff where the school was going regarding formative assessment and how they were going to get there; a formative act in itself. A school culture was developed that focused on professional development and peer review where teachers would share literature and their expertise on formative assessment with one another. An hour a week was set aside for teachers to engage with formative assessment professional development and therefore school started an hour later every Tuesday. In addition, consultation took place with teachers, parents, and students where feedback was gathered on the whole school approach. Senior leadership cited that the creation of a school culture focused on improving student learning was the key determinant in the success of their initiative. Following this, the case study cites some key results from this whole school adaption of formative assessment including improved teacher student interactions, constant attention being provided to students including performance criteria, feed forward and feedback, improvement in national assessments, and increased motivation and engagement among both teachers and students.

What is to learn about formative assessment enactment from New Zealand is that their education policy includes contributions from experts in the field including John Hattie. In addition, curriculum frameworks are written in the form of seven essential learning areas, and eight essential skills for schools where the guidelines establish learning goals and describe the importance of diagnostic and formative assessment for enhancing teaching and learning (Organisation for Economic Co-operation and Development, 2005). Comparisons can be made here to the Junior Cycle Framework in Ireland where guidelines are set out as principles, statements of learning, and key skills (Department of Education and Skills, 2015a), and to the Curriculum for Excellence in Scotland where the curriculum is broken down into: Experiences and Outcomes, Principles and Practice, Benchmarks, and Curriculum Review (Scottish Executive, 2004).

Looking next to international policy on education from Queensland Australia, research demonstrates that although schools may vary in context and culture, it is possible for a state-wide curriculum to effectively ingrain formative assessment in practice (Organisation for Economic Co-operation and Development, 2005). As part of the OECD report (2005), Sebba and Maxwell examined two case study schools where there was extensive use of formative assessment. In Our Lady's College formative assessment took the form of sharing student work among teachers to discuss feedback, appropriate think time provided to students, sharing learning objectives and success criteria, and higher order questioning. This resulted in less competition among students and improved feedback practices among teachers and students. The school attributed its implementation of formative assessment to the national curriculum framework introduced in 1989 that focused initiative that focused on Key Learning Areas (KLAs) for a variety of subjects. As part of the KLAs support materials were developed and state-wide professional development was rolled out to aid implementation. In addition, the syllabuses were rolled out over several years so that teachers could adapt gradually to the new outcomes-based curriculum.

Woodridge High School was another case school that made extensive use of the classic elements of formative assessment including sharing learning objectives, higher order questioning, effective feedback, self, and peer-assessment. They also attributed their use of formative assessment to the KLA strategy as it helped them to place a greater emphasis on investigative work and integrated studies. Of interest is that Woodridge High School has a very different socio-economic context to that of Our Lady's College. In Woodridge there was high

unemployment in the community paired with low incomes and low levels of education. Following the curriculum overhaul, the students' learning improved, and they attributed this partly to the approachability of the teachers and the openness of their classroom environments. For example the students commented that "if they don't understand something they just ask a friend or the teacher and that getting the wrong answer was not embarrassing" (Organisation for Economic Co-operation and Development, 2005, p. 199).

What can be learned from examining the policy in Queensland is that state-wide initiatives in formative assessment are effective when there is adequate time and training provided for implementation. Moreover, providing schools with more autonomy in setting the curriculum meant that teaching, learning, and assessment could be adapted to suit the needs of each individual school. Although some teachers felt there was lack of consultation in the curriculum making process, overall the success of the KLA approach is helping to improve learning in schools.

Moving finally to examining teaching, learning, and assessment policy in Norway, lessons can be learned from their decentralised education system where high stakes incentives do not exist and local actors are responsible for monitoring performance and making improvements where necessary (Organisation for Economic Co-operation and Development, 2020). In addition, there is high investment in education in Norway when compared to other countries in the OECD. In 2006 education policy in Norway began to focus more on assessment for learning practices in school. Following this an Assessment for Learning Programme was devised where guidelines for implementation were set by the Directorate, but implementation was the responsibility of local authorities. The Directorate also provided training for teachers and schools in the form of seminars, conferences, and online training. There were over 630 schools involved in this programme and results showed that participation led to a more learning-driven assessment culture, increased use of formative assessment, and an improved planning and research culture. Although there were some issues in understanding what effective assessment is and getting students to self-assess their work, overall the implementation of the programme resulted in improved formative assessment enactment.

From examining international policy with a focus on formative assessment, it can be concluded that there are several factors that are crucial to effective implementation. These factors include:

- High investment in assessment initiatives including research and teacher training

- Increased professional development for teachers
- Increased autonomy in schools to implement curriculum
- Change occurring slowly over a number of years

Empirical Research on Teaching, Learning, and Assessment

This section focuses on three areas. Firstly, literature on teaching, learning, and assessment from Ireland and Scotland is presented, then an exploration of formative assessment empirical literature follows. Finally, insights into research on teacher identity and agency are provided. The literature from Ireland and Scotland sets the scene as to what the main areas of research are in both countries, while the formative assessment literature review explores studies that involve intervention and the five different strategies for formative assessment. The section finishes by looking at teacher professional identity and agency.

Research from Ireland

There is a dearth of empirical literature on teaching, learning, and assessment in Ireland (Darmody, Lysaght, & O'Leary, 2020; Devine, Fahie, & McGillicuddy, 2013; Gilleece, Sheil, Perkins, & Proctor, 2009). Beginning by examining the Irish literature on teaching practices, Sheehan (2003) found that in Junior Certificate science, teaching was mostly content driven and exam focused. Students were passive recipients of knowledge and classes were set up in a traditional, didactic, teacher-centred way where lower-order questions were prominent. These findings were consistent with a study by Lyons and colleagues (2003) who also found lower-order questions, the use of the textbook, and teaching to the exam predominated in second level mathematics classrooms. The prevalence for teaching to the test can be in part attributed to the high stakes nature of second level education in Ireland (McSweeney, 2012; Smyth & Banks, 2012) and a lack of teacher professional development focused on active learning for students (Lysaght & O'Leary, 2017) . With the implementation of the revised junior cycle framework that cites a move away from exam preparation and a focus on "formative assessment as a normal part of teaching and learning in classrooms"(Department of Education and Skills, 2015a, p. 29) this thesis explored if formative assessment was given more prominence in second level science classrooms.

The NCCA began advocating for education with a focus on formative assessment in 2004 by providing guidance to teachers on how they could support student learning through different assessment practices. The first phase of their research project involved:

> "developing a general understanding of formative assessment among post-primary teachers. Web-based information and exemplar material was placed on the NCCA website and a leaflet, giving an overview of assessment for learning and drawing attention to the site was circulated to schools, education centres and support services."
>
> (National Council for Curriculum and Assessment, 2004, p. 7)

In total there was two phases of the research and the NCCA published an interim report (2005b) and a report on the second phase of the study (2005a) to disseminate their findings. Although there were many positives coming out of this research including teachers utilising formative assessment strategies such as learning intentions and comment only marking, the research signified that teaching, learning, and assessment practices at this time were still "indicative of a traditional teacher-led classroom environment" (2005a, p. 8). Furthermore, whole staff involvement in assessment for learning was recommended to see the positive benefits of formative assessment on student learning.

A key focus of this thesis was the contradictions that arose between a teacher's intended and enacted practice. Again, research from Ireland in this area is scarce however studies by O'Grady, Simmie, and Kennedy (2014), and Devine, Fahie, McGillicuddy (2013) begin a conversation on what teachers believe to be effective practice. Devine and colleagues made use of mixed methods to study teachers' practices and beliefs across 12 primary and secondary schools. Their results indicated that there were contradictions between teacher beliefs and what the researchers saw during classroom observation. They suggested that the sociocultural context of the school (for example gender or social class) was a factor at play that influenced how teachers constructed and taught their lessons. Further exploration of sociocultural influences on teaching practice was advocated for by the authors. O'Grady, Simmie, and Kennedy's work (2014) was very relevant to this thesis as it was conducted in the second level science classroom. They researched the practices of pre-service and in-service teachers and focused on active learning methods (Bonwell & Eison, 1991), a set of practices that has common ground with formative assessment strategies (Handelsman, Miller, & Pfund, 2007). O'Grady, Simmie, and Kennedy also found that teachers were aware of what practices were effective in improving student learning, however due to the high stakes nature of second level education in Ireland, teachers often reverted to teaching to the test as they were constrained by

this engrained culture. So far, the literature from Ireland has shown that teaching with a focus on examinations was the cultural norm in schools from 2003 to 2014 with little to no change in methodologies. This rationalised the need for a change in lower second level curriculum: Junior Cycle Framework (2015a). The lack of change in teaching practices, combined with a new curriculum as an impetus for change merited exploration in this thesis. Specifically, how cultural context influences teaching, learning, and assessment practices in Irish schools.

To find out how students learn and how they perceive teaching, learning, and assessment practices in schools in Ireland, student voice must be considered in empirical research (Ní Chróinín & Cosgrave, 2013). Again, there is a lack of research in this area in Ireland. One study that collected data from students in Ireland was carried out by Smyth and Banks (2012). Their research focused on the impact of high stakes assessment at second level education in Ireland. Following the analysis of questionnaire and interview data, the researchers found that students favoured active learning methods in the classroom, however as iterated earlier, their preferences changed when examinations were approaching resulting in them favouring a narrow approach to exam preparation. Another finding of this research emphasised the importance of a positive and caring classroom environment for learning where teachers were helpful, easy to talk to, and had a good sense of humour.

Empirical research on formative assessment in Ireland is mostly conducted in primary schools. This small body of knowledge suggests that formative assessment practices are still in their infancy for a variety of reasons. For example, studies cite that teachers are often constricted by the cultural contexts of their schools and find it difficult to implement practices that are not common practice in their schools (Darmody et al., 2020; McSweeney, 2012). Data arising from the Assessment for Learning Audit Instrument (Lysaght & O'Leary, 2013) provides the most comprehensive information on formative assessment practices. This instrument was built on previous work by Lysaght (2009), and took guidance from Thompson and Wiliam (2007) on their strategies for formative assessment, discussed in Chapter 2. Findings from a sample of 476 primary teachers suggested a lack of understanding of assessment terminology and approaches to formative assessment by teachers, resulting in sporadic implementation of formative assessment strategies. Again data suggested that teacher led approaches to assessment were the most common and a lack of student involvement in their assessments (Lysaght & O'Leary, 2013). The authors more recently published further data from the Assessment for Learning Audit Instrument (Lysaght & O'Leary, 2017) advocating for its

potential to act as a catalyst to site-based professional development in formative assessment that celebrates a school's individual cultural context, rather than a top-down model where professional development is designed as a generic one size fits all model for teachers (Roseler & Dentzau, 2013; Vangrieken, Meredith, Packer, & Kyndt, 2017). The authors drew attention to the specific cultural contexts of schools and how teacher training must be individualised to the needs of schools, i.e., a one size fits all model is not effective in teacher professional development.

Continuing with the concept that a school's cultural context effects assessment practices in Ireland, a recent study found that second level teachers were susceptible to the contextual constraints of their school and felt pressurised by accountability i.e. to produce good exam results from students (Darmody et al., 2020). This study explored teachers' conceptions of assessment, a concept that has had little attention in the Irish context to date. By examining questionnaire data, teachers felt strongly that the purpose of assessment was to provide feedback to students and regular summative assessments were a key feature of their teaching practices. However, the authors posited that:

> "It would appear, therefore, that participants believe that internal summative assessment feeds back information on performance, but that this does not equate to feedback which helps learners identify where they need to go in their learning and how best to get there."
>
> (p.514)

The data suggest that although teachers believe that feedback is important, they do not adapt a formative approach to feedback where it helps students move forward in their learning (Wiliam & Thompson, 2007). The type of feedback being articulated in second level classrooms in Ireland merits further exploration to ascertain if teachers are providing students with effective feedback that moves learning forward, and if not, what are the factors constraining this formative assessment strategy.

The sociocultural theorisation of formative assessment from Chapter 2 positioned agency as a key concept within formative assessment enactment. To reiterate, agency was defined and understood in this research as follows:

> "the capacity of actors to make practical and normative judgements among alternative possible trajectories of action, in response to the emerging demands, dilemmas, and ambiguities of presently evolving situations"
>
> (Emirbayer & Mische, 1998, p. 971)

This is known as the practical-evaluative interpretation of agency that consists of three main facets: cultural, structural, and material agency (Priestley et al., 2013). There is a focus on agency in this research due to the curriculum reform in both Ireland and Scotland. Both the Junior Cycle Framework (Department of Education and Skills, 2015a) and the Curriculum for Excellence (Scottish Executive, 2004) have an increased focus on the centrality of the teacher in school-based curriculum development (Priestley, Biesta, & Robinson, 2015), therefore a discussion on agency is warranted at this point in the literature review.

It is evident from the scholarship on teacher agency that it was a key area of focus for educational research in Scotland (discussed in more detail later in this chapter). This is not the case in Ireland where research in this area is still in its infancy. However, recent research conducted by Scanlon and colleagues (Scanlon, Calderón, & MacPhail, 2021; Scanlon & Connolly, 2021) is providing useful insights into teacher agency in Ireland. Both Irish projects cited above studied teacher agency within curriculum reform. The first study centred around the introduction of physical education as a senior cycle subject (Scanlon et al., 2021), and highlighted "the minimal role a teacher appears to have in the process of achieving agency" (p.64). This finding from their case study research emphasised that importance of context when considering policy enactment. The authors found that it was combination of teachers' relationships, networks, and their contextual and structural influences that effected teachers achieving agency over their practice.

The second study was also concerned with agency in an era of policy change within a senior cycle subject: computer science (Scanlon & Connolly, 2021). Like the findings from the physical education teacher, the computer science teachers cited supportive relationships as a key factor in them achieving agency over a new curriculum. These relationships were between teachers and their students, colleagues, online support community and professional development services. Additionally, the study suggested that educating pre-service teachers on pedagogical approaches that can help them to achieve agency could have a positive effect on both teacher and learner agency in Irish second level classrooms. Learner agency is conceptualised by Manyukhina and Wyse as:

- learners' personal sense of agency, i.e., a belief in their ability to make a difference to their learning within given settings

- learners' agentic behaviour - the point at which students actually exercise their agency by playing an active role in directing the learning process, e.g., making decisions, assuming control, taking an action or refraining from one.

(2019, pp. 227–228)

Learner agency shows similarities with the formative assessment strategy of activating students as owners of their own learner (Wiliam & Thompson, 2007) by putting the active engagement of students in their learning at the forefront of their educational experiences. Scanlon and Connolly's research suggests that by teachers having heightened agency over their practices they can pass this agency on to their students and subsequently improve their learning.

Research from Scotland

Educational research based on teaching, learning, and assessment in Scotland can be broadly categorised into the following areas: research at primary level, research focused on curriculum reform and enactment, research on formative assessment across primary and secondary schools, and research concerning teacher agency. In addition, there has been some research conducted in the science classroom based on students' views of the curriculum (Colucci-Gray & Fraser, 2012), students' attitudes towards physics (Colucci-Gray & Fraser, 2012), and teachers as scientists (Rushton & Reiss, 2019), however this research is not extensive and therefore more research in the science classroom at second level is warranted.

When reviewing the literature at primary level in Scotland, there was a focus on active learning (see Maitles & McAlpine, 2012) and formative assessment enactment. Millar and Lavin (2007) conducted research with primary students and teachers on formative assessment techniques and their influence on primary children's views of themselves as individuals and learners. Data were gathered through questionnaires, individual interviews, and group discussions. This research was exploratory, and findings suggested that employing formative assessment in the classroom led to improvements in children's self-perceptions. In addition, gains were observed in self-esteem and beliefs about competence. However, differences were evident in terms of gender, ability groups, and those who lacked confidence in their learning abilities. The authors noted that a longer-term implementation of formative assessment techniques would be more beneficial to student learning than sporadic short-term initiatives. This research highlighted the importance of seeking out the student voice on their learning and how educational initiatives such as formative assessment are more effective over time.

Crossouard has conducted extensive research in teaching, learning, and assessment at primary level in Scotland with a focus on both formative assessment and activity theory (Crossouard, 2009, 2011, 2012; Pryor & Crossouard, 2008). Her in-depth case study of formative assessment (2011) made use of cultural historical activity theory, a branch of activity theory concerned with intervention research (Nussbaumer, 2012). Data were obtained through classroom observation and interview from teachers and students about critical skills tasks: "complex, open-ended tasks that pupils tackled in groups, followed by presentations by each group of their task resolutions" (Crossouard, 2011, p. 60). Her findings revealed that the design of these tasks allowed for effective collaboration among students and teacher and peer assessment. These practices are commonplace among formative assessment strategies (Black & Wiliam, 1998b; Wiliam & Thompson, 2007). Her use of CHAT provided for tensions to be uncovered between the object of the activity system (rich, interdisciplinary learning) and its tools (e.g., language tools) where positive reinforcement was utilised in place of rich dialogic engagement with students. This research draws attention to how feedback can be shared with students but not provide them with the information on how to improve their learning. This was made possible using CHAT and examining the elements of an activity system (Engeström, 1987) in detail.

There has been extensive empirical literature focused on curriculum at second level education in Scotland. Of particular importance was the research on the Assessment is for Learning (AifL) programme (Scottish Government, 2005) and its effect on student learning. Priestley and Sime (2005) took a case study approach to examining a school's implementation of formative assessment through AifL and noted contradictions among teacher values and whole school enactment of policy. The teachers interviewed as part of this research has personal values largely congruent with the principles of AifL, however data suggested that the cultural and structural difficulties present in schools can impede formative assessment implementation. The authors concluded by suggesting that formative assessment strategies can be enacted successfully through support from school management and professional trust of teachers. This research draws light on the contradictions that can occur between a teacher's intended and enacted practices, discussed in the preceding literature from Ireland.

Another study from Scotland that examined the AiFL programme found that using formative assessment led to students being more responsible for their learning, motivated, confident, and raised achievement levels, especially among those who would be considered as low attainers (Kirton, Hallam, Peffers, Robertson, & Stobart, 2007). The study gathered data from students, teachers, and parents in 16 primary and two high schools in Scotland. The AifL programme contributed to teaches conceptual knowledge of formative assessment "moving some from a teacher-centred pedagogy to one which placed pupils and their learning needs at the heart of teaching" (p.605). To summarise, the article cites some constraints teachers had with formative assessment enactment including professional support, the need for constant self-awareness, difficulty implementing practices with students who are not familiar with formative assessment, and funding from the project. These can all be considered as factors impeding formative assessment enactment.

Wallace and Priestly have written extensively on curriculum enactment in Scotland. (Priestley, 2011; Priestley, Edwards, Priestley, & Miller, 2012; Priestley, Miller, Barrett, & Wallace, 2011; Wallace & Priestley, 2011, 2017). Findings from their body of research suggest that implementing reformed curricula requires a multidimensional approach in schools. Looking to the cultural context of the school, their work found that a bottom up model of implementation i.e. teachers expressing agency over how they would enact reformed curriculum, proved effective in aligning teachers' practice with the ideas of the CfE (Wallace & Priestley, 2011). Teacher agency and the sustainment of curriculum reform was promoted through strong leadership and the relationship between senior management and staff in a school was fundamental in developing teachers' practices (Priestley, 2011). Moreover collaboration among teachers was a key factor in enacting reformed policy (Priestley et al., 2011). Teachers cited that time was needed "in or outside of school for collaboration, dialogue and to disseminate ideas, supported by appropriate resources is necessary for teachers to make sense of, develop and translate policy in their own working contexts" (p.280). Finally, it was found that teacher agency could be enhanced and/or restricted by the cultural context of a school (Priestley, 2011). The findings from this body of Scottish research highlights the various factors that can promote or inhibit curriculum reform and aligned teaching, learning, and assessment practices. As Scotland was used for a comparative in this research, the above findings were influential in examining factors promoting or inhibiting formative assessment practices both in the participating Irish and Scottish schools.

The second to last research area of interest from Scotland concerns studies focused on formative assessment enactment. Hayward (2015) considered what Scotland learned from a large-scale evaluations of its AiFL programme. Of interest in this study was the fact that the researcher uncovered contradictions among practitioners intended and enacted formative assessment practices, similar to the studies by Devine et al., (2013) and Priestley & Sime (2005) Hayward's study was conducted with 25 primary schools and 4 secondary schools and found that "without exception, in all the innovations observed, gaps had appeared between the original aspirations and practice in classrooms" (p.39). This was in part attributed to the changing cultural context of schools where attitudes had changed towards the AiFL initiative. Another finding from this research reiterated the social aspect of learning, be it in the classroom, or at home with family. Finally, Hayward advocated that the misalignment of practice needs to be tackled openly and systematically by researchers and policy makers. This thesis is a step towards investigating the misalignment between teachers' intended and enacted practices and the factors contributing to these contradictions.

Looking to specific strategies for formative assessment, Crichton and McDaid (2016) took an in-depth look at learning intentions and success criteria (Leahy et al., 2005; Wiliam & Thompson, 2007). The authors note a paucity of research in the way learning intentions and success criteria are perceived by students and teachers. This research was conducted at second level in Scotland and found that although teachers and students found learning intentions and success criteria useful in learning, actual enactment in lessons was rare. Again, this demonstrates a contradiction between intended and enacted formative assessment. Furthermore, teachers were frustrated with the tokenistic way that these strategies were often implemented and suggested that there needed to be more of an alignment in understanding between research and policy through focused professional development.

There has been extensive research (both empirical and theoretical) into teacher agency from Scotland (see for example Biesta & Tedder, 2007; Priestley, Biesta, Philippou, & Robinson, 2015; Priestley et al., 2013; Priestley, Biesta, & Robinson, 2016; Priestley et al., 2012; Wallace & Priestley, 2011) with the theoretical literature being discussed in Chapter 2. Empirical research from Scotland on teacher agency found that when a bottom up approach to curriculum was in practice, where teachers were both curriculum creators and enactors, their then agency increased, leading to increased enactment of reformed policy (Wallace & Priestley, 2011). Their research found that the AifL programme (Scottish Government, 2005), that built on the

King's Medway Oxfordshire Formative Assessment Project in England (Black et al., 2004) provided for more flexibility in formative assessment for teachers in Scotland and therefore they held a more powerful role in curriculum design rather being transmitters of information. This is important research finding as it draws an explicit link between teacher agency and the success of reformed policy. Additionally, Wallace and Priestley (2011) found that teacher agency improved when they were engaged with professional development that helped them to understand and reform their practices to improve student learning. This was a noteworthy caveat in their findings as all teachers in Ireland and Scotland must engage with professional development as part of their registration with respective Teaching Councils (Department of Education and Skills, 2017; General Teaching Council for Scotland, 2020).

A variety of empirical research regarding teacher agency in Scotland was summarised by Priestley, Biesta, Philippou, and Robinson (2015). From the *Cultures of Curriculum Making in School and College study* in Scotland (Priestley et al., 2012), it was found that teachers' agency was shaped differently by their past experiences, in ways which effected their approaches to teaching, learning, and assessment in their professional lives. Even when the teachers were based in the same subjects with the same students, their approaches to practice varied due to factors such as their own education trajectory and their level of alignment with school culture.

Alignment with school culture and teacher agency was also a focus of the *Social Practices of Curriculum Making* study in Scotland (Priestley, 2011). This research found that when a particular teacher's approach to teaching (pupil-centred) contrasted with that of their colleagues and their school (raising attainment through transmissive pedagogies), it led to the becoming marginalized in the school decision-making processes. The teacher's opportunity to progress into management was negatively affected by the agency he expressed over his practice as he did not just go with the flow of his school.

Finally the *Teacher Agency and Curriculum Change* project (Priestley et al., 2013, 2016) showed when teachers expressed a lack of confidence in engaging with new curriculum, achieving agency was difficult for them. This was clear in one school where there existed a high degree of professional isolation. The authors drew links between professional isolation i.e., having teaching practices different to others in the school, and agency where teachers believed they needed to fall in line with whole school practices for them to progress in their career. In contrast, when teachers were a part of a school culture where innovation and risk-

taking was encouraged and supported, they expressed enhanced levels of confidence in delivering reformed curriculum. These findings were significant because both Ireland and Scotland were chosen for this thesis due to their relatively recent reformed curricula. Priestly and colleagues illustrate the importance of the school culture on curriculum enactment and one of the main objectives for this thesis is to ascertain the influence of cultural context on teaching, learning, and assessment practices within schools.

Summarising this section on empirical research from Ireland and Scotland, research in Scotland on teaching, learning and assessment is much more common while in Ireland it is still in its infancy. The empirical literature from both countries displayed contradictions among teachers' intended and enacted practices, importance of formative assessment specific professional development, the influence of teacher agency and cultural context of the school on practice, and the importance of aligning teaching, learning, and assessment with the ideals of new curriculum. Specifically in Ireland literature found that teaching, learning, and assessment is still exam focused and teacher centred, while the ideas of the Junior Cycle Framework call for a learning centred approach to lower second level education. All the findings were relevant to this thesis and helped to identify gaps in the literature and to ascertain how this research would add to the limited body of knowledge on formative assessment in both Ireland and Scotland.

Teacher Professional Identity

The theoretical literature from Chapter 2 cited that teacher identities are implicated in formative assessment processes (Pryor & Crossouard, 2008). Emphasis was placed on sociocultural factors including teacher professional identity that can influence how formative assessment is enacted in the classroom. Therefore, what is necessary in this chapter is a review of the literature on professional identity and its implications for this research.

According to a meta-analysis conducted by Beijaard, Meijer, and Verloop (2004) there are three categories that characterise teacher professional identity research: formation, characteristics, and those represented by teacher stories. Empirical research on teacher identity formation tells us that it can be dependent on professional community and institutional context including classroom environment (Coldron & Smith, 1999; Goodson & Cole, 1994; Mawhinney & Xu, 1997), it stabilises after initial teacher education (P. Gardner, 1995), it can be shaped by combining knowledge from a variety of sources (Antonek, McCormick, &

Donato, 1997), and a teacher's own experiences of schooling can form part of their professional identity (Samuel & Stephens, 2000). When examining the characteristics of teachers who have a highly developed professional identity, Moore and Hofman (1988) align it with striving for quality in the workplace while Beijaard (1995) explains how perceptions of identity can change depending on a teacher's stage in their career. This literature suggests that sociocultural factors including past experiences and community have a part to play in how teachers enact different teaching, learning, and assessment practices. This directly impacts formative assessment enactment as depending on how a teacher's professional identity was formed, their enactment may vary in effectiveness.

A discussion on teacher identity cannot be complete without exploring literature on teacher knowledge, in particular a teacher's pedagogical content knowledge (PCK). Shulman explains that PCK is when a teacher goes beyond understanding the content which they are teaching by reconstructing it and presenting it in a way that meets the needs of all students (1987). Looking at PCK in terms of formative assessment, it marries closely with the idea that teachers need to be able to adapt their practices, the *big idea* of formative assessment (Wiliam & Thompson, 2007), in order to improve learning for all students. Empirical literature on PCK suggests that it is a difficult concept to capture and document (Loughran, Mulhall, & Berry, 2004) as a teacher's PCK may not be evident to a researcher within the confines of one lesson or teaching experience, i.e. an extended period of observation is needed in order to capture the nuances of PCK. Considering this, more recent research conducted on PCK has found that professional development opportunities for teachers that is situated in the real work of teachers in classroom can have a significant influence on teacher knowledge and skill (Gess-Newsome et al., 2019). Yet enhancing teachers' PCK through intervention is not without its problems. Gess-Newsome and colleagues cite how factors including personal beliefs, school contexts, and resistance from students negatively affected their motivation to implement practices that would enhance their PCK. The findings from this research suggest that teacher PCK is only one factor that influences how teachers enact practices such as formative assessment in the classroom and that teacher professional identity is a complex and multifaceted entity (Dillabough, 1999).

Examining literature from Ireland and Scotland on teacher professional identity, it is evident that the research from Scotland is more prominent (see for example Priestley, Biesta, Philippou, et al., 2015; Priestley et al., 2016) , while research from Ireland is lacking. MacDonald Grieves research from Scotland was concerned with the types of teacher characteristics that attribute to

excellence (2010). She considered excellence as the capacity to build the four student capacities cited in Curriculum for Excellence documentation: "successful learners, confident individuals, responsible citizens and effective contributors to society." (Scottish Executive, 2004, p. 3). Data were collected using teacher questionnaires illustrated how teachers' personal qualities and interpersonal skills contributed to achieving excellence. These qualities and skills can be considered as part of a teacher's professional identity. In addition, a positive classroom ethos and teacher student relationships were also fundamental in achieving excellence. The author concludes by suggesting that professional development should consider these key attributes of a teacher's professional identity. These findings are relevant to this research as there was a focus on the factors that can promote or inhibit formative assessment practice and MacDonald Grieve's research suggests that a teacher's professional identity is an important factor in improving student learning and more research in this area is needed.

Assessment Literacy

Taken broadly, assessment literacy is a term used to describe a person's understanding of the language of assessment It involves teachers being prepared to "define, teach, and assess the different kinds of competencies that match the higher order instructional goals for the twenty-first century" (Koh, 2011, p. 257). To enhance the effectiveness of assessment, and to develop student learning skills, it is important that those involved in learning including teachers and students are assessment literate (Chan & Luo, 2021). Understanding assessment literacy can be approached from two different directions: teachers' assessment literacy and student assessment literacy, the former requires the teacher to have a meaningful knowledge of what assessment is, while the later enables students to enhance their learning through processes such as self-assessment and metacognition.

A lack of teacher assessment literacy can cripple the quality of education (Popham, 2009). Teacher assessment literacy can be developed through professional learning opportunities including initial teacher education, and ongoing professional learning. Stiggins (1991), coined the term assessment literacy in education, he cites five standards necessary for a teacher to be competent in assessment literacy. These include:

1. Having a clear purpose of assessment
2. Understanding the importance of assessing different achievement targets
3. Selecting proper assessments based on achievement targets

4. Sampling and collecting student achievement based on performance tasks
5. Avoiding assessment bias and distortion.

However, research in this area demonstrates an underdeveloped assessment literacy among teachers (Charteris & Thomas, 2017; DeLuca, LaPointe-McEwan, & Luhanga, 2016; Koh, 2011; Mertler, 2004; Smith, Worsfold, Davies, Fisher, & McPhail, 2013). It is necessary for teachers to develop their assessment literacy in order for them to understand the assessment needs of the students on front of them and adapt their teaching as appropriate (Stiggins, 1991) For example, Koh (2011) found that there was a lack of assessment literacy among teachers and school leaders due to a number of constraints including inadequate training, lack of time, lack of support, and classroom management factors. In addition, fiscal constraints were a factor leading to poor assessment literacy in Ireland (Lysaght & O'Leary, 2017).

Research into improving teachers' assessment literacy has found that when training is ongoing and sustained a better understanding of authentic assessment can be achieved by teachers (Koh, 2011). This means that for teachers' assessment literacy to improve, the training they receive needs to be consistent and long term. Yet in Ireland, this is not the case with professional development. Research into assessment literacy from Lysaght and O'Leary (2017) has found that the fractured nature of the current provision of professional learning in Ireland means that teachers' assessment literacy is underdeveloped, and they call for an urgent need for teacher training on assessment literacy. Considering this, DeLuca, Chapman-Chin, and Klinger (2019) built on their previous work on teacher professional learning to create a continuum that is useful for describing how teachers enact formative assessment practices. Their study relied heavily on Marshall and Drummond's conceptualisation of the *letter* and *spirit* of assessment for learning (2006) where teachers who adopt the *spirit* of assessment for learning involve students actively and authentically in the assessment process whereas those who follow the *letter* demonstrate superficial and procedural practices that have little influence on pedagogy and learning.

DeLuca and colleagues used this conceptualisation of assessment for learning to characterise teacher learning progression on a five-step continuum: learning the letter, practicing the letter, responding to the letter, adopting the spirit, and leading the spirit. Those at the beginning of the continuum had the most to learn about enacting formative assessment, while those at the latter end of the scale were leading learning in terms of formative assessment enactment. This research has implications for looking at teacher professional development in assessment

literacy. As professional development can cause a shift in pedagogy and professional identity, it is important to understand the facets that can support effective formative assessment enactment. DeLuca, Chapman-Chin, and Klinger summarise their work by characterising professional learning that supports formative assessment. These characteristics include the importance of culture and community for teachers, reframing professional learning so that what is learned in professional development is modelled in the classroom, beginning with teacher learning then moving on to examining student learning, and finally the presence of a knowledgeable other is important to facilitate effective professional learning.

DeLuca and colleagues (2016) found that the multiple dimensions of assessment literacy mean that conceptions of it have changed over time and are in a state of continual flux. This presents a problem in relation to teachers having effective formative assessment skills. Considering this in Ireland, *The National Strategy to Improve Literacy and Numeracy among Children and Young People 2011-2020* sets out actions for improvement of student literacy and numeracy in primary and post-primary schools (Department of Education and Skills, 2011). This document was born out of students' poor performance in the PISA[7] assessment, therefore a national literacy and numeracy strategy was created. In this document assessment is tied to the teaching of literacy and numeracy, however the strategy is not concerned with understanding assessment through literacy. The focus of the strategy is on teaching literacy and how teachers can go about this yet, there is a lack of clarity on how teachers are to gain these skills with the strategy citing the provision for professional development from national professional development services. Returning to Lysaght and O'Leary (2017) who examined provisions for teacher training, they called for a greater investment in teacher training so that teacher assessment literacy in turn can help to improve student assessment literacy however between 2011 when the literacy and numeracy strategy was created and 2017 this had yet to be the case in Ireland. This raises concerns about the provisions for professional development for teachers in Ireland.

Student Assessment Literacy

There is a strong link between students' assessment literacy and their capabilities to become self-regulated learners (Chan & Luo, 2021; Smith et al., 2013). To date the empirical research on student assessment literacy is scant with Smith et al. providing a comprehensive insight into

[7] PISA is the OECD's Programme for International Student Assessment. PISA measures 15-year-olds' ability to use their reading, mathematics and science knowledge and skills to meet real-life challenges.

this phenomenon (2013). Their intervention study on undergraduate students provided insights into how student learning can be improved through the development of student assessment literacy. They cite that the greatest predictor of improved student learning was "the development of their abilities to judge standards of performance on student work created in response to a similar task" (p.44) What this means is that students being able to actively engage in learning by assessing the work of others and applying criteria for success to exemplars of work can help to develop their self-regulation skills. This has strong links with the values of formative assessment whereby students acting as instructional resources for one another and using success criteria are key premises of effective formative assessment enactment. This study was the first of its kind to explicitly look at student assessment literacy as a factor that influences student learning. This work sparked an interest in the area of student assessment literacy, leading to the development of a framework for effective student assessment literacy (Chan & Luo, 2021).

Chan and Lou (2021) concluded from their research that there are four holistic competencies in their framework that can promote student assessment literacy, namely knowledge, attitude, action, and critique. Knowledge involves students understanding the assessments they are undergoing, attitude comprises of students' willingness to engage and avoid defensiveness in assessment, action is about students reflecting and using feedback to improve their learning, and finally critique involves a student's right to challenge feedback and critically engage in dialogue with teachers and other students. The research from Smith et al., and Chan and Lou provides food for thought when examining student assessment literacy. Reflecting on their work it can be concluded that student assessment literacy ties closely with strategies for formative assessment that can improve student learning. This is a concept that has yet to be explored within second level research and research coming out of Ireland.

Formative Assessment Research

The body of research on formative assessment is skewed toward studies with a focus on intervention and others that focus on one or two key strategies for formative assessment such as learning intentions and success criteria (see for example Black, Harrison, Lee, Marshall, & Wiliam, 2003, Crichton & McDaid, 2016). As the policy section of this review stated earlier, curriculum with a strong focus on formative assessment is a relatively new concept in educational research, therefore intervention studies were warranted to promote these strategies

among schools and teachers. Looking at how teachers enact formative assessment without intervention is not sufficiently examined in the literature, therefore this thesis aims to address that gap in the knowledge. This section begins by looking at the most prominent intervention studies and then follow into an exploration of research that concentrates on the five strategies for formative assessment (Wiliam and Thompson, 2007).

Intervention Studies

The *Kings College Medway Oxford Formative Assessment Project* (KMOFAP) is the most well documented large scale project on formative assessment, with many publications arising from its implementation (see for example Black, Harrison, Lee, Marshall, & Wiliam, 2003; Black & Wiliam, 2005, 2012). This project followed the 1998 review of formative assessment research by Black and Wiliam (1998a, 1998b) and aimed to improve teachers' formative assessment practices through professional development. In total the researchers in England worked with 6 schools, 48 teachers of science, maths, and English and conducted whole day meetings every five weeks for two years. The results of the project indicated that improvements were made in student learning through the formative assessment strategies of oral feedback through classroom dialogue, feedback through marking, peer and self-assessment, and the formative use of summative tests. Of note was that the strategy of oral feedback through classroom dialogue helped to develop teachers' responsive teaching skills and they were able to respond to students' pre-knowledge and misconceptions about content.

Stemming from the KMOFAP project the *Embedding Formative Assessment Project* worked with 60 schools in the United Kingdom by facilitating in-school professional development through a package developed by Leahy and Wiliam (2009) A focus of the project was the development of teacher learning communities where teachers would come together monthly to give feedback on their formative assessment practices and suggest ideas to try in future lessons. A key aspect of the project was peer observation where teachers would provide feedback to one another on their enactment of formative assessment. A report published on the project cited five major impacts of embedding formative assessment with the participating schools. Over 80% of schools state that teachers were providing feedback that moved learners forward which created a structure for students to act on feedback, teachers valued the importance and impact of formative assessment techniques on students, schools saw a cultural change where

teachers reflected and refined their practices, students acted on feedback, and teachers' classroom practices of formative assessment improved (Wiliam & Leahy, 2016).

Another project related to the work of the KMOFAP group was the *Learning how to learn in classrooms, schools and networks* (LHTL) project that centred on finding out how learning practices be can be developed and embedded in classrooms without intense outside support and what conditions in schools and networks support the creation and spread of such knowledge and practices (James et al., 2006; James & McCormick, 2009). The researchers worked with 40 primary and secondary schools in the United Kingdom and gathered data via questionnaires, interviews with school leaders and teachers, classroom observation and video. They built their "light touch" professional development materials (James & McCormick, 2009, p. 975) so that schools could tailor resources to the specific cultural context of their school. An interesting finding from this project was teacher enactment of formative assessment practices. The researchers referred to this as the *letter and spirit* of assessment for learning, discussed earlier in the assessment literacy section of this chapter (Marshall & Drummond, 2006, p.133), whereby some teachers showed a deep understanding of the underpinning principles of formative assessment, and others were focusing on more on surface techniques. For example, one of the formative assessment strategies that differentiated the two groups of teachers was that the *spirit* of assessment for learning teachers made use of student self-assessment, while the *letter* teachers did not make full use of this strategy to improve student learning.

Examining the above literature, it was apparent that intervention-based research on formative assessment is common and widespread. Looking at formative assessment practice without external intervention is under researched and therefore is a focus of this thesis. In addition, what can be inferred from examining the large-scale studies on formative assessment is that intervention via professional development is a key focus in this area of scholarship. Of note for this thesis is the effect that professional development has on formative assessment enactment and that issues can arise with superficial adoption of formative assessment in the classroom. This superficial adoption often takes the form of a tools-based model for formative assessment where research looks at one specific tool (for example learning intentions or questioning) and the spirit of formative assessment i.e., improved learning and responsive teaching isn't given due consideration. The following literature will now highlight this discrepancy.

Strategies for Formative Assessment

In Chapter 2 Wiliam and Thompson's domain of different types of formative assessment activity was conceptualised in five key strategies:

- Clarifying and sharing learning intentions and criteria for success
- Engineering effective classroom discussions and tasks that elicit evidence of learning
- Activating students as instructional resources for one another
- Providing feedback that moves learners forward
- Activating students as the owners of their own learning

(Wiliam & Thompson, 2007, p. 63)

In addition, they cite that the purpose of formative assessment is to improve student learning often through adaptive teaching known by Wiliam and Thompson as the "*big idea*" of formative assessment (2007, p. 64). It is important to remember that these strategies were founded in empirical research discussed in Chapter 2 (Leahy et al., 2005) and are considered as "non-negotiable in that they define the territory of assessment for leaming" (p.20). The following subsections will discuss the empirical literature on the five strategies and the big idea to ascertain the current understanding and enactment of formative assessment in the research.

Clarifying and Sharing Learning Intentions and Criteria for Success

The first of the strategies involves the preparation of students for the learning that is to follow and is intended to make success in learning visible to all (Wiliam, 2014). It involves guiding the next steps in learning (Black et al., 2013). This strategy is rationalised as a means for formative assessment as students can often experience failure when they do not know what is required of them in lessons (Black & Wiliam, 1998a; Leahy et al., 2005). Crichton and McDaid's research argued that learning intentions and success criteria were discussed in Scottish classes and can often be adopted in a tokenistic manner (2016). These findings were dissimilar to Irish research that showed how sharing learning intentions and success criteria with students was an established practice by teachers (Lysaght & O'Leary, 2013), however the authors cite the unreliability of self-reported data from teachers as they may not wish for their school to be perceived badly (Lysaght, 2009). Problems with implementing this formative assessment strategy can arise from a variety of factors including a lack of understanding of the strategy, variations in the level of support teacher receive and increased teacher workload (Khechane, Makara, & Rambuda, 2020).

According to Thompson and Wiliam's framework (2007) clarifying and sharing the learning intentions and criteria for success is the responsibility of the teacher, while understanding these intentions and success criteria is the task of students. One way that teachers can communicate what is expected of students is using rubrics. According to the OECD:

> "Rubrics provide specific guidelines and criteria for evaluating student work… A good rubric also describes levels of quality for each of the criteria, usually on a point scale. In other words, rubrics help students and teachers define quality."
>
> (Organisation for Economic Co-operation and Development, 2011, p. 38)

Tools such as rubrics and feedback forms can be used to facilitate student goal setting, where students can "formulate their own goals, giving them a sense of direction of what they are to achieve, and providing them with a blueprint of where they are going" (Mak & Lee, 2014, p. 74). Providing students with rubrics as guidance in learning enables the formative assessment strategy of activating students as owners of their own learning, because they are a means for students to reflect on their learning and put steps in place to improve. Research into rubrics has demonstrated that they can be time constraining as they require a teacher to dedicate time to reflecting on the learning intentions and success criteria. However, because students are often not aware of the standards that are expected of them, demystifying the assessment process and engaging students with the standards that are required of them can help to expand their self-regulation skills and in turn improve their learning (Black et al., 2013; Carless, 2006).

The quality of an assessment rubric is an important factor in whether or not it is effective in improving student learning (Brookhart, 2018). One means by which teachers can ensure the quality of a rubric is by engaging students in the creation process. Again, this links to the formative assessment strategy of activating students as owners of their own learning. When students are involved in creating their own assessment rubrics, many benefits have been cited including improved understanding of content, increased self-regulation, increased accuracy in self-assessment, and a reduction in goal avoidance (Panadero, Alonso-Tapia, & Huertas, 2014). The literature on rubrics has largely been conducted at third level with a gap in the knowledge on how assessment guidelines such as rubrics can contribute to student learning at second level.

Engineering Effective Classroom Discussions, Questions, and Learning Tasks

This strategy is largely concerned with classroom talk and questioning. Engineering effective classroom discussions can be facilitated by exploring the collective works of Alexander and

Mercer on dialogic teaching (see for example Alexander, 2018; Mercer, 2019). Dialogic teaching builds on the social aspect of learning developed by Vygotsky and Bruner (see Chapter 2) and explains how the quality of classroom talk should be distributed appropriately among teacher and students. Alexander's empirical research on dialogic teaching has expanded the idea that each classroom is unique and every teacher needs to develop their own dialogic teaching pedagogy to refine their skills and the dialogic skills of their teacher (Alexander, 2018). There is a large overlap between the research on dialogic teaching and formative assessment. Alexander notes how dialogic teaching is influenced by formative assessment methods as well as teachers' handling of classroom time, student grouping, classroom layout, and the balance between oral and written work. His more recent empirical work has demonstrated that students participating in a dialogic teaching intervention were academically two months ahead of their control peers in English, maths, and science (2018). Moreover his earlier research reiterated the complexity of classroom culture, with cultural norms, community, and teacher professional identity all playing a role in creating a dialogic classroom (2001, 2008, 2009). In addition, others who have carried out research on dialogic teaching have found that it encourages teacher reflection on how they use language in the classroom to promote learning (Reznitskaya, 2012), it links strongly to processes of scaffolding learning and has the potential to be a useful learning tool (Bakker, Smit, & Wegerif, 2015), and students who engage with dialogic teaching in science are more motivated to learn while teachers who participate in training on dialogic teaching considered it effective in helping students to learn and understand science (Mercer, Dawes, & Staarman, 2009).

Engineering effective classroom discussions also involves questioning activities that take place in the classroom. Leahy and colleagues (2005) express how this strategy is about teachers asking students questions that either prompt students to think or provide information that can be used to adjust instruction to meet leaming needs. Additionally, questioning is an important factor in assessing student understanding and keeping students engaged with learning activities (Caram & Davis, 2005; Chin, 2006; Lee & Kinzie, 2012; Volante, Beckett, Reid, & Drake, 2010). The big bodies of research that stand out when questioning is mentioned is the work of Bloom on his classification of learning objectives (1956) and Rowe on *wait time* around student responses (1974). In the KMOFAP project discussed earlier, it was found that increasing wait-time for students to answer questions meant that students became more involved in class discussions and increased the length of their replies (Black & Harrison, 2001).

There are many different ways that teachers interpret questioning practices, higher-lower, open-closed, convergent-divergent etc. (Tofade, Elsner, & Haines, 2013) however its functionality should always be consistent:

> "Using questioning, teachers assess students' knowledge, determine needs for focused reteaching, and encourage students to think at higher cognitive levels"
>
> (Caram & Davis, 2005, p. 20).

However, this is not always the case. In a study by Tofade et al. (2013) it was found that lower order, recall questions are used in educational settings frequently leading to hampered effort in promoting deeper, critical thinking in students. Similarly, Lee and Kinzie (2012) found that after video observation and teacher interviews in the pre-kindergarten classroom, teachers mostly asked closed questions and were often too quick in changing from open ended to closed questions when they thought students were struggling.

For students to truly learn from teacher questioning, teachers must develop their higher order questioning skills and challenge students to think deeply about the question being asked (Harrison, 2015). Effective questioning requires an investment by classroom actors in rich dialogue stemming from the idea that knowledge is socially constructed: first by dialogue with others then internally on an intrapsychological plane (Vygotsky, 1978). In their work around developing problem solving skills with students in mathematics Swan and Pead (2010) highlighted five principles for effective questioning. They are as follows:

1. Plan to use questions that encourage thinking and reasoning
2. Ask questions in ways that include everyone
3. Give students time to think
4. Avoid judging students' responses
5. Follow up students' responses in ways that encourage deeper thinking

The first principle highlights the importance in planning effective questions prior to lessons. In a study by Albergaria-Almeida (2010) it was found that there was a clear mismatch between teachers' questioning perceptions and practice and that careful planning of questions ensured that students were being asked higher level questions in class. It could be concluded that teachers were not following through with formative questioning so that student learning could be improved. This is an interesting finding as it converges with activity theory (Engeström, 1987) that suggests a disequilibrium or contradiction can often exist between the intended and enacted practices of subjects of an activity system. Principles two and four consider the culture

of the learning environment, and the importance of the teacher student relationship in formative assessment. Empirical research on the classroom community demonstrates that comfortable discourse environments are needed for a conversation of questions to become common in the classroom (Van Zee, Iwasyk, Kurose, Simpson, & Wild, 2001). Principle three reflects Rowe's research on wait time (1974) where providing students with time to think made student answers longer, more confident, and students were able to challenge their peers' responses and offer alternative explanations to questions. The final principle was expanded in the research by Chin (2006) who found that a teacher's ability to pose follow up questions that build on student responses and that stimulate a variety of cognitive processes will promote student activity beyond recall.

Activating Students as Instructional Resources for One Another

This strategy involves both peer assessment and co-operative learning. Peer assessment is described as "the process of having the members of a group judge the extent to which each of their fellow group members has exhibited specified traits, behaviours, or achievements" (Kane & Lawler, 1978, p.555). This tool for activating students as instructional resources for one another is rooted in feedback, be it face-to-face or otherwise. This feedback is usually distributed reciprocally among the assessors and the assessed (Topping, 2009). Findings from the KMOFAP project demonstrated that peer-assessment is valuable in learning in many ways:

- If students are struggling with a concept, it is likely that their classmates will be able to describe it effectively using student talk which all students and particularly low achieving student will be more familiar with.
- It is likely that students will listen to advice or criticisms from peers' rather than from the teacher.
- It frees up the teacher's time in class so that they are free to observe peer-assessment in action, reflect on it, and constantly improve these practices.

(summarised from Black & Harrison, 2004; Leahy et al., 2005)

Gielen and colleagues (2010) posit that students must be trained in this process in order for it to be effective. This echoes Sadler (1989) who cites how students may not know what to do with feedback when its provided. Additionally, Harris and Brown found that students are not convinced of the benefits of peer assessment to their learning and prefer teacher led assessments (2013).

Another technique in activating students as instructional resources for one another is co-operative learning. Johnson and Johnson described it as "the instructional use of small groups so that students work together to maximize their own and each other's learning" (Johnson, Johnson, & Johnson Holubec, 1994, p.1:3). In a large scale international meta-analysis on the effectiveness of co-operative, competitive, or individualistic learning, it was found that that higher achievement and more positive peer relationships were associated with co-operative practices rather than competitive or individual learning (Roseth, Johnson, & Johnson, 2008). Research from the science classroom found that students preferred co-operative learning to individual work and getting to work as groups meant students had more positive attitudes towards their laboratory work (Raviv, Cohen, & Aflalo, 2019). Also co-operative learning was found to be more effective than direct instruction with respect to achievement and attitudes of eighth grade students in science classes (Kose, Sahin, Ergun, & Geser, 2010). Other research into co-operative learning shows that the social dynamics of the group needs to be managed carefully in order for an activity to be truly co-operative (Cohen, Lotan, & Catanzarite, 1990; Haller, Gallagher, Weldon, & Felder, 2000) i.e. is not enough to put students in groups but they need to be immersed in an environment where social learning is the norm.

Providing Feedback that Moves Learners Forward

Good feedback can be broadly defined as anything that might strengthen the students' capacity to self-regulate their own performance (Nicol & Macfarlane-Dick, 2006) yet, varied interpretations of the term feedback means that its effectiveness often does not reach full potential. Feedback has been discussed in detail in Chapter 2 with Sadler's interpretation of feedback (1989) advocating for a constructivist approach to formative assessment practices. At this point, empirical literature will be discussed to ascertain if Sadler's interpretation is being enacted in classrooms. To begin, a variety of research has found constructive effects of feedback on student learning. Hattie and Timperly (2007) in their model of effective feedback cite feedback as one of the most powerful influences on learning and achievement. They note how the most effective feedback comes in the form of cues, reinforcement, can be aided by technology and is often related to goals or targets set in lessons. This is reinforced by Gamlem and Munthe (2014) where their research found that when learning targets are set in lessons, teacher tend to engage more in dialogic processes such as feedback loops. These findings echo Sadler's work and present positive findings on feedback as an integral part of formative assessment and self-regulation. However, other literature suggests that feedback processes are

often enacted superficially (Atjonen, 2014; Harris, Brown, & Harnett, 2014b; Molloy & Boud, 2012; Nicol & Macfarlane-Dick, 2006). Teachers often assume that students will know what to do with feedback once they receive it from their teachers or peers (Price, Handley, Millar, & O'Donovan, 2010; Sadler, 1998). Usually teachers concentrate on developing their feedback skills without realising that they need to teach students what to do with that feedback in order for them self-regulate and improve learning (Price et al., 2010).

Learning environments have a part to play in determining whether feedback practices are successful in improving learning or not. Feeding into the narrative of this literature review so far, the context of learning is fundamental in determining the effectiveness of formative assessment or as Hattie and Timperly posit: "feedback has no effect in a vacuum" (2007, p. 82). Many studies have picked up on this with research from New Zealand finding that in jurisdictions where exams were viewed as high stakes, few student-led feedback practices were observed (Harris, Brown, & Harnett, 2014). Gamlem and Munthe (2014) found that "teachers are more skilled at building supportive emotional learning environments and fostering students' social and emotional well-being than giving high-quality instructional support" (p.88). Moreover, they noted that a positive classroom environment did not necessarily bring about quality feedback among teachers and students. It is also interesting to note that in this study variables such as metacognition and scaffolding were found to be rare or almost absent in teachers' feedback practices begging the question are teachers forgetting about the self-regulatory purposes of formative assessment?

Leahy and colleagues (2005), assert that feedback needs to cause thinking. Although teachers can be concerned with factors surrounding feedback such as time and reactions from parents and schools, it cannot be denied that feedback plays a pivotal role in building students' self-regulatory learning skills, and if teachers and schools are implementing formative assessment practices, then the demand of feedback should be lessened by other strategies such as peer-assessment and self-assessment.

Activating Students as Owners of Their Own Learning

This strategy can be considered as any process that helps students to become self-regulated learners. It is concerned with self-assessment and goal setting (Black & Harrison, 2001; Boud, 1991; R. J. Stiggins, Arter, Chappuis, & Chappuis, 2004; Wiliam, 2014; Xiao & Yang, 2019)

along with other student learning processes such as metacognition, motivation, and student interest (Black & Wiliam, 2009b; Shepard, 2005). Training in self-assessment can lead to substantial enhancements in both learning and attainment (Nicol & Macfarlane-Dick, 2006). Paraphrasing Sadler, learning involves students setting clear learning goals, being aware of where they stand in relation to this goal and then having the skills to bridge the gap between where they stand and where they want to be (1989). In a study conducted by Sullivan & Hall (1997) third level students were introduced to self-assessment by using a marking rubric along with their written work. This study highlighted that student who tended to overestimate their grades were unsure of what was expected of them and how to judge their work[8]. It also noted that students were very willing to try self-assessment and were keen to get specific guidance on how to do this. The second finding is of interest as like feedback, students need specific guidance or training to be able to fully participate in this formative assessment strategy. Overall Sullivan and Hall highlighted that self-assessment helped students to reflect on their own work, organise their time better and analyse their own performances in class.

Successful student self-assessment requires time investment by both the teacher and the student. Firstly, students need to set clear learning goals for themselves, and teachers can aid this by providing students with exemplars of how to set goals and monitor them. Studies have shown that goal setting effects classroom performance and can raise student achievement (Moeller, Theiler, & Wu, 2011; Sadler, 1989), however it can often be ignored in classrooms as student autonomy is not innate and students need sufficient training in goal setting in order to improve their learning (Benson, 2001; Dickinson, 1987; Holec, 1981). If the formative assessment strategy of sharing and understanding learning intentions and success criteria is enacted effectively in lessons, then this first step should be easier to implemented with students. However as this chapter cited earlier (Crichton & McDaid, 2016; Hattie, 2005), this is not often the case.

Next students must part take in self-evaluation to truly regulate their own learning. Self-evaluation involves students making "decisions about the quality and impact of their performances or choices" (Hewitt, 2011, p.7) and has been seen in research to have a positive impact on student achievement (Klenowski, 1995; Olina, 2002). However, the extent to which students are provided the time to self-evaluate their learning in lessons is underexamined in the

[8] Students basing their work on what they believed the lecturer wanted not what they thought appropriate.

research begging the question if students are provided the time to engage with self-assessment? Reflection gives students the time to think about what they have learned and to evaluate any confusions or misconceptions they came up against. Students analysing what they have learned, where they can make improvements, and how they can achieve their goals can all support deeper understanding rather than superficial knowledge (McMillan & Hearn, 2008).

There exists a link between self-assessment practices and cultural influences. In a study by Pham and Renshaw (2015, p. 48) self-assessment was perceived by educators as "culturally inappropriate" as students in Asian countries are brought up to be modest, keep their heads down and told not to "brag or stand out" in class (p.48). Boud (1995) also makes reference to the impact on culture on self-assessment by noting the reciprocal interdependency between individuals and the collective community in the learning process. This is pertinent in this thesis as the guiding theory of activity (Engeström, 1987) considers sociocultural factors such as community and societal rules as influential in achieving successful activity. Data in this thesis sought to ascertain if these sociocultural factors were having an influence on how formative assessment is understood and carried out in science classrooms in Ireland and Scotland.

The Big Idea – Moments of Contingency

A major issue in the enactment of formative assessment is that it can be adopted on a superficial level using the framework table put forth by Wiliam and Thompson (2007) alone. Although they cite in their work that the *big idea* (p.64) of adaptive teaching must play a role in formative assessment, this is often not the case. By examining assessment literature, a strong link between the *big idea* and what are known as *moments of contingency* was apparent. Literature suggests that noticing and responding to student feedback is a challenge as it requires teachers to select what is important to focus on out of a myriad of information that is being gathered at any one time (Cowie, Harrison, & Willis, 2018). Leahy and colleagues describe this process as follows:

> "Teachers design their instruction to yield evidence about student achievement; for example, they carefully craft hinge-point questions to create "moments of contingency" in which the direction of the instruction will depend on student responses".
>
> (2005, p. 24)

This section will look at how moments of contingency are crucial to formative assessment enactment in classrooms. This is a relatively underexplored research area where often the focus

is on the strategy for formative assessment, and the adaption and response stage is not given due consideration(Cowie et al., 2018).

Research into moments of contingency has denoted positive effects on student learning (Ruiz-Primo & Furtak, 2006; Van De Pol, Volman, & Beishuizen, 2012). Another study found that learning or hearing about student ideas was the most prevalent trigger of contingency in mathematics teaching (Rowland, Thwaites, & Jared, 2015). This demonstrates the strong link between formative assessment strategies such as engineering effective classroom discussions and the bigger picture of formative assessment which is to respond to students and adapt teaching if necessary. This is further exemplified by Aschbacher and Alonzo (2006) who found that science notebooks can be used as effective contingency tools however the instruction and criterial set for tasks were essential in a teacher adapting their instruction or feedback accordingly i.e., what is happening upstream of contingency is paramount in its effective enactment. Another tool that can provide for moments of contingency is technology. Pachler, Daly, Mor, and Mellar (2010) found that technology can enhance the capacity for feedback for both learners and teachers. However, they were cautious in warning that technology does not guarantee contingency but can shape the potential for it to occur.

The research suggests that responsive teaching is more likely to occur when students are actively engaged in their learning and teachers are provided with specific training in formative assessment (Lysaght & O'Leary, 2017; MacDonald Grieve, 2010). However, teachers may be unable to notice and act on moments of contingency. This has a negative effect on student learning as the teacher can miss out on crucial information on student learning (Stockero & Van Zoest, 2013). Yet the teacher may not be entirely at fault. Without adequate training in formative assessment teachers would find it difficult to pick up and act on these learning moments. Professional development plays a key role in how teaching, learning, and assessment is implemented in schools and was explored throughout the data to ascertain if teachers were adequality trained in formative assessment and if not why?

Moments of contingency are crucial in the regulation of learning processes and the literature presents an interesting finding that regulation can be achieved in different ways depending on the culture of the classroom, schools, or jurisdictions. For example, Wiliam and Thompson (2007) posit that in the United States regulation is more than likely to occur at a one-to-one level among teacher and student, however in Japan the teacher will tend to observe all students

and then discuss major issues with the class on a whole. This is interesting as a strong foothold of this research is concerned with how culture can influence the effectiveness of formative assessment in educational settings.

Summary of Findings from the Literature

There are several key findings stemming from this empirical literature review that are relevant to this thesis. The chapter began with an exploration of curriculum policy in Ireland and Scotland. One of the main objectives of this thesis was concerned with the influence of cultural context on formative assessment enactment. The literature highlighted how policymakers need to be mindful of policy borrowing and the influence of cultural contexts on a countries implementation of curriculum reform. Moreover, from examining international policy on formative assessment it was concluded that high investment, increased professional development, increased school autonomy, and a slow pace of change in reform were influential in embedding formative assessment in policy. Looking at this through the policy from Ireland, it was evident that neither teachers or parents wanted schools to have increased autonomy over teaching, learning, and assessment practices. The 2012 Junior Cycle Framework presented a curriculum that provided schools with the space to make their practices more contextually relevant for students, however pushback from teachers and parents meant that this was given decreased value in the 2015 framework. As data were gathered in this research after the implementation of the 2015 framework, the influence of top-down prescribed curriculum on school autonomy and the provision of teacher professional development were areas of interest.

The next section of the literature review was concerned with teaching, learning, and assessment literature from Ireland and Scotland. The main finding here was that this research is majorly lacking in Ireland at second level, with student voice in this body of knowledge being minimal. The literature also suggested that teaching, learning, and assessment practices in Ireland are still following traditional methods with exam preparation and teacher centred methods being prevalent. In contrast, the importance of formative assessment specific professional development, and aligning teaching, learning, and assessment with the ideals of new curriculum were more prominent in Scotland. Moreover, the Scottish scholarship indicated that teacher agency was a factor in successful curriculum reform and therefore this thesis needed to examine this in more detail.

There was a very small body of literature from both Ireland and Scotland that emphasised contradictions between teachers' intended and enacted practices, particularly in relation to formative assessment practices. Further exploration is needed to identify why contradictions exist so that steps can be taken by policymakers and schools to rectify the gap between what teachers say they do and what teachers do. The last finding from this section of the literature review is concerned with how formative assessment is enacted at second level in Ireland and Scotland. Findings from Ireland suggested that formative assessment was often implemented in a tokenistic manner with the true benefits for student learning not being actualised.

This section of the literature review concluded by examining teacher professional identity and assessment literacy. The empirical research puts forth that teacher professional identity is given more consideration in Scotland than in Ireland. Furthermore, the research states that professional development needs to give more consideration to teachers' personal qualities and skills to optimise formative assessment implementation. Regarding assessment literacy, again the researcher showed that professional development as well as high investment was key in developing teachers' assessment literacy. In addition, student assessment literacy strongly linked to the implementation of strategies for formative assessment in schools.

The final section of the literature review focused specifically on formative assessment research. To begin, it was noted how formative assessment studies often have an intervention focus with researchers stepping in to improve practices. However more research is needed that looks at how teachers enact formative assessment without intervention, this is a focus of this research. Next, returning to the idea that formative assessment is often enacted in a tokenistic manner without due consideration being given to the *spirit* of formative assessment, scholarship on the five strategies for formative assessment suggested a surface level enactment due to a variety of reasons:

1. Strategies are often implemented as tools and follow up is often ignored. For example, a teacher may present students with learning intentions for the lesson but not use them to elicit evidence of understanding at the end of the lesson. Furthermore, a teacher could ask a higher order question to challenge students to think deeply but not use the response to plan subsequent learning.
2. The underpinning theories of learning that gave rise to many of these strategies are often ignored when implementing strategies such as learning intentions and success

criteria. In addition, strategies such as peer assessment are lacking a theoretical grounding that would help to engage students more in these kinds of tasks.

3. Problems exist with teachers' intended and enacted practices. Often teachers wish to engage with formative assessment practices but do not enact these effectively in lessons to improve student learning. This is particularly obvious when it comes to questioning and class discussions.
4. It is often the case that the power lies with the teacher in setting up these strategies and as a result students are not provided the opportunity to actively engage with their learning. This was evident in research pertaining to co-operative learning and learning intentions.
5. Feedback is fundamental in formative assessment being embedded in teaching, learning, and assessment however research noted that it was often enacted superficially. This was due to several constraints including a lack of training in this strategy for students and the set-up of the classroom learning environment.
6. Cultural context plays a defining role in how formative assessment is enacted. Emphasis is needed on how the teacher student relationship effects the teaching, learning, and assessment practices in schools. Moreover, the relationships with the community are fundamental in a true enactment of formative assessment.
7. The *big idea* of formative assessment is under analysed in the literature. While the aim of formative assessment is for students to self-regulate, this is achieved through effective enactment of formative assessment strategies followed by responsive teaching i.e., a teacher may change the subsequent learning activities based on the knowledge they ascertained from students. This *big idea* is often referred to as *moments of contingency.*

Considering what was learned from the literature review, the methodology of this research took into consideration the gaps in the literature and a research design was created to address these shortfalls. This is discussed in the introduction section of Chapter 4.

4. Methodology

Introduction

How is formative assessment understood and enacted in lower second level classes in Ireland and Scotland. What are the factors that shape formative assessment enactment in science classes in these countries? The literature review demonstrated that often the nuances of formative assessment have not been fully explored, sometimes leading to superficial adaption or a misunderstanding of its purpose: to improve student learning. Considering this it was important to design a research study that would help to answer these questions.

To begin this chapter, the research philosophy is discussed, and a research design presented. Following this, the different methods of data collection used in this research, and a justification for their use, are discussed in relation to the overall methodology. Additionally, the chapter reiterates the aims, objectives, and central research questions of the study, and describes the research sample and data analytic techniques. Issues of reliability, validity, ethical concerns, and the limitations of the study are also addressed. Finally, a position statement is provided.

Research Philosophy

This research sought to examine the contextual and culturally constructed realities of its participants (teachers, students, and school leaders) and was situated in the interpretivist paradigm. Close attention was paid to the social constructivist and sociocultural theories associated with this paradigm. The interpretivist paradigm has its origins in hermeneutics and phenomenology (Blaikie, 2007) and draws on Weber's notion of *Verstehen* (understanding). The interpretivist researcher's methods are driven by their ontology and epistemology.

The ontological foundations of this thesis lay within social constructivism where reality is produced through social interaction and along with knowledge is indeterminant and in a constant state of revision (Bryman, 2008). Social interaction is a key aspect of formative assessment (Black & Harrison, 2004; Shepard, 2000) and thus the relationships among those in the classroom (teacher and students, and students with one another) were an area of focus to see how and if they were influential on formative assessment enactment. This ontological positionality proposed that formative assessment is not a static phenomenon. Chapter 2 explored how the understanding and enactment of formative assessment has been perceived differently through different learning theories. This was given consideration in this thesis by

examining how policy, school leaders, and teachers understood formative assessment. In addition, education systems are often in a state of flux due to a myriad of factors including curriculum reform and cultural context. Hence, this focused on the sociocultural aspect of learning and what promotes or inhibits formative assessment practices, including curriculum reform.

The epistemological position of this research was that knowledge is socially constructed, there are no absolute truths emerging from research and research is not theory free. Blaikie describes epistemology as "a theory of how human beings come to have knowledge of the world around them (however this is regarded), of how we know what we know" (2007, p. 18). The epistemological assumptions of this study help to determine what sort of contributions to knowledge research can make. Considering this, this research adds to the scholarship on:

- Teaching, learning, and assessment in Ireland and Scotland
- Methodological approaches with a focus on activity theory
- Q methodology
- Curriculum policy enactment, in particular curriculum reform and policy borrowing

Drawing on the ontological and epistemological standpoints discussed above, it was obvious to situate the research in an interpretivist paradigm. Interpretivist approaches "focus on the meanings that social actors construct about their lives and in relation to the world" (Wyse, Selwyn, Smith, & Suter, 2016, p. 246) i.e. meaning is always negotiated socially. In this thesis, adapting this approach allowed for a richer understanding of the nuanced realities of teaching, learning, and assessment in the Irish and Scottish context. Moreover, this links once again to the importance of relationships in formative assessment enactment.

In this research the dialectical tradition was used as a frame of reference. Hegel's dialectics suggests that opposing sides or contradictory processes are the subject matter being observed in a research study (Hegel, 1969). This was actualised in this research through the exploration of teachers' intended and enacted formative assessment practices. Data on this were gathered through teacher interview, classroom observation, fieldnotes, and video. Inferences were drawn on how teachers intended to enact formative assessment by exploring their interview data. The video and fieldnotes were then analysed to determine if contradictions arose between their intended and enacted practices. The dialectic process leads to increased universality and drives towards the *Absolute*: the final and completely all-encompassing or unconditional concept or

form in the relevant subject matter under discussion (Maybee, 2019). Thus, this thesis adds to the body of knowledge on formative assessment and helps to add understanding to this multidimensional process. The epistemologically interpretivist and ontologically constructivist bases of this work aptly reflected the theoretical framework in which this research is situated, discussed in detail in Chapter 2. Figure 6 summarises the research philosophy of this study and demonstrates its influence of the research the methodology and methods chosen in this research.

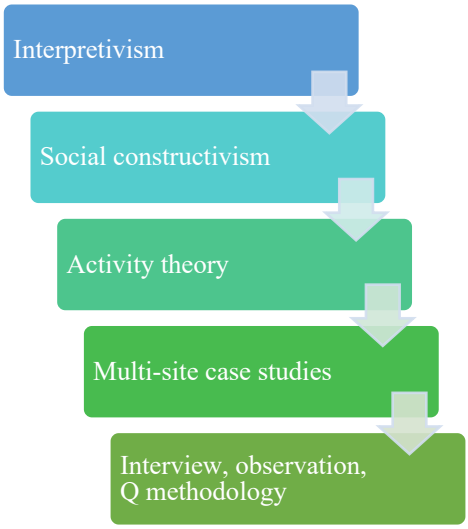

Figure 6: Research Philosophy

Research Design

An appropriate research design "identifies the evidence needed to address the research purposes, objectives and questions, i.e. the logic that underpins the connections between purposes, objectives, questions, data and conclusions drawn" (Cohen et al., 2018, p. 175). Thus, this research design built upon the research philosophy outlined in Figure 6 and considered existing theoretical and empirical research that has been conducted in formative assessment. The research design was based largely on multi-site case studies utilising a mixed methods approach to data collection. As this research sought to investigate the influence of education policy on an education system, it was deemed necessary to add a comparative aspect to data collection and analysis. Data were collected in both Ireland and Scotland: two schools in each country with two science teachers in each school and their lower second level science classes in each school.

Multi-site Case Study

The research design necessitated a multi-site approach to data collection in each of the four schools. Undertaking a multi-site case study required an intensive examination of each setting (Bryman, 2008, p. 53). Each setting was a second level school (with two science classes in each and their science teachers) giving rise to case studies from four science teachers, analysed, and reported on later in the thesis. Each case (consisting of the science teacher and their lower second level science class) was a focus of interest in its own right and was analysed through the use of evaluative episodes (Hardman, 2007) and Q data (Stephenson, 1935) described later in this chapter. Recognisably, there existed alternative research methodologies that could have been used to guide this research study. Common educational research designs include ethnographic, historical and documental research, meta-analysis, and action research (Cohen et al., 2018). Although ethnography is largely observation based, it requires a considerable amount of time in the field, with the researcher immersing themselves in the group at study. Ethnography also discourages the use of interview as it is a non-natural situation (Cohen et al., 2018), therefore for the reasons above it was deemed inappropriate for addressing the objectives of this study. Additionally, historical and document research, meta-analysis, and action research were considered, but were not suitable as they did not fully address the research objectives. For example, a meta-analysis on formative assessment has already been well documented in formative assessment scholarship (see Black & Wiliam, 1998a, 1998b), and action research was not appropriate as research design was multi-site case study.

Along with the multi-site design, the aim, questions, and objectives of this research were in line with a case study design. It was necessary at the beginning of the research to explore the various interpretations of case study available in the methodological literature, and which definition was most appropriate. Table 3 presents some key interpretations of case study research.

Definitions of Case Study	
Adelman, Kemmis, & Jenkins (1980)	The study of an instance in action.
Stake (1995)	The study of the particularity and complexity of a single case, coming to understand its activity within important circumstances (p.xi)
Yin (2003)	An empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. (p 13)

Bryman (2008)	An intensive examination of a setting where the case is a focus of interest in its own right (p.53)
Simons (2009)	An in- depth investigation of a specific, real- life project, policy, institution, program, or system from multiple perspectives in order to catch its complexity and uniqueness (p.21)
Tight (2010)	The detailed examination of a small sample (p.337)

Table 3: Adapted from Cohen, Manion, & Morrison (2018)

After careful consideration, for this research, Bryman (2008) and Yin's (2003) interpretations of case study were most suited to needs of this research. While all the above definitions were relevant, Bryman put forth the case for exploring the nuances of exemplifying cases and this was most suited to the research analysis where cases were explored in detail through evaluative episodes (Hardman, 2008) and using a variety of data collection methods. In addition, Yin (2003) considers five types of case study: the critical case, the extreme or unique case, the representative or typical case, the revelatory case, and the longitudinal case. After careful consideration, this research employed the representative or typical case where "the objective is to capture the circumstances and conditions of everyday or commonplace situation" (Yin, 2003, p. 41). This type of case study can also be referred to as the exemplifying case because of its ability to exemplify "a broader category of which it is a member" (Bryman, 2008, p. 56).

The multiple sites for the cases were sourced in Ireland and Scotland, with a total of four second level schools being chosen. The research design allowed for pre-specified groups for comparison to be chosen based on their already implemented formative assessment practices. Having pre-specified groups for comparison is common among interpretivist researchers (Wyse et al., 2016). Each site was a school, and each case was one science teacher from that school and their lower-second level science class. Examining four different schools meant that there was flexibility in gathering the data and added to the paucity of empirical research on formative assessment in these countries. There exists some empirical research in this area from both countries (see for example Crossouard, 2011; Dunphy, 2010; Ní Chróinín & Cosgrave, 2013) however the area is largely under researched at second level and with a policy focus in both countries on formative assessment, further empirical investigation was merited.

One case from each participating school was chosen to be written up. To represent formative assessment enactment, cases were chosen on the basis that they represented the dialectic relationship between teachers' intended practice, and their observed lessons. The cases written up demonstrate both contradictions within, and confirmation of embedded formative

assessment practices. Intended enactment was explored through the data sources of teacher and school leader interview, and a review of lower second level curriculum policy in Ireland and Scotland. Data on enacted practice were gathered through fieldnotes and video, then compiled into evaluative episodes for analysis. Each of the four chosen cases provided the deepest insights into formative assessment enactment out of all the teachers participating in this research (a total of eight) and were most relevant to addressing the research questions of this study. While the overall research design was based on multi-site case studies, data collection methods focused on mixed methods discussed in the next section.

Methodological Approach

Mixed Methods

For this research the data collection methods were mostly qualitative, with the Q methodology adding a quantitative component. Therefore, the study was considered mixed methods. Mixed methods draw on the strengths of both qualitative and quantitative research, mitigate their weaknesses and allow for a synergy in data collection methods. In order for a study to adopt a mixed methods design the use of both qualitative and quantitative methods should be intentional at the design stage and link closely to the research questions (Wyse et al., 2016). To reiterate, this study sought to explore formative assessment enactment by gathering and analysing data from a variety of participants involved in formative assessment: school leaders, teachers, and students. Hence at the design stage the decision was made to explore student voice through the Q methodology which is made up of both qualitative and quantitative components. According to Tashakkori and Teddlie (2003) in order for a truly mixed methods approach, research must meet the following criteria:

1. The researcher must use multiple approaches to data collection and analysis at all stages of the study.
2. The approach must include a transformation of the data i.e., one section of the data should be analysed two separate ways.

Moreover, Creswell and colleagues suggest that a mixed methods study should have five defining features where the study is:

1. focusing on research questions that call for real-life contextual understandings, multi-level perspectives, and cultural influences.

2. employing rigorous quantitative research assessing magnitude and frequency of constructs and rigorous qualitative research exploring the meaning and understanding of constructs.
3. utilizing multiple methods (e.g., intervention trials and in-depth interviews).
4. intentionally integrating or combining these methods to draw on the strengths of each; and
5. framing the investigation within philosophical and theoretical positions.

(Creswell, Klassen, Plano Clark, & Clegg Smith, 2011, p. 4)

Considering the scholarship and their guidance on mixed methods research, this study adopts a mixed methods approach by:

- Using the research questions to gather data from a range of sources to address the objectives of the research see Table 4.
- Using multiple approaches to data collection including both qualitative (interviews and lesson observations) and quantitative (Q methodology) methods.
- Analysing the data arising from the Q methodology both qualitatively and quantitatively. The Q sort results were analysed quantitatively while the interview data was analysed qualitatively to combine the numbers with the story, thus creating a rich synergy of data. The Q methodology is described in detail later in this chapter.

Objective	Type of data	Methods for data collection
1. Observe assessment practices in science lessons to determine if formative assessment is embedded in practice	Qualitative	Classroom observation: fieldnotes and video
2. Determine teachers' understanding of formative assessment and identify what they believe to be the significant influences on their teaching practices.	Qualitative	Teacher interview
3. Ascertain the influence of cultural context on teaching, learning, and assessment practices within schools.	Qualitative and quantitative	School leader interview Teacher interview Q methodology Classroom observation: fieldnotes and video
4. Examine students' beliefs about the teaching, learning, and assessment practices enacted in their school and science classes.	Qualitative and quantitative	Q methodology
5. Investigate the influence of curriculum policy on a school's approach to formative assessment.	Qualitative	Desk research School leader interview Teacher interview

Table 4: Methods linked to research objectives

In educational research, the use of mixed methods alongside activity theory is a novel approach. Some research has been carried out in this area at third level (see Ellis, Mcnicholl, Blake, & McNally, 2014; Williams, 2011) however there is a paucity of research using mixed methods and activity theory at second level. One study conducted by Deignan and Brown (2016) utilised an activity theory framework for analysis with the Q methodology to explore third level educators views on alternate assessments in Master's programmes. Their research was helpful in guiding the methodological approach of this thesis; however, this thesis is the first to adopt a mixed methods approach with activity theory at second level, and hence adds to this underexplored body of scholarship.

Cross-national Comparative

The fifth objective of this research was concerned with investigating the influence of curriculum policy on a school's approach to formative assessment. More specifically, the influence of national policy on the intended and enacted approaches to formative assessment was examined to better understand how cultural contexts affect teaching, learning, and assessment. It is not uncommon for policy borrowing to take place among western countries where practices that are apparently effective are transcribed onto a similar education setting (Osborn et al., 2003). Ireland and Scotland were the two countries chosen for comparison. This two countries were chosen countries as Scotland's two assessment initiatives, Assessment is for Learning (AiFL) (Scottish Government, 2005) and the Curriculum for Excellence (Scottish Executive, 2004) were used in part as a blueprint for Irelands Framework for Junior Cycle (Department of Education and Skills, 2012, 2015a; National Council for Curriculum and Assessment, 2010). Moreover, the National Council for Curriculum and Assessment (NCCA) consulted with key Scottish academics when drawing up the Junior Cycle and visited Scotland on several occasions to observe the Curriculum for Excellence in practice.

An OECD report from 2015 (two years before the data was collected for this research) cited high standards of education and achievement among Scottish second level students. Of note was that academic achievement was above the international average and students had positive attitudes and connections to their school. Three in four students felt they got along with their teachers and believed their teachers to be a good source of support. Disruptive behaviour was believed to be in decline by Scottish teachers. This report was largely complimentary of the Curriculum for Excellence (CfE) where "learners are enthusiastic and motivated, teachers are

engaged and professional, and system leaders are highly committed" (2015, p. 9). However a recent OECD report (2021) reflecting on the CfE cites problems with policy overload, with a lack of structure and long term vision leading to challenges with implementation. This is in part due to the pressure placed on teachers to plan and implement curriculum locally despite their high in class contact time with students. The fact that during the time of research there was a movement from the CfE being a gold standard in education to having fundamental flaws with policy overload adds to the rationale and need for this research as the data was collected in the space between the first report in 2015 and the second in 2021.

With comparative research, there can be a variety of problems with comparative analysis, including conceptual equivalence, equivalence of measurement, linguistic equivalence, and sampling problems (Osborne, Simon, & Collins, 2003). Taking these factors into consideration, two were relevant in this research. Issues with conceptual equivalence where concepts may have different meanings among different cultures, were apparent in relation to the terminology around assessment. In Ireland the term *assessment for learning* is used more commonly to represent *formative assessment*, while in Scotland the term *formative assessment* is more widespread. Therefore, to minimise this problem, the term *assessment for learning* in Ireland was taken to mean *formative assessment* and this was addressed particularly in teacher and school leader interview where the researcher made it clear to the participants that the terms were the same method of assessment in the context of this research. Sampling problems were minimised by matching schools based on formative assessment practices in both countries (specific details on sampling is provided later in this chapter). Although the four schools differed in context, they were chosen after consultation with experts in the field (including the research supervisors, a second level school principal working in Ireland, and a Scottish academic) who considered these schools to be the most exemplary in enacting formative assessment in their respective countries.

Existing scholarship on comparative research (Donnelly & Hughes, 2006; Hofman, Hofman, & Gray, 2008; Iannelli, 2004; Lindberg & Silvennoinen, 2018; McNess, 2006; Osborn, 2001; Osborne et al., 2003; Raffe, Brannen, Croxford, & Martin, 1999) were reviewed to determine how best to proceed with comparative analysis. It was determined that in comparative research a variety of qualitative and quantitative methods are employed, and data can be represented in a variety of ways including tables, quotations, individual country summaries, and graphs. Giving due consideration to the relevant literature, the theoretical framework, and objectives

of this research, comparative findings were presented through a variety of methods including cross-national tables, individual quotations from both countries and a discussion comparing lower secondary education policy in Ireland and Scotland.

Data Collection

Five different types of data were gathered:

- School leader interviews,
- Science teacher interviews,
- Classroom observation and video data,
- Q methodology: card sort and student interview and,
- Desk research.

An overview of the data collection process with participants is provided in Table 5, and a discussion of each stage of data collection follows.

Data collection method	Date of data collection	Participants	Duration
Pilot research	April - May 2017	4 (one school leader, two teachers, one student from a school in Ireland)	Interviews: 18 minutes on average Observation: 1 hour
School leader semi-structured interviews	Ireland[9]: November and December 2017 March 2018 Scotland: June 2017	4 (one from each school)	45 minutes each on average
Teacher semi-structured interviews		8 (two from each school)	45 minutes each on average
Classroom observation and video		8 science teachers and one of their lower second level science classes	1 weeks' worth of lessons equating to approximately 3 hours of observation per teacher
Q methodology		48 students (12 from each school, six from each science class)	30 minutes of card sort and interview on average

Table 5: Data collection process

Sampling

Fieldwork was conducted in two second level schools in Ireland and two second level schools in Scotland with students aged 12-14. In each school in Ireland, the research proceeded with the school principal, two science teachers and their first-year science students. Fieldwork in each of the schools in Scotland proceeded with the head teacher, two science teachers and their

[9] Data was gathered in Oakpark in November and December 2017 and Greenview in March 2018

S2 science students. In all, this comprised of four schools, four school leaders, eight science teachers and approximately 192 lower secondary students. The relatively small cohort of teacher participants was in line with case study research design and provided for an in-depth insight into teaching, learning and assessment in the second level science classroom.

Purposive sampling was applied in this research. The choice of participants was deliberate, non-random and it was at the discretion of the research to decided what needed to be known about the participants. As enactment of formative assessment was the key area of focus for this research, schools were invited by the researcher to take part based on this. The process of recruitment for Irish schools began by selecting schools from a list of 24 NCCA pilot second-level schools for the new Junior Cycle Framework (Department of Education and Skills, 2015). Single sex schools were excluded as second level schools in Scotland are predominantly co-educational and for this reason working with co-educational schools in Ireland was obvious to minimalize the school type variability. With the remaining schools from the NCCA list, their websites were examined to see if they placed importance on formative assessment practices. Further to this the schools in question were then discussed with the researcher's PhD supervisors and other professional colleagues (including a school principal from Ireland and second level teachers working in Ireland) to identify which schools would be most suitable for this study. The choice of participating schools was finally narrowed down due to factors including access to the school for data collection and geographical location.

Recruiting schools in Scotland began with contacting the Director of Assessment at the NCCA in Ireland. The NCCA have a strong connection to the East Renfrewshire local authority in Scotland, who are known to put a strong emphasis on formative practice within their schools. To reiterate, schools were chosen based on their formative assessment enactment i.e., what schools would exemplify formative assessment in practice. The NCCA provided a contact person in Scotland involved with the East Renfrewshire local authority who helped with school recruitment. One school from this local authority participated in the research. In addition to sourcing a school East Renfrewshire, a second school was recruited from the Angus local authority. The second school was known to assessment experts in Scotland as a school with advanced formative assessment implementation.

In the chosen four schools, data were collected from four school leaders, eight science teachers, and eight lower second level science student groups across Ireland and Scotland. Students in

lower secondary education were chosen for a variety of reasons not least because of curriculum reform. Within the 2016-2017 academic year, first year science students in Ireland were the first group to experience the new Junior Cycle science specification (Department of Education and Skills, 2015) that emphasises formative assessment techniques. Due to this fact, first year science students were chosen and their corresponding counterparts in Scotland were then sought to take part in the study. Additionally, students in their first year of their second-level education were chosen due to their willingness to engage in different activities in comparison to their more senior counterparts. Research suggests that younger second level students are more engaged in their education compared with second year students who tend to drift away from learning, and third year students who are for the majority, exam focused and driven (Smyth, 2009).

Letters were sent to school leaders inviting them to participate in this research and outlining details of the project, the principal and teacher information sheets and consent forms were contained in this letter, see Appendix F. The letter requested a meeting with the researcher to outline the specificities of the project. It was at the discretion of the school leaders and their science teachers if they wished to be involved in the research. Consent for participation was obtained from each school's Board of Management, school leader, science teachers, and parents once they had agreed to participate. There was an information sheet and consent form made available to parents (Appendix F). Assent was sought from students, and they were informed of the project and what it will involve via an information sheet (Appendix F).

The school leader was the first point of contact when liaising with schools. The school leaders were involved in the selection of science teachers and were also interviewed as part of the research process. It was made clear to school leaders that teachers who frequently used formative assessment practices and who teach science to the required age group were sought to participate in the research. Random selection was used when choosing students for the Q sort activity. Each science teacher randomly selected three male and three female students to participate in the activity from their class. In one teacher's class, four female students were chosen due to the ratio of boys to girls in the class. Random selection took place using the raffle method where the teacher placed the names of the male and female students who assented to participation in the Q-Sort in two separate boxes and picked out three male and three female students from each class.

Design of Research Instruments

Teacher and School Leader Interview

Conducting interviews with teachers and school leaders is a common qualitative method used within the educational research community (see for example Davis & Neitzel, 2011; Farrell & Mom, 2015; Halbert & MacPhail, 2010; Riggan & Oláh, 2011; Sach, 2015). While the explicit purposes of interview may vary, the face-to-face nature of interview allows for a deeper insight into the mind of the interviewee and allows for the expansion of ideas that would not be facilitated through other methods such as questionnaires (Cohen, Manion, & Morrison, 2000). The theoretical framework and interpretivist paradigm of this research advocated that classroom practice cannot be attributed to the teacher alone. In activity theory, school and societal culture have a defining role in how teaching, learning, and assessment practices are enacted in schools. Therefore, a school leader interview was deemed necessary in addition to teacher interviews, to gather data on whole school approaches to teaching, learning, and assessment. The interview protocols for teachers and school leaders are contained in Appendix A.

After considering the different approaches to interview, a one-to-one, semi-structured approach was chosen for this project as it can be closer to naturalistic conversation (Wooffitt & Widdicombe, 2006) versus its structured counterpart. This approach has also been referred to as the general interview guide approach (Patton, 2002) and has the advantages of making interviews more straightforward for the participants, making the most of limited time constraints, while still allowing for interviewee individuality to emerge. Time constraints were particularly pertinent in this research as teachers tend not to have much free time during the working day so keeping the interviews one-to-one meant that they could choose a time that suited their teaching requirements. The semi-structured approach with teachers linked strongly to the second objective of the research which was to determine their understanding of formative assessment and identify what they believe to be the significant influences on their teaching practices. School leader interviews aimed to complete the picture of how teaching, learning, and assessment practices come to be enacted in schools.

The interview questions for teachers were the first to be drawn up. They were influenced by interview protocols from the FaSMEd Project (2015) and the TALIS teacher questionnaires (2013b), literature surrounding interviews, and the theoretical perspective of the research.

Inspiration was drawn from these sources as they were tailored for studies that focus on teaching, learning, and assessment with the FaSMEd protocol being specifically focused on formative assessment. Piloting the initial teacher interview protocol pinpointed changes that needed to be made. There were 23 questions in the initial protocol however after the pilot and careful consideration of the pilot data it was felt that some questions were superfluous and did not address the research questions of the study. For example, questions surrounding employment status were not included in the final protocol. There was also a need for further probing of the teachers' responses. This was achieved in the final protocol by reflecting on observed lessons and asking the teachers to expand on their answers based on what was seen by the researcher. This helped link the intended and enacted pedagogy when analysis observation data. Additionally, the phrasing of the questions about formative assessment was unclear in the pilot and research suggests there are many different ways that formative assessment is interpreted (Bennett, 2011). Therefore, questions surrounding assessment were more explicit and the term assessment for learning was used interchangeably based on the individual school. In Scotland the common term is formative assessment, whereas in Ireland the term assessment for learning is used more frequently.

The biggest problem with the initial pilot was the lack of a theoretical guidance. Although some questions alluded to the elements of an activity system, this was not clear. Therefore, in the final protocol the list of questions was assigned based on their links to the activity system of the classroom. The final interview protocol for teachers (see Appendix A) was divided into four sections:

1. *Introduction:* these questions were focused on background and demographic information about the teacher.
2. *Tools and division of labour*: these questions were divided into two subsections, questions about teaching science and questions about using formative assessment.
3. *Community:* these questions were concerned with influences on teaching practice including the school, parents, and the wider educational community, that may affect teachers' teaching, learning, and assessment practices.
4. *Closing:* the final question allowed for interviewees to relay any opinions about a topic that they believed would be beneficial to the researcher.

Brenner (2006) suggested that an interview should begin with questions that help to develop a rapport with interviewees and Patton (2002) commented how it is good practice to start with questions relating to participants experiences (e.g. a typical day in their life) and then move

onto questions regarding opinions and feelings. Experience questions are perceived as easier to answer. These suggestions were accounted for in the initial questions of the interview. The concept of funnelling questions (Brenner, 2006; Cohen et al., 2000) was considered where questions address bigger concepts to begin with and are worked down to more specific ideas. This was achieved through the use of probes that can "deepen the response to a question, increase the richness and depth of responses, and give ques to the interviewee about the level of response that is desired" (Patton, 2002, p. 372). For example, in Oakpark the teachers were asked to expand on the use of technology in their practice, while in Milltown the teachers were asked to discuss on their implementation of *Visible Learning* (Hattie, 2012) in their science lessons.

The compilation of school leader questions followed a similar method, and had the same influences as the teacher section above (FaSMEd, 2015; Organisation for Economic Co-operation and Development, 2013a). However, this protocol differed from the teacher questions as it was more focused on the wider aspects of an activity system including rules, community, and division of labour, i.e., the school norms or culture. Once again, the list of questions was complemented by probing questions individualised for each school leader and the rationale for asking a question was included on the protocol. Piloting the initial instrument did not uncover many changes to be made, the biggest change was the order in which the question was asked. This change was made based on the guidance from the literature that suggests that funnelling questions to deepen responses from participant (Brenner, 2006; Cohen et al., 2000). The final protocol for school leaders was divided into five sections:

1. *Opening:* introductory questions based on school leader experience and school demographic questions.
2. *School community:* questions concerning school ethos, surrounding community, and the teaching of science in each school.
3. *Tools and division of labour:* questions about teaching, learning, and assessment practices within the school along with provisions for teacher professional development.
4. *Wider educational influences:* questions that asked about parental involvement in the school and general wider influences on the day to day running of each school.
5. *Closing:* the final question allowed for school leaders to relay any opinions about their school that they believed would be beneficial to the researcher.

The final interview protocol used with school leaders is contained in Appendix A.

Classroom Observation

Observation is a staple in educational research for various reasons from supporting the professional development of novice and experienced teachers, the inspection of schools, to examining the effects of an intervention study on classroom life (see for example Alvi & Gillies, 2015; Bryan, 2011; Chang & Song, 2016; Farrell & Mom, 2015; Mak & Lee, 2014; Riggan & Oláh, 2011). O'Leary notes that many studies fail to define what observation will entail within the particular research study (2014). Hence, this research followed a qualitative and semi-structured approach to data collection within classrooms, where a holistic interpretation of the classroom was gathered and analysed. The observation schedule used in created for gathering data in this research is contained in Appendix B. According to Cohen, Manion, and Morrison (2000) a semi-structured approach to observation has an agenda but will "gather data to illuminate these issues in a far less pre-determined or systemic manner" (p.305). This method of classroom observation was chosen due to the nature of the research questions of this study, which sought answer the how and the what of classroom practices.

To fully appreciate how teaching, learning, and assessment practices come to be operationalised within schools, it is vital to move beyond what Cohen, Manion and Morrison refer to as "perception-based data", where data gathered are based exclusively on the views and opinions of research participants, and adapt a more lived reality approach to data collection where data are gathered from live situations (2000, p. 305). In the context of this research, classroom observation was necessary to observe teaching, learning, and assessment practices first-hand. It was of interest to explore whether the intended practices of the teachers (data gathered through interview) and enacted practices (data gathered through observation) were aligned or if they were in contradiction. Hardman (2007) provided the rationale for including observation with interview in an activity theory study. She cited how teachers may not be aware of their motives for acting and these intended motives (unearthed during interview) may differ from what happens in the classroom. Hence, observing lessons was necessary to observe first-hand the enacted nuances of classroom life and the interactions among teacher, students, and peers.

Developing the classroom observation schedule required examining the research questions of this study in detail and drawing inspiration from other classroom observation schedules that have been utilised by teachers and researchers. The observation schedule needed to address

different strategies and tools involved in formative assessment practice, so guidance initially came from Wiliam and Thompson's (2007) five strategies for formative assessment:

- Clarifying and sharing learning intentions and criteria for success.
- Engineering effective classroom discussions and tasks that elicit evidence of learning.
- Providing feedback that moves learners forward.
- Activating students as instructional resources for one another.
- Activating students as the owners of their own learning.

In addition, Oswalt's Formative Assessment Observation Protocol (2013) was considered. The latter protocol consisted of a lengthy list of specific formative assessment practices that build upon and expanded Wiliam and Thompson's work so that very specific practices of formative assessment could be observed. Following initial piloting of the observation schedule, it was deemed too prescriptive as it focused very specifically on certain observable aspects of formative assessment and neglected how a teacher could mould their formative assessment practices in alternative ways to suit the needs of their students. In addition, this instrument did not sufficiently address the second research question of the study which sought to go beyond specific formative assessment practice and address the factors that lead to becoming embedded in classroom practice. The final observation schedule is contained in Appendix B.

Q Methodology

The psychologist/physicist Wiliam Stephenson (1935) introduced this mixed methods approach to research as a systematic way to explore human subjectivity where the researcher gathers information on participants' views, opinions, and beliefs about a chosen topic through a card sorting activity usually followed by a semi-structured interview. In this thesis the Q methodology was used to explore students' beliefs about the teaching, learning, and assessment practices enacted in their school and science classes.

In some educational research, students' viewpoints are obtained via interview or questionnaire, yet both methods, while popular among researchers, can be flawed. Although questionnaires are a relatively easy way to obtain data from participants, the data collection method is static as the participant cannot expand on their answers and if unsure about a question may be able to ask for clarification. In contrast, the interview process can be more flexible, allow for expansion of thoughts and provide a vast amount of qualitative data. However, research suggests that conducting interviews with young people can pose difficulties such as

unwillingness to answer questions or not wanting to be voice recorded (Bassett, Beagan, Ristovski-Slijepcevic, & Chapman, 2008). As this research was conducted with lower second level students, a stand-alone interview posed difficulties for the reasons listed above.

The researcher had first-hand experience of Q methodology from a previous project where students' willingness to engage was successful in producing rich data (Burke O'Connell, Dempsey, & O'Shea, 2019). Participants may not always be certain about their feelings about a specific topic (e.g., teaching, learning, and assessment) and the Q methodology helps to add statistical significance to these feelings. A benefit of this "qualiquantalogical" (Watts & Stenner, 2012, p. 69) method is that it utilises statistics to obtain and/or expand on qualitative findings (Akhtar-Danesh, Baumann, & Cordingley, 2008; Killam, Timmermans, & Raymond, 2013; Parker & Alford, 2010). A further benefit of conducting this method of data collection in place of standard interview and/or questionnaire is that it offers "clarity of instruction" as it is conducted face-to-face with participants and allows the researcher to provide the participants with verbal instructions and guidance about the task (Killam et al., 2013, p. 28). This clarity of instruction provided the opportunity for students to change their minds about where they sorted their placement cards, an opportunity lacking in questionnaires.

The Q methodology is not without its disadvantages. The first disadvantage concerns the time-consuming nature of the Q sort activity (Karim, 2001; J. Simons, 2013). The researcher must be mindful of not overloading the participants with too many statements to sort (between 40 and 80 is generally acceptable) as this can lead to incomplete or inaccurate responses. In addition, the participants taking part in Q may object to the forced distribution of the sorting activity and therefore be unwilling to complete the activity (J. Simons, 2013). As this research took place in a school setting, it was a disadvantage of Q that it was not appropriate for students who had additional education needs. Finally as Q is concerned with the subjectivity of both the participant and the researcher, personal biases on the part of the researcher may be apparent (Thomas & Baas, 1992). For this reason, the Q methodology was subject to reliability and validity checks as with the other research instruments of this study. Reliability and validity are discussed in greater detail at the end of this chapter.

According to McKeown and Thomas (2013, pp. 5–6) there are five main steps in a Q methodological study:

1. Creating the Q samples
2. Selecting the research participants

3. The Q sort activity
4. Factor analysis
5. Factor interpretation

This section will discuss the first step, while the second and third step are discussed in the stages of data collection section. The fourth step is discussed in the analysis section of this chapter. Factor interpretation is explored in Chapter 9.

The creation of the Q concourse is the beginning point of any Q study. Research recommends that a set of between 40 and 80 statements are considered satisfactory during a Q sort activity (Shinebourne, 2009). Inspiration for the statements was drawn from existing Q sort statements (n=33) from the FaSMEd Ireland research (2015). Further statements (n=40) were derived to inform the research questions of this study: extrapolating what formative assessment looks like to a student, considering the literature surrounding teaching, learning, and assessment, and examining the factors affecting student learning both within and external to the classroom. These statements were validated by the researcher's supervisors considering the research questions and objectives. Activity theory also played a part in creating the concourse of statements as it helped to focus the statements on specific tools utilised by students, how teaching and learning is distributed throughout a lesson and how the wider community affects student learning. The Q concourse was reduced to 48 statements included in the Q activity, see Appendix C. Within the final 48 statements 13 stemmed from the FaSMEd project while 35 were derived by the researcher.

It is recommended that the language of statements be as natural as possible (McKeown & Thomas, 2013), hence the language of the statements in this thesis was carefully considered to ensure that the items were accessible to all students. Piloting of the instrument helped to structure the language in a student friendly way. The final statements (n=48) were chosen based on their comprehensiveness to model the larger process being examined (Brown, 1993) and to address the specific research objective of exploring students' views about teaching, learning and assessment, to identify what factors contribute to their learning.

Stages of Data Collection

Teacher and School Leader Interview

Teachers and school leaders were interviewed on an individual basis with each interview lasting approximately 45 minutes. Interviews were audio recorded and transcribed for analysis. Interviewees were told in advance that the interviews would be audio recorded for transcription purposes. Interviews with the head teachers and teachers in Scotland took place in June 2017, while interviews with the principals and teachers from Ireland took place in November and December 2017 (Oakpark), and March 2018 (Greenview).

Teacher interviews took place after at least one observation was carried out in their classrooms so the researcher could ask teachers to expand on what was observed in lessons. School leader interviews were conducted during the observation periods in schools. The exact time and date of the school leader interviews were at their discretion as they all had busy schedules.

Classroom Observation and Video

A fundamental aspect of this method of data collection is deciding on the appropriate duration of data collection i.e., how many hours should be spent observing each science class. After due consideration was given to literature on classroom observation (see for example Chang & Song, 2016; Farrell & Mom, 2015; Mak & Lee, 2014; Riggan & Oláh, 2011), it was deduced that it observation is largely dependent on the research questions of a study, number of participants, and whether other data collection methods are being used. After considering this, and discussions with critical peers, it was decided that a minimum of three hours of observation per teacher would take place approximating to one week of time-tabled science lessons.

In total, just over 25 hours of lessons were observed, equating to roughly one week of science lessons per school. Observation began with the two schools in Scotland (Woodhill and Milltown) in June 2017. Observation took place in the first school in Ireland (Oakpark) in November and December 2017 and took place in the second school (Greenview) in March 2018.

In Woodhill, four 50-minute lessons were observed, and video recorded with Amy's S2 science class, the same applied for Sophie's lessons. In Milltown, four 50-minute lessons were observed, and video recorded with Alice and her S2 students (one of these was not video

recorded so the students would get used to the researcher) and three lessons were observed and recorded with Nora and her S2 science class. In Ireland lesson lengths varied. In Oakpark there was one double first year science lesson per week equating to 110 minutes. Two of these lessons were observed and videoed with Rebecca and two with Matthew. Finally in Greenview the 1st year science lessons were of 58-minute duration. Three of Dylan's science lessons were observed and videoed, as were three of Lilly's lessons.

Including video was important in compiling the data on classroom practice. Video recording was used in this study to strengthen the classroom observation data. The power video has to aid classroom observation analysis has been widely documented (Derry, 2007; Erickson, 2006; Harford, MacRuairc, & McCartan, 2010; Savola, 2008). One of the major advantages of video recording in the classroom is that it can be revisited on several occasions. Erickson (2006) comments how "fine-grained information about the actual conduct of social interaction comes best from making audio-visual recordings of it" (p. 177), while Santagata, Zannni and Stigler posit that "because video can be played over and over and accessed digitally, it allows for a depth of reflection and analysis not possible during live observations" (2007, p. 125). Including video as data facilitated the detailed analyses of each case *evaluative episodes*. These are moments within a lesson where "the dynamism of an activity system is momentarily frozen, enabling one to model human activity in the system under investigation" (Hardman, 2007, p. 53). This meant that short sections of a lesson were analysed in detail so that the intricacies of each teacher's activity system can were examined, and research questions addressed.

Based on the literature on video data (for example Andersen & Nielsen, 2013; DeCuir-Gunby, Marshall, & McCulloch, 2012; Jacobs et al., 1999), there were certain factors that needed to be considered prior to the collection of video data. Erickson (2006) was very influential in deciding how video footage of lessons would be gathered. Firstly, since the research was making use of an observation schedule along with video recording in the classroom, one camera only was used when video-taping lessons. Additionally, Erickson's recommendation that video footage should be raw i.e., with minimal editing, continuous shots, and little camera movement, panning and zooming, was considered, and utilised in the research as it can, for the most part, capture phenomenologically neutral data. It would be naïve to think that a video camera in the classroom would produce purely phenomenologically neutral data as its mere presence may alter the behaviours of classroom participants, however it has been noted by Erickson that by capturing raw footage, the distraction to lessons would be minimalised

compared with moving the camera around the room or focusing in on specific interactions. This has been echoed by other researchers who note that changing what is in view can lead to discontinuities in the data (Hall, 2007), and editing what is captured can distort the data collected (Patton, 2002). Hence, a single stationary camera was used when collecting video footage of lessons in this study.

The position of a video camera in the classroom can influence the focus of the data collection. Depending on what the research wants to capture the camera can be placed at various locations around the classroom. For this research, the position of the camera was decided after the initial pilot of the data collection instruments and from reviewing Erickson's recommendations (2006). It was concluded that the back of the classroom would be most suited for the camera placement as it minimally interfered with classroom learning, leading to a more natural experience of lessons.

Q Methodology

It is not uncommon for studies utilising Q to select a small number of participants (referred to as the P sample or P-set) to take part in the Q sort process. Again, Stephenson advocated for small numbers due to the intensive and time consuming nature of Q (quoted in McKeown & Thomas, 2013). Brown (1993) posited that in Q, the focus should be on quality over quantity. With that in mind, in this study, 48 students in total were chosen to participate in the Q sort activity. In all, three male and three female students from each of the 8 classes (n=48) participated in the study. That equated to 24 students from two Scottish schools and 24 students from two Irish schools. This was consistent with Van Excel and de Graaf's suggestion that there should be no more than six participants defining each anticipated viewpoint (2005, p. 6).

The Q sort activity is a process where a research participant ranks items concerning the research topic at hand. Each of the 48 students completed the Q activity individually creating 48 individual sorts of 48 statements. During the process statements are not evaluated in isolation, their position is always contextualised in relation to the other statements to be sorted (McKeown & Thomas, 2013, p. 25). The Q sort is typically conducted on a one-to-one basis with researcher and participant. These items are ordinarily statements written on cards (as is the case for this study). A review of the Q literature indicated that there are three main steps within the Q Sort activity. The first step involves the participant sorting the statement cards into three groups: agree, neutral, and disagree (Van Excel & de Graaf, 2005). During this process, the participant is encouraged by the researcher to ask any questions about statements that they may be unsure of, to clarify their meaning. This is particularly pertinent when undertaking a study with students as the language of the statement may not be in line with their vernacular.

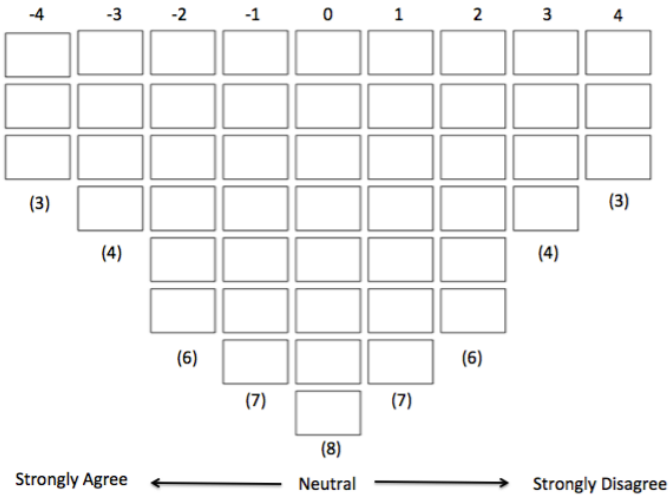

Figure 7: Placemat in Forced Normal Distribution. Ranking values range from -4 to +4. Numbers in brackets indicate the number of items that can be assigned to any rank. A total of 48 items can be sorted in the distribution illustrated

The second step requires the researcher to lay down the condition of instruction (Brown, 1993; McKeown & Thomas, 2013; Van Excel & de Graaf, 2005) that acts as a guide for the sorting process. This is where the researcher explains to the participant how the statements will be ranked according to a rule. To illustrate this, Figure 7 displays how in this study, the statements were ranked on a nine-point scale from strongly agree (-4) to strongly disagree (+4) in a forced normal distribution. The ranking of statements is a self-directed process (Cross, 2005) and the researcher should not, to the best of their ability, influence the placing of the statements. Once the participant is finished ranking the statements, the researcher must take note of their

placings. In this study, photographs were taken of the completed placemats and used for analysis.

In the final step of the process it is recommended that an interview is conducted to elaborate on any salient statements that the participant ranked (Van Excel & de Graaf, 2005). Normally an interview would be conducted after all the statements have been placed, however due to time constraints, the interview was conducted during the Q sort activity so that the students' thoughts on a statement could be shared while they were choosing where to place the card. In addition, the interview was conducted alongside the Q sort so that if a student changed their mind about a placing i.e., swapped cards, the researcher could pick up on rich data that may have otherwise been overlooked in a post sort interview.

Framework for Analysis

The process of data analysis began coding the data to draw out meaning in an activity theory perspective, with respect being paid to the sociocultural interpretation of formative assessment (Pryor & Crossouard, 2008). This was undertaken by considering Engeström's elements of the activity system (see Figure 2) and Wiliam and Thompson's five strategies for formative assessment (2007). To reiterate, the main bodies of data for analysis were:

- Teacher and school leader interview
- Observation of classroom practice (including video)
- Q methodology: card sort and student interview

Coding was guided by the research questions, objectives, and theoretical framework of this study. This helped to identify a priori themes and allowed the flexibility for other themes to emerge. Patton refers to a priori themes as sensitising concepts and describes them as categories brought to the research by the analyst or researcher (2002). The a priori themes stemmed from the elements of the activity system (Engeström, 1987) and Wiliam and Thompson's framework for formative assessment (2007). Additionally, emergent themes were taken into consideration as to focus solely on a priori themes would force the analysis and neglect potential important research findings. A researcher can "impose a world of meaning on the participants that better reflects the observers world than the world under study" (Patton, 2002, pp. 459–460) and therefore it is at the discretion of the researcher to follow a coding system that will help to manage the data gathered in a neutral way.

Qualitative Analysis

Analysing the qualitative data began with a focus on each science teacher. They were chosen as the starting point of qualitative analysis as each of them were the driving force of their classroom activity system and were a fundamental part of the unit of analysis (i.e., the teacher and their science students.) At this point it is pertinent to recall how in an activity system the object can exist twice, both mentally and physically (Engeström, 1987). This drew attention to the intended means of classroom practice and the enacted practice observed in lessons. For example, how a teacher plans to provide students with feedback on their science work may be different to the feedback they provide in real time during lessons. The qualitative data analysis was undertaken in the following sequence:

1. Coded interview data from teachers were examined to ascertain their views on how they enact formative assessment in the classroom. Questions pertaining to their understanding and enactment of formative assessment were reviewed to provide a benchmark of their intended practice.
2. Data gathered from the coded data, fieldnotes and video data were examined to source evaluative episodes that would represent the teachers' intended formative assessment practices. Video data were reviewed several times to ascertain which teachers and their science students were suitable to best address the research questions of this study.
3. Case teachers were chosen (n=4) based on their formative assessment enactment and the relationship between their intended and enacted practice, this aligned with the theoretical framework of activity theory. For example, contradictions existed among some teachers' intended and enacted practice, and therefore presented as interesting cases that would address the research questions. Moreover, one teacher had a strong consistency in her practice that she discussed in interview and enacted during classroom observation. Therefore, she was chosen as a case due to exemplifying classroom practice focused on formative assessment implementation. Sections of the four case teachers were transcribed using video and the fieldnote data gathered using the observation schedule.
4. Evaluative episode tables were created for each case study teacher which linked classroom talk and practice to the elements of the activity system. The tables were based on what was seen and video recorded during classroom observations. The following headings were used based on Hardman's interpretation of *evaluative episodes* (2007):
    a. Timestamp
    b. Action

c. Description
d. Teacher/student talk
e. Activity theory elements

Two cases consisted of one episode, while the other two cases contained two episodes. Using more than one episode per teacher is not uncommon in research and it was necessary to use two episodes with two teachers (Matthew and Nora) as they were needed to exemplify their specific formative assessment practices.

5. Once evaluative episode tables were compiled, coded teacher and school leader interview data were then examined to identify the factors that were influencing their formative assessment enactment. These data were necessary to gather information on the bottom tier of an activity system triangle: rules, community, and division of labour.
6. The coded qualitative student interview data were utilised to complete the picture on how formative assessment was enacted in science lessons.
7. Finally, an activity system diagram based on Engeström's triangle (1987) was created for each case exemplifying the factors promoting and/or inhibiting formative assessment enactment in lower second level science classes. Compiling data into an activity system diagram is common in the literature and is the presentation of choice in many studies focused on activity theory (see for example Beatty & Feldman, 2012; Mukute & Lotz-Sisitka, 2012; Norton, McRobbie, & Ginns, 2007).

A breakdown of how each qualitative data source was analysed will now be forwarded. In addition, the quantitative factor analysis of the student Q sorts will be unpacked.

Teacher Interview

The qualitative analysis and interpretation of the teacher interview data ensued using MAXQDA to help with the thematic analysis of their comments. Each interview with each teacher produced a transcript that could be loaded into MAXQDA. These transcripts were then coded. This process began by looking at one transcript from Ireland and one from Scotland.

The following a priori codes were drawn up to begin sorting the teacher interview data:

- Formative assessment
    - Prior knowledge and adaptive teaching
    - Learning intentions and success criteria
    - Self-assessment
    - Peer learning

    - Feedback
    - Questioning
- Summative assessment
- The school
- Science class
- Wider educational influences
- Professional identity

After reflection on this process thematic codes were changed, and sub codes were created, and some were moved around to better fit the data. This was because the initial codes neglected key factors that arose in interview on how teachers enact formative assessment. These included the influence of behaviour in the classroom and how a school can support specific teaching practices. Once thematic coding was completed the coded statements were printed and key statements highlighted. Notes were drawn up to summarise initial impressions and the emergent data was used to structure the activity systems of each individual teacher. The following list was the final coding system used to code the teacher interview data:

- Formative assessment
    - Prior knowledge and adaptive teaching
    - Learning intentions and success criteria
    - Teacher facilitated self-assessment
    - Peer learning
    - Feedback
    - Questioning
- Summative assessment
- The school
    - Involvement outside the classroom
    - Support from school
- Science class
    - Resources/activities
        - Technology
    - Homework
    - Discipline (behaviour)
    - Student teacher relationships
    - Student traits

- Wider educational influences
    - Curriculum
    - Parents and families
- Professional identity
    - Continuous professional development
    - Collaboration with other teachers
        - Departmental collaboration
    - Planning lessons

School Leader Interview

The school leader audio recordings were transcribed and inputted into MAXQDA. Initial thematic coding began with one Scottish head teacher and the interview was initially coded based on the theoretical framework guiding the research, so codes included rules, community, and division of labour among others. Following this the codes were re-examined, and the initial codes were added to and regrouped to best fit the data. The original coding did not capture the nuances of the individual school so sub codes such as collaboration with other schools, head teacher practice, and extracurricular activities were added to explore the individualities of each school. Once coding had ceased the school leader data was condensed and summarised into a table for direct comparison of schools. The final coding system for the school leader interview data is set out below:

- Principal/Head Teacher Practice
- Outside Influences
    - Collaboration with other schools/teachers
    - Curriculum
    - Community
    - Parents/Families
- The School
    - The Students
    - Teacher Agency
    - Homework
    - Staff
        - Classroom Observation
    - Extra-Curricular Activities

    - Resources
- Formative Assessment
    - General Assessment
- Science Education
- Professional Development
- Ethos

Video and Field Notes

The video data were reviewed considering the fieldnotes collected during classroom observation. As Santagata, Zannni and Stigler suggest "because video can be played over and over and accessed digitally, it allows for a depth of reflection and analysis not possible during live observations" (2007, p. 125). Therefore, each lesson video was watched and re-watched, and field notes were expanded using the information gained from the videos. Extra notes/comments were added in pencil. The video notes and the field notes were then typed up into single documents (one per teacher). Video was an important aspect in terms of gathering and studying the evaluative episodes (Hardman, 2007, 2015) present in each lesson. A detailed discussion regarding *evaluative episodes* is provided below.

Evaluative Episodes

Qualitative observation data were compiled and analysed using what are known as *evaluative episodes* in the literature. This type of analytical framework arose due to the dearth of methodological tools available to analyse classroom practices through the activity system in activity theory (Hardman, 2008). Within this framework the chosen focus for analysis is "primarily on teacher and student talk as it encodes rules, tools, division of labour, object and the outcome of the activity" (p.74). *Evaluative episodes* are chosen based on their ability to represent disruptions in the pedagogical script (Hardman, 2005, 2007). In the case of this thesis, these disruptions consisted of moments or activities where a teacher attempted to enact formative assessment practice in their science lessons. In total six episodes were chosen (two teachers had one episode each and the other two had two episodes each). Table 6 served as a starting point to help analyse what was happening in each episode.

AT concepts	Questions to ask when analysing evaluative episodes
Outcomes	What is produced in the episode?
Mediating artefacts	What tool(s) is/are used?
Object	What is the object/focus of this episode? What is the purpose of the activity for the subject? What is the teacher working on? Why is s/he working on it?
Division of labour	Who does what in this episode? Who determines what is meaningful?
Community	What community is involved in this episode? What group of people work together on the object?
Rules	What kinds of rules: instructional rules, evaluative rules and pacing rules? Social order rules, disciplinary rules, and communicative interaction rules

Table 6: An activity theory checklist (Hardman, 2008, p. 75)

Table 7 provided a broad picture of what was happening in each episode. This was then expanded, and a more detailed picture was created using transcripts of the *evaluative episodes.* Inspiration was drawn from Hardman's analysis of the pedagogical object in a primary school mathematics classroom (2007). Evaluation of these episodes helped to form the picture of each teacher's activity system and an activity triangle was created for each case study.

Activity Systems

The final step in the framework for analysis was to present a diagrammatic representation of each case teacher's activity system (n=4) drawing on Engeström's triangle (1987), see Figure 2. For each case teacher's activity system, the subject and the outcome of the system were constant. The subject consisted of the teacher and their science class, while the outcome was improved learning and responsive teaching, the intended outcomes of formative assessment. The rest of the triangle was constructed by looking first at the evaluative episodes to explore what elements of the activity system were prevalent and impacting on reaching the intended outcome of the activity. Following this teacher, school leader, and student interview data were examined to identify elements of the activity system not apparent in the evaluative episodes. For example, in Chapter 5, Dylan's activity system includes continual professional development as a rule. These data were obtained during interview with Dylan, not from his evaluative episode.

Once each activity system was assembled, they were reviewed with research supervisors where their ideas, explanations, and interpretations of the activity systems were taken into consideration. The dependability of each activity system presented as a concern for the validity and reliability of each activity system and the question was asked: would each activity system stay stable over time? Answering this question effectively would have required a different research design where data were collected over a long period of time, however this issue was minimalised by ensuring the reliability of data in each element of the activity system. For example, when collecting and analysing data on the tools, rules, community, and division of labour data were gathered from multiple sources (observation, interview, Q-sort), research instruments were consistent, and data were collected at various times during the school day. Validity and reliability are discussed in more detail later in this chapter.

It was decided early in the research that the participants views on the interpretation of their activity system would not be sought. This was due to a number of factors including time constraints with PhD level research, the reluctancy of participants to express criticism of researchers' work (Slettebø, 2020), and how it may be in participants' interests to misinterpret or incorrectly describe their own actions to be viewed in a better light (Fangen, 2010). However, by not getting teachers to engage in participant validation the opportunity may have been lost to re-examine the validity of each activity system. This may have added to the trustworthiness of the data and can be considered as a limitation of the data analysis process.

Q Methodology

Student Interview Data

Each audio recording of the interview aspect of the Q methodology (n=48) was transcribed and loaded into MAXQDA. Thematic coding of the data proceeded in the same way as the teacher and school leader interview data: one Scottish and one Irish interview was coded using the a priori themes. The initial themes were as follows:

- Influence of summative assessments
- My science class
- Learning outside school
- Reliance on teacher
- Peer learning

- Learning intentions and success criteria
- Questioning
- Self-assessment
- Feedback

Once the first two interviews were coded using the themes above, it became apparent that the student data were much more nuanced than the initial seven themes. The interpretivist nature of this study allowed for an inductive-deductive research cycle meaning that although there were obvious a priori themes that matched this research, other interesting findings could not be ignored. Therefore, the themes were further coded, and sub-codes were added to appropriately categorise what the students were saying. The following list details the final coding system used to code all 48 student transcripts:

- Prior knowledge and adaptive teaching
- School influences
- Feedback
    - Peer feedback
- Self-assessment
    - Teacher facilitated self-assessment
- Questioning
    - Student questioning
    - Teacher questioning
- Learning intentions and success criteria
- Peer learning
    - Negative peer learning/individual learning
- Reliance on teacher
- Learning outside school
    - Family input
- My science class
    - My science teacher
- Influence of summative assessments

Once thematic coding began, all comments relevant to the above themes were coded, totalling 1,794 coded segments. Coding all relevant comments meant that a full picture of what student beliefs about teaching, learning, and assessment practices were. This allowed for comments from both a priori themes and new themes to emerge.

Quantitative Factor Analysis

The purpose of carrying out the quantitative factor analysis was to gain an insight into students' beliefs about teaching, learning, and assessment in their schools and science classes (objective four of the research). The method drew heavily on McKeown and Thomas's guidance for conducing factor analysis in the Q methodology (2013). Once each Q sort activity and interview was complete, and photographs taken of the finalised Q sort, they were analysed quantitatively leading to the emergence of factor arrays (a shared viewpoint of a cohort of students). The aim of this statistical analysis was to produce factors that would represent typical viewpoints of students that could be interpreted by the researcher and backed up by the qualitative interview data from students. The analysis of the Q data began with the quantitative aspect and once this was completed the interview data was then analysed qualitatively using the methods discussed previously. PQMethod software (Schmolck & Atkinson, 2002) was utilised to carry out quantitative analysis as "only these types of packages provide the type of output reports required to interpret the participants' view on a topic" for a Q study (Newman & Ramlo, 2010, p.513). Each sorting array (48 students so 48 sorting arrays) was entered into PQMethod software which carried out factor analysis school by school and country by country. A detailed description of the mathematical process involved in Q analysis is contained in Appendix D.

Research Quality Checks

Validity and Reliability

The principles of validity and reliability are at the core of any research design. These two interlinked properties call on researchers to consider if what we want to study and what we studied are consistent and whether the measures we use can be used repeatedly and obtain similar results. Validity and reliability were given careful consideration in the data collection methods employed in this study.

Classroom Observation

In this research, validity was ensured during classroom observation through repeated observations of practicing teachers. The researcher was mindful of observer biases as research has shown that observers with higher levels of education (i.e. a masters qualification and above)

tend to be quite lenient when rating teachers, and female observers tend to rate teachers more harshly than their male counterparts (Roberson, 1998). Consistently using the observation schedule and video recording lessons lessened this observer bias. Moreover, the Heisenberg Principle was considered whereby the "act of measurement alters what is being measured" (Roberson, 1998, p. 9) . What this indicates is that the mere presence of the researcher in the classroom may change or alter the way a teacher carries out a lesson, or the students may act differently knowing that there is another adult in the room. To lessen the influence of the researcher being in the room, at least three observations were carried out for students to get used to another adult in the room, and lessons were observed for the most part in sequence to lessen the chances of the researcher being present influencing the class.

For this study, reliability in classroom observation took into account the three main factors put forth by Medley, Coker, and Soar (1984) whereby it can be maintained using:

1. Internal consistency of the instruments scoring key.
2. The accuracy of the observer.
3. The stability of the behaviours being measured.

Considering these suggestions to maintain reliability in data collection the same observation schedule was used for each observed lesson and phenomenologically neutral video data was collected to ensure accuracy. In addition, the researcher was the only observer throughout all classroom observations. This lessened the chances of different researchers skewing observation data.

To strengthen the validity and reliability of data obtained through observation, Adler and Adler (1994) suggest the following:

1. *Cross-check findings from observations with others to reduce inaccurate interpretation:* This was accomplished by reviewing observation data with the supervisory team and critical peers.
2. *Describe the setting (i.e., the classroom, school context) in a way that allows for the reader to see and feel what it was like:* This was taken into consideration during data collection through the observation schedule and during the write up of results. The nuances of each case study are presented in the data chapters later in the thesis.
3. *Gather data at various times of the day, week, and/or month:*
   This was accomplished as the different timetables in each individual school leant themselves to the change up of lesson times.

Interviews

Validity issues tend to arise during interview in relation to the attitudes, opinions and expectations of the person conducting the interview (Cohen et al., 2000). There can also be problems with respondents misinterpreting questions and with interviewers misperceiving what the respondent is saying. Therefore, to minimise validity issues, the researcher engaged in reflexivity to take a step back from the research to make the interview process a focus of inquiry, realising that how one views knowledge and participants view knowledge may influence the interpretation of data. These issues were minimalized by informing teachers at the beginning of the interview that honesty is very important in the development of this research and that the overheads in their schools would not be given the unanonymised interview data. Reliability came into play for the most part upon the analysis of the interview data. This was discussed earlier in the chapter however to reiterate, each set of interviews (student, teacher, and school leader) were coded using the same themes in an iterative process.

Q Sort Statements

The researcher engaged with critical peers and research supervisors when constructing the Q statements and there were numerous iterations of the statements before the final list was compiled (see Appendix C). Moreover, much of the Q concourse was made up of statements used in previous research.

Triangulation of Data

There are various ways that triangulation can be achieved in research. There are four ways of achieving triangulation according to Denzin (1970) include theoretical, investigator, data, and methodological triangulation. Methodological triangulation was a focal point for this research.

Methodological Triangulation

The purpose of triangulation is not only to cross-validate research findings, but to capture different dimensions of the same phenomenon resulting in greater confidence in research findings (Bryman, 2008). In methodological triangulation there exists two approaches: within method, where several methodological approaches are combined in one qualitative method, and between methods which involves “combining several qualitative methods or qualitative

and quantitative methods of data collection in a study" (Flick, 2018, p. 536). The methods chosen act as filters through which the research space is experienced. The main benefit of using both qualitative and quantitative approaches can be summarised as having more methods means more confidence in the research findings (Cohen et al., 2018). This was an important aspect in using the Q methodology to gather data. In the Q methodology, data were gathered both qualitatively and quantitatively to add strength to the findings. Overreliance on one method can result in "method-boundedness" where the value of having a combination of methods is lost (p.265).

This thesis made use of the *between methods approach* to methodological triangulation. For example, the use of teacher interview and classroom observation revealed some discrepancies among the teachers' intended and enacted practices. This corroborates with the theoretical framework of activity theory where uncovering these contradictions is vital to understanding how an activity system operates. Without this type of triangulation, rich data on these contradictions would not have been revealed. In addition, triangulation was achieved by examining student data both quantitatively through the card sorting activity, and qualitatively through the simultaneous interview with each student. Triangulation was also considered through the varies means of data collection on the same phenomenon i.e., formative assessment. For example, data were gathered on teachers' engagement with formative assessment both through interview and classroom observation. Moreover, these data were also triangulated via the student data as they were active participants during the classroom observations. Finally, triangulation was achieved through discussion with other researchers in the field of science education. The researcher discussed data interpretation with critical peers and research supervisors and took into consideration their ideas, explanations, and interpretations of the data.

Ethical Considerations

As this study collected data from vulnerable persons (students under the age of 18), many ethical considerations needed to be given due consideration. The following key principles set out by BERA's (British Educational Research Association) Ethical Guidelines for Educational Research (2011) to ensure that unethical research was prevented from the outset.

- *Respect:* All participants in the study (teachers, principals/head teachers and students) were treated fairly, sensitively, with dignity and with an ethic of respect and freedom from prejudice.
- *Voluntary Informed Consent:* Schools and teachers signed consent forms to participate in the project see Appendix F). Consent was asked of parents/guardians with assent being sought from students to participate. The researcher ensured that all participants in the research understood the process in which they were engaged with, including why their participation was necessary, how the data will be used and how and to whom it will be reported. Detailed information sheets on the project were circulated to schools, teachers, parents/guardians, and students prior to commencement of the field research. These are to be found in Appendix F.
- *Openness and Disclosure:* Deception of any form was not used throughout the project.
- *Right to Withdraw:* Research participants participated in a voluntary way, free from any coercion. They were free to opt out of the project at any stage.
- *Working with Young People:* The students had the opportunity to express their views about the project and teaching, learning, and assessment through the Q methodology. Students gave assent to participate in the project. Garda Vetting was obtained prior to working with young people.
- *Privacy:* Participants' data were confidential and only accessible to the researcher. Identifiers were removed from the interview recordings at the point of transcription. Interview participants were assigned pseudonyms. Record of the pseudonyms and identifiers were stored separately from the transcripts. The video data was used only for the purposes of research; it was not made publicly available.

The Scottish Educational Research Association (SERA) Ethical Guidelines for Educational Research (2005) and Maynooth University's Research Ethics Policy (2020) were also given due consideration throughout this project. The project got ethical approval by the social research ethics sub-committee at Maynooth University on the 7th of February 2017.

Limitations to the Methodology

A major limitation to this research was the generalisability of the findings. As the unit of analysis for this research was each science teacher and their students, and the research design was multi-site case study, it was not possible to generalise the findings to other people in other settings. Another limitation to this study was time constraints. As the second level school year

in Ireland is notably shorter than in other countries, the research in Ireland had to be completed in a relatively short space of time. Additionally, as the researcher carried out the classroom observation and video analysis alone, personal biases and idiosyncrasies may have been overlooked in the data analysis. This concern was assessed in the sections about on validity and reliability; however, it is important to be aware of these issues when entering the field.

If the research was to be undertaken again there would be changes to strengthen the argument. Data would have been gathered from policy actors involved in curriculum reform. This would have been beneficial when examining the curriculum policy from both Ireland and Scotland. However, it is pertinent to remember that a PhD is limited in time and resources and therefore decisions needed to be made on where to source data from during this time. The researcher's expertise was in the classroom therefore there is more of a focus on practice over policy in this PhD thesis.

Positionality

Now that the methodology for this research has been discussed in detail, it is important at this point to reflect on my positionality and how it may have affected my research. As I am a female, white, Irish second level teacher I brought with me to the research certain assumptions. The interpretivist paradigm believes that people "give meaning and value to their environment and themselves, that the ways in which they do this are shaped by the particular cultures in which they live, and that this generates the actions and institutions in which they participate." (Hammersley, 2012) Thus, I offer my findings as only one possible interpretation of my participants experiences based on my standpoint.

My main role in this project was researcher however as I come from a teaching background, I believe this had an impact on my research. I had a lot of investment and interest for my project to succeed and therefore this may have influenced me when analysing the data. I needed to be careful not to influence participants when gathering interview and observation data and needed to consider the cultural context of the school. I assumed that because I was a teacher, I could easily build a rapport with the teachers and school leaders I was working with, and this would make gathering data easier for me. However, as I am an outsider to them, i.e. I work in a different school, and in Scotland working in a different education system, I was concerned that the teachers would take it personally that I was judging their practice and act differently when

I was in the classroom. This was a concern and something I needed to be mindful of as the purpose of classroom observation was to get a true reflection of everyday formative assessment enactment. Additionally, I needed to be mindful that I began the research with an intuition that teachers may be using formative assessment superficially and needed to be careful this did not bias my judgments when gathering data.

I also needed to be aware that I was working with lower second level students who are classed as a vulnerable population. As I am an adult the students may have felt uncomfortable discussing their teachers and schools with someone in a position of authority. I tried to mitigate this by making them aware that the data from the Q methodology would not be communicated to their teacher or anyone else in their school including their peers and school leaders. Their information sheet made clear that they could opt out at any point of the research.

5. Case Study 1: Using technology to elicit evidence of student understanding

Introduction

Dylan is a teacher of science, mathematics, and physics in Ireland. He had been working in Greenview for three years at the time of research. Greenview was the first school he had worked in after completing his Professional Diploma in Education. At this time, it was his first year to teach the Junior Cycle Science Specification (Department of Education and Skills, 2015b). In interview Dylan expressed his strong advocacy for technology in learning, and identified it as the way he enacted formative assessment in his science lessons:

> "Using formative assessment, I'm just trying to find my way, see what works and see what doesn't. Each student has a Microsoft Surface in the class which does make it a little bit easier, I find, to get snapshots of where the students are at a particular time through using different things like Quizlet, or different sort of apps and stuff."

Analysis of observation data and video are presented in this chapter through an evaluative episode. An *evaluative episode* (Hardman, 2007) allows for activity theory researchers to analyse teachers' actions in detail while paying respect to different aspects of the activity system including the object of the activity, tools, rules, and division of labour (DOL). In the evaluative episode presented in this chapter, Dylan used *Quizziz*, an online quiz application where students answered questions on their devices, and answers were reviewed by the teacher at the end of the quiz. Following the quiz, the class engaged in a modelling activity combined with a question-and-answer session facilitated by Dylan. A detailed breakdown of the episode is contained in Table 7. In addition to data obtained from observation and video, this chapter also drew on data gathered through interviews with Dylan, the Greenview Principal, and the students from Dylan's class who participated in the Q methodology.

An in-depth analysis of Dylan's activity system using the data demonstrated the affordances and constraints that influenced formative assessment enactment in his science lessons. Interview data suggested Dylan intended to embed formative assessment using technology in his science lessons, but as the data were analysed his intended practice did not align with his enactment. Looking further at the activity system, it was deduced that the whole school approaches to teaching, learning, and assessment in Greenview were constraining Dylan's practice. The school was trying to implement two whole school initiatives at the same time

(technology and formative assessment) which suggested there was not adequate time allocated for meaningful enactment of either process. A further constraint stemmed from the professional development Dylan was provided in Greenview: formative assessment practices had been reduced to tools without due consideration being given to the purpose of formative assessment: responsive teaching for improved learning. However, Dylan was skilled in using technology that interested the students and made learning more personalised for them. This suggested that he held social constructivist beliefs about teaching, learning, and assessment although the data on this was limited. The technology he used in his evaluative episode helped him to identify problems students were having with content, however his follow up (formative assessment response) was ineffective in terms of formative assessment. Considering the teacher professional learning continuum (DeLuca et al., 2019) Dylan was considered as a teacher who was practicing the *letter* of formative assessment. He was implementing a variety of planned activities to monitor students' learning yet these activities were not fully integrated into formative assessment practice as he did not use his learning to adapt his teaching to meet the learning needs of his students. In summary, he started a formative assessment activity but didn't finish it to reach the outcome of the activity system: improved learning and responsive teaching. The class activity system derived from data analysis is provided in Figure 8.

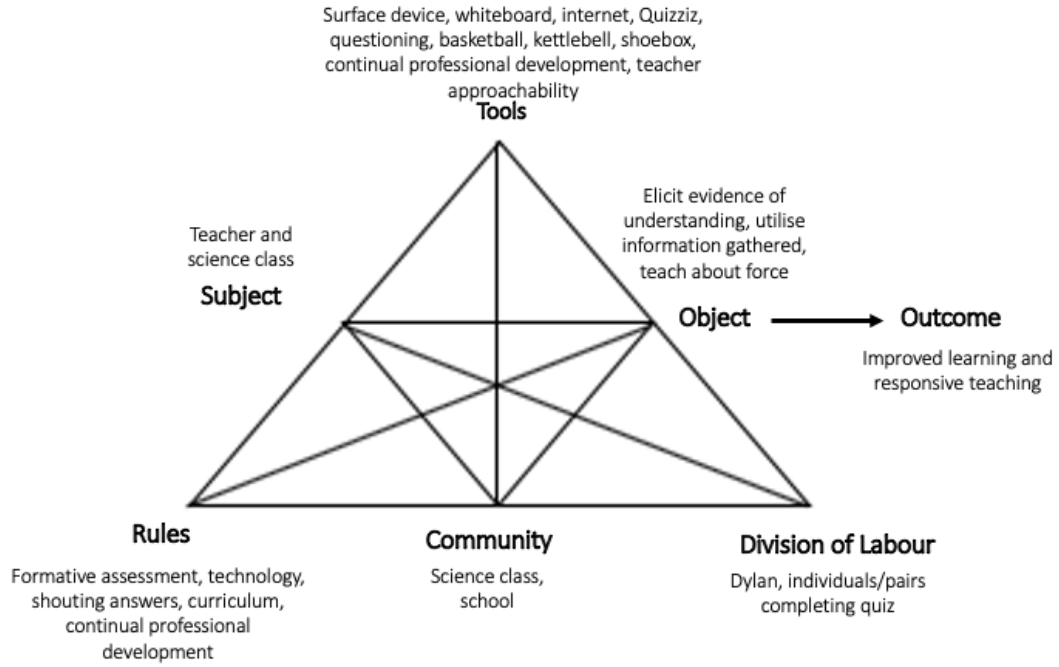

Figure 8: Diagrammatic representation of Dylan's Activity System

Dylan's Evaluative Episode

In the preceding lesson students began the topic of *Force*. During that lesson they learned about the rules of forces through discussions, note taking, videos, and a homework task of writing a paragraph on the scientist who discovered force. The lesson in which the evaluative episode takes place began with Dylan correcting homework by getting students to share what they wrote about their scientist with the class. He then began a quiz. The quiz and surrounding discussions constitute the evaluative episode discussed. The episode is broken down into smaller time intervals where the actions of the participants and how they relate to their activity system were uncovered.

Time Stamp	**Action**	**Description**	**Teacher/Student Talk**	**Activity Theory Elements**
6:18	Teacher introduces the multiple-choice quiz	Screen behind the teacher displays the *Quizziz* home screen.		**Rule:** Using technology in lessons.
6:33	Teacher explains rationale for the quiz	Teacher is standing at the top of the room.	**Teacher:** Don't worry if this is difficult. This is to see what we can remember or what we were able to figure out, don't worry if it's difficult it is just to see what we need to go over again or what didn't make sense the first time.	**Object:** Elicit evidence of understanding from previous lesson and to pre-assess content for today's lesson. **Rule:** Formative assessment.
7:04	Teacher loads quiz on his screen so students can access the quiz	Internet isn't working well, and the quiz takes time to load. Most students disengage, some get up to talk to others, others start chatting to the people beside them. Teacher ignores this while he tries to fix problem with quiz		**DOL:** Teacher has created this quiz. **Tool:** Technology (internet, teacher device).

8:26	Students complete quiz	Students engaging with the quiz on their own device. There are 16 questions, each with four multiple choice answers. Some students are sharing one device due to internet issues.		**DOL:** Students complete quiz individually and in pairs. **Tool:** Technology (student devices and internet).
16:00	Group discussion based on results begins	Teacher's screen displays that students got 75% of questions correct. Teacher begins to scroll through the questions to identify where students are having problems. Students have stopped using their devices at this point.	**Teacher:** Very well done. It shows we learned a lot from the last class and that we were picking stuff up…some of them were tricky and some of them we hadn't talked about, so you were trying to figure it out on your own.	**DOL**: Teacher in control of going through the answers. **Tool:** Quiz results on teacher's device projected on whiteboard, teacher's feedback.
16:28	Teacher goes through question 3 with group	Question asks about how force affects motion. Teacher's screen displays that it took students an average of eight seconds to answer this question and 53% got the answer incorrect. Little wait time given for students to respond to teacher's questions. Shouting out answers common and often undistinguishable.	**Teacher:** Do we know what friction is? **Many Students:** When two things rub together. **Teacher:** What do forces make happen? **Some Students:** Movement **Teacher:** Motion. We talked about how if force acts on an object the motion has to change. Is speed up changing the motion of something? **Some Students:** Yeah. **Teacher:** Is friction changing the motion of something? **Some Students:** No. **Teacher:** No, not really friction is actually a force that we are going to talk about. Is push a force	**Object:** Possible moment of contingency - using results to address incorrect answers. **Tool:** Quiz results on teacher's device projected on whiteboard. **DOL:** Teacher controlling discussion, class engagement poor.

			(undistinguishable responses from students) so it's not motion? Speed up and slow down are both those changing the motion? **Some Students:** Yes **Teacher:** This is the answer they were looking for the two things that motion is changing in alright, so that that was a little bit tricky.	**Rule:** Teacher only asks questions. Small cohort of students shout out replies to teacher's questions. Acceptable for some students to disengage.
17:33	Teacher goes through question 6 in detail with group	Question asks about balanced/unbalanced forces. Teacher's screen displays that it took students an average of ten seconds to answer this question and 33% got the answer incorrect. Little wait time given for students to respond to teacher's questions. Shouting out answers common coming from a small group of students and often undistinguishable.	**Teacher:** Number 4 was very well answered, number 5 was very well answered, number 6: when forces are something the object does not move. **Some Students:** Balanced. **Teacher:** Balanced very good. So, when we put the table on the floor and didn't touch it was it moving? **Some Students:** No. **Teacher:** But was gravity working it? **Some Students:** Yeah. **Teacher:** But there was also a balancing for underneath, but it doesn't move because the forces are? **Some Students:** Balanced **Teacher:** Very good	**Object:** Possible moment of contingency - using results to address incorrect answers. **Tool:** Quiz results on teacher's device projected on whiteboard. **DOL:** Teacher controlling discussion, class engagement poor. **Rule:** Teacher only asks questions. Small cohort of students shout out replies to teacher's questions.

				Acceptable for some students to disengage.
18:09	Teacher goes through question 9 in detail with group	Question asks about the forces acting on an object without touching it. Teacher's screen displays that it took students on average nine seconds to answer the question. 47% of students got the question incorrect.	**Teacher:** Two forces that act on an object without touching are, now this is something we haven't done, so this is new. What are we thinking? *(undistinguishable responses from students)* Okay what did we say friction was? Were people able to tell me? *(undistinguishable responses from students)* It's a force it's when things are rubbing off each other, when they're rubbing off, are they touching? **Some Students:** Yeah. **Teacher:** Yeah, so it is a force, but the things are touching so it won't work for this answer…So gravity, do you need to be touching something for gravity to work? **Some Students:** No. No gravity kind of works when you're not touching something when you're up in the air, and magnetism, when you put two magnets close together, are they actually touching? **Some Students:** No. **Teacher:** No but what do they do? *(undistinguishable responses from students)* They jump in together and get stuck or they push each other apart. **Student A:** It's like the pen on your surface. **Teacher:** Exactly so the pen on your surface or your Surface Pen	**Object:** Possible moment of contingency - using results to address incorrect answers. **Tool:** Quiz results on teacher's device projected on whiteboard, Surface pen **DOL:** Teacher controlling discussion, often answering his own question and/or ignoring responses. Class engagement poor, except Student A. **Rule:** Teacher only asks questions. Small cohort of students shout out replies to teacher's questions. Acceptable for some students to disengage.

			if you put a close to a piece of metal it will jump to it.	
21:09 – 27:53	Demonstration of mass and friction acting on an object. Teacher and student volunteer take part.	Teacher places a shoebox, basketball, and kettlebell on the floor at the top of the room. He gathers the students around and begins a questioning session. A student volunteer uses a sweeping brush to apply a force to each object. This student is disengaged and doesn't join in answering questions. Majority of class are paying attention to activity; many are leaning over at their desks to see the demonstration better. Teacher questions throughout. Teacher asks 49 questions during this time, on average one question every eight seconds. Little wait time given for students to respond to teacher's questions. Shouting out answers common coming from a smaller group of students and often undistinguishable. Some incorrect	**(Excerpt from 26:02-27:53)** **Teacher:** Which has more mass? **Many Students:** The basketball. **Teacher:** The basketball. So, we said if things had more mass, they needed a bigger force or a smaller force to move. *(Some students reply bigger, some students reply smaller)* **Teacher:** The kettlebell is much heavier that need a lot of force or a little bit of force? **Many Students:** a lot of force. **Teacher:** So, if the basketball has more mass, it should take more…? **Some Students:** Force. **Teacher:** Why does it not take more force? *(undistinguishable responses from students)* So, the shape of it, more specifically…? **Student B:** Surface area. *(This student is loudest, other answers are undistinguishable)* **Teacher:** Surface area touching the…? **Student B:** Ground. *(This student is loudest, other answers are undistinguishable)* **Teacher:** Ground, yes, so how much of the basketball is touching the ground all the time? **Student B:** Not a lot. *(This student is loudest, other answers are undistinguishable)* **Teacher:** Very little and as it rolls there is very little touching the ground, and how much of the box	**Object:** Teach students about the effect of friction and mass on the movement of an object **Tool:** basketball, kettlebell, shoebox, sweeping brush. Linking everyday empirical knowledge to abstract concepts. Teacher questioning. **DOL:** Teacher controlling discussion, often answering his own question and/or ignoring responses. Class engagement poor. Student B and C are engaged. **Rule:** Teacher only asks questions. Small cohort of students shout out replies to teacher's questions.

		answers ignored. Teacher answers many questions himself.	is touching the ground all the time? *(undistinguishable responses from students)* The whole bottom of it so the floor is putting a force of friction onto the object, and when there is a force of friction, does the force of friction speed up the movement or slow down the movement? **Some Students:** Slows down. **Teacher:** Slows it down, it makes things slow down okay. So, on our cars, why do cars move pretty easily on the road? **Student B:** Because we have tyres. **Student C:** Because there is only a bit of the tyre on the road. *(These students are loudest, other answers are undistinguishable)* **Teacher:** What is touching? Like is the car a heavy thing? **Some Students:** Yeah. **Teacher:** Yeah. But how much of the car is actually touching the road? *(undistinguishable responses from students)* Only a little bit of the wheels, but if we took the wheels off and we put the car flat down *(picks up the shoebox)* like this is our car we took these wheels off either side and put the bottom of the car on the ground. You think it would move pretty well? **Many Students:** No. **Teacher:** No, it would scratch along the road and move really poorly because there is much more what there?	Acceptable for some students to disengage.

			Student B: Surface area. *(This student is loudest, other answers are undistinguishable)* **Teacher:** *(Ignores Student B answer)* Much more friction. Do you agree with that? **Many Students:** Yeah. **Teacher:** Okay so guys, can you take a seat for a second? We're just going to make a note of that.	

Table 7: Dylan's Evaluative Episode

Analysis of the Evaluative Episode

Object

What was the purpose of getting the students to complete this quiz? From examining the evaluative episode, the object of this activity was threefold. Firstly, Dylan created the quiz to elicit evidence of student understanding. He did this by including two types of questions, the early questions in the quiz were based on knowledge from the previous lesson while the later section focused on pre-assessing the content for the current lesson. The second object was to use the information gathered from the quiz to address any issues that the students were having with the content on force. A strength of the first two objects was that Dylan made it explicit to students why he was getting them to complete the quiz (6:33), this would help ease student anxiety about getting the questions correct. The first two objects can be considered as techniques to enact formative assessment, where the purpose is to find out what the students know or don't know and respond accordingly based on their knowledge to improve learning. Dylan's final object was to teach students about the effect of friction and mass on the movement of an object. The third object made use of modelling to link students' everyday empirical knowledge of force to the more abstract concepts of friction and mass. In addition to the evaluative episode, in interview Dylan was asked what formative assessment meant to him in his teaching. He replied:

> "If I'm checking if the students are learning it would mean that first of all I need to see what they don't know originally and then see if they've improved on that."

So, his intended practice matched the first two objects of his activity system. He created the quiz to "see what they don't know originally" and intended to use the information gathered from the quiz "to see if they've improved on that". In interview Dylan was clear about formative assessment partly being about eliciting evidence of student learning, however both

the interview data and the evaluative episode data suggest that Dylan did not effectively enact formative assessment as he did not respond to student responses so they could improve their learning.

For Dylan's group of first year science students the object of the activity was to learn about the relationships between force, mass, and friction. This was to be achieved through completing an online quiz and watching their teacher and a student volunteer demonstrate how mass and friction affect the movement of an object. Additionally, as part of the students completing this activity, they were involved in a class discussion, something that was continuous in the latter part of the evaluative episode (from 16:28-27:52). After examining the objects of this activity system, the question now is raised if these objects were transformed into the outcomes of improved learning and responsive teaching? By careful examination of the rules, tools, and division of labour of this activity, it will be uncovered if the objects of this system were achieved or if contradictions arose that hindered the effectiveness of the activity system.

Tools

In this episode Dylan made use of a variety of mediating artefacts (tools) to reach the objects of the activity. Tools can be both physical and mental, have the ability to enable or constrain activity, and can mediate between subject and object depending on the nature of the tool (Plakitsi, 2013). The physical tools in this episode consisted of the teacher and students' device (Surface), the whiteboard at the top of the room, internet access, *Quizziz*, basketball, kettlebell, and shoebox. These physical tools had a range of different functions that were intended to reach the objects of the activity. A large selection of the tools used in this episode were technology based and much of the activity was based on the *Quizziz* app. Using *Quizziz* on the student devices allowed for students to engage with a quiz and for Dylan to get results in real time to address any issues the students were having.

Dylan created this quiz on *Quizziz* where his questions were in the form of fill in the blanks or complete the sentence. By examining the questions, it appeared that the content challenged students to think. For example, in one question students had to fill in the blank: "when forces are ____ the object does not move". The four answers students had to choose from were:

1. Unbalanced
2. Balanced

3. Heavy
4. Light

The four multiple-choice answers Dylan had created challenged students as the answers were similar and there was not one clear answer. Careful reading of the question was required as students could have easily chosen "heavy" as objects do not move as much when they are heavy. Looking at the questions Dylan created, they were set up to assess the students' prior knowledge and could be considered as formative at this stage as they were intended to elicit evidence of student understanding. However, how Dylan followed through with the class discussion did not explicitly address the learning needs of all his students. Although Table 7 showed how the technology via *Quizziz* helped Dylan to identify problems the students were having (16:28, 17:33, 18:09), how he executed the discussions beginning at 16:00 was ineffective in terms of formative assessment enactment. This was because his questioning techniques did not match how questioning should be used formatively i.e., opportunity for everyone to actively participate, time to think, and questions that require deep cognitive thinking.

The technology further hindered the activity due to issues with internet access. As seen at 7:04, Dylan's problem with internet access caused the students to disengage and begin chatting to one another. Additionally, at 8:26 the internet problem meant that some students had to share their devices with others. Completing the *Quizziz* was intended to elicit evidence of understanding from everyone, however possible misconceptions about force may not have been recorded as some students were working in pairs and having to contribute shared answers. Upon analysis it was clear that the tool was falling short of enacting formative assessment. In conversations with students during the Q activity, students spoke about the technology Dylan used in lessons but were unable to explicitly articulate how the tool improved their learning or how Dylan's used it to respond to their needs.

> "I like that we're using tablets or surfaces because it makes our learning much easier than having to learn with books we can research about stuff in class"
>
> (Greenview Student 3)

Comments such as the one quoted above were as specific as the students were about technology. Other students mentioned the applications they used including *Quizziz* but again they did not make the link as to how technology was helping them to improve their learning. This was consistent with Dylan's evaluative episode demonstrating the ineffective use of this tool to enact formative assessment.

Modelling played a role in the tools Dylan chose for this activity. In science education, models are "scientists' and teachers' attempts to represent difficult and abstract phenomena in everyday terms for the benefit of their students" (Harrison & Treagust, 1998, p. 421) . Dylan made use of physical tools (kettlebell, basketball, shoebox) to demonstrate to the students the effect of friction and mass on the movement of an object (21:09). For this modelling activity he had a student volunteer push each object with a sweeping brush, described in Table 7. These tools were intended to link students' everyday knowledge of the movement of objects to the more abstract concepts of friction and mass. If Dylan had only provided written explanations of how force effects movement instead of physical objects, it could be argued that students would have disengaged from the content as it was not applicable to them in their everyday lives. The sociocultural interpretation of formative assessment calls for making learning individualised to students and this is what Dylan intended to do by modelling the effect of force on movement. By making the learning relevant to the specific cultural context of students' lives, formative assessment enactment can be greatly increased to improve student learning (Engeström, 1987). However, analysis of the evaluative episode (21:09 – 27:53) showed that much of the class were not engaged with Dylan's modelling demonstration. The lack of engagement was attributed to the rules and division of labour of this activity system. This showed that even if a teacher is using a tool to enhance learning through modelling, unless other elements of the activity system such as the rules or division of labour are aligned with it, it is of no additional value to the students' learning. These rules and division of labour will be discussed in more detail in their own upcoming subsections.

In addition to the physical tools in the episode there were also mental tools observed. At 16:00, 16:28, 17:33, and 18:09 Dylan used the results from the quiz to provide the students with feedback and open discussions based on results. The feedback observed at 16:00 was ineffective in meeting the objects of this episode. At this time students were provided with the statistic that 75% of the questions on the quiz were answered correctly. Dylan commented on this but rather than providing feedback that would help students to address the 25% of incorrect answers, he used the time to affirm to the students the effort they were putting into this topic. While praise is important for keeping students engaged and motivated, it presents a behaviourist view of assessment, and the literature tells us that this kind of feedback isn't formative feedback as students are unable to act on how to improve based on his comment (see Chapter 2 for literature on behaviour theory). Dylan was not using this valuable feedback time

to clarify for the students what mistakes they were making and how to rectify these mistakes. Later at 16:28, 17:33, and 18:09 Dylan used the results from the quiz to open a possible moment of contingency. As many students got these questions incorrect, Dylan used this information to open discussions based on the content of the questions. Here there was some evidence of Dylan adapting his teaching to address the learning needs of his students. This is a desired outcome of a formative assessment event. Although Dylan explained where the students were going wrong, the data did not demonstrate that this moment of contingency helped to improve learning.

Teacher questioning was a tool frequently employed by Dylan in this lesson and others. Questioning is a very important aspect of formative assessment as it can elicit evidence of student learning, help to provide students with feedback, activate students as owners of their own learning, and provide for moments of contingency for the teacher where lessons can be adapted (Leahy et al., 2005; Wiliam & Thompson, 2007). Evidence of Dylan's preference for questioning was most evident through the modelling activity. There were some fundamental problems with Dylan's use of questioning as a tool for formative assessment during this period. These included Dylan asking too many questions and not providing wait time for answers, answering questions himself, ignoring responses from students, and asking lower order questions that did not challenge the students' thinking. Interview data from students substantiated Dylan's ineffective use of questioning:

> "sometimes when the teacher asks a question, if you're thinking sometimes, you wouldn't put your hand up straight away, but the people that do know (the answer) their hand is up and they'd get asked."
>
> (Greenview Student 1)
>
> "Mostly they shout out (when responding to questions) because like they just don't have patience to put their hands up."
>
> (Greenview Student 2)

During the modelling section of the episode Dylan asked 49 questions in the space of approximately six and a half minutes. That was on average one question every eight seconds. This did not allow adequate time for students to formulate an answer and express it to Dylan. Furthermore, the questions did not require a lot of cognitive demand from students. As evident from the excerpt in Table 7 (26:02-27:53), Dylan's questions often only required yes or no answers from the students and did not push their learning skills beyond recall. Another

questioning issue arose in this excerpt that showed how Dylan ignored student responses and answered the questions himself. For example, at one time Students B and C responded to a question about car movement but Dylan did not acknowledge these answers and instead asked another question. Similarly, when Student B suggested that surface area effects the mobility of a car on the road, although his answer was correct, Dylan was looking for the answer of friction and therefore ignored this student. Dylan was more interested in asking as many questions as possible rather than listening to answers and interpreting student understanding. This linked strongly to the division of labour in this episode where Dylan was reluctant to relinquish control of the class by deviating from his class plan. This was line with Dylan's interview data where he conveyed his need to plan his lessons in detail:

> How do I plan? Well, the first thing I do is I either look through a OneNote book, which is our content book, and I also have a book from a publisher, and I will look through the topic that we're discussing. Because I've never really taught the course before and I haven't really dealt with it in any detail, especially the new junior cycle curriculum, I kind of need to make sure I know myself what I am doing.

Here he explained that because he was unfamiliar with the new science specification, he is not completely comfortable enacting the new curriculum, therefore he was in control for most of his lessons as he did not feel confident enough yet to step away from his lesson plans.

Rules

Looking at the rules of an activity system, they refer to the explicit and implicit norms that influence the activity within the system (Engeström, 1993). In this episode we saw the teaching and learning rules: using technology and formative assessment in lessons. These two rules were school based, meaning that they were used to support learning and they were common practice among all teachers in Greenview. These rules are discussed in more detail later in this chapter where interview data illustrated how these rules became operationalised within the school.

Another rule observed was more tacit and involved the students shouting out answers to the teacher's questions. This rule was linked to classroom behaviour. When the students answered questions, it was often inaudible as they were all speaking at once or it was specific students (like Students A, B, and C in Table 7) that provided answers to Dylan. This rule was a behavioural rule seen throughout all observations of Dylan's lessons and rarely challenged the students to engage fully in discussion. This behaviour was linked to the teacher's professional

identity. As stated by the students in interview, Dylan was approachable, so the students were not afraid to share their thoughts with him. However, this rule also implied that whoever shouted the loudest was heard. This made it difficult for some students to engage as others spoke over them. Active engagement in learning is paramount in students improving their learning through formative assessment techniques (James, 2006). In interview one student commented on their frustration with this rule:

> "Mostly they (other students) shout out cause like they just don't have patience to put their hands up".
>
> (Greenview Student 2)

This student was not happy with others shouting out the answers before they got the chance to think about the question properly. Another student articulated something similar:

> "sometimes if when the teacher asks a question, if you're thinking sometimes, you wouldn't put your hand up straight away, but the people that do know their hand is up they'd get asked so then the answer would already be told"
>
> (Greenview Student 1)

Some students were putting their hands up straight away or shouting out answers and this meant that limited engagement was evident among many students. This was clear during observation when students unenthusiastically responded to Dylan, knowing that the question would be answered correctly by someone else, and he would soon just ask another question. Additionally, having a small cohort of the same students shout out the answers while others disengaged meant that answers were often inaudible or undistinguishable as noted in Table 7. This caused selective hearing on the part of the teacher where he sought out the correct answer and failed to address the wrong answers or the silent students. This was a potential cause for a contradiction arising between the rules of the classroom and the object of the activity which was to elicit evidence of student understanding. How was Dylan going to find out what students were thinking if he couldn't hear them or if they were not provided with the appropriate means to communicate with him?

The multiple-choice answers Dylan had created in *Quizziz* challenged students to think as there was not one clear answer. Careful reading of the question was required of students as answers were often similar with minimal distinguishing differences. Dylan set up this task to elicit evidence of learning from the students. However, as is essential with formative assessment, it is the activity that follows the tool being used that provides the conditions for improved learning by adjusting instruction in real time (Allal, 1988). Once the students had finished the

quiz, Dylan's enactment of eliciting evidence was ineffective. He proceeded to go through each question to analyse results at the top of the room where he had access to his computer to scroll through the answers. While Dylan scanned the answers some (but not all) students were engaged. Some were shouting out answers. The intention of this activity was good however Dylan was unable to keep the whole class engaged. The most vocal of the students got their voices heard.

Division of Labour

The element of division of labour in an activity system "refers to both the division of tasks and the status relations between actors" (Daniels, 2004, p. 123). Essentially it is about power and how the power is divided up among different actors in an activity system. Analysis of this episode exemplified that Dylan was largely in control of this activity. He created the quiz, analysed the results, picked what answers needed to be expanded on, lead discussions, and set up the modelling activity. Students although active in completing the quiz, were passive participants for much of the episode. There were opportunities missed by Dylan to activate students as owners of their own learning (a formative assessment strategy) in this episode. For example, the students could have been provided the opportunity to create a quiz themselves or tasked with analysing the class results and picking out areas of focus. It was evident that in discussions (at 16:28, 17:33, and 18:09) Dylan was asking questions but not allowing adequate time for students to conceptualise their answers before sharing them with the class. Furthermore, Dylan's questioning technique implied that he was always the one in control of the lesson to the detriment of his students' learning. This raised the issue of control and formative assessment practices in the classroom. Formative assessment practices require students to be actively involved in their learning however this was not evident for all students in this episode with Dylan controlling how the lesson played out and some students engaging more than others.

A big picture evaluation of Dylan's episode demonstrated contradictions between the tools, rules, and division of labour and their intended objects. Having contradictions in the activity system meant that the outcomes of the system were not being met and hindered its effectiveness at achieving the desired outcomes. It was theorised that the contradictions arose from Greenview's desired teaching, learning, and assessment practices and how they tried to implement initiatives such as formative assessment and technology. It was clear from speaking

with Dylan that he valued the in-house continual professional development (CPD) he had received in formative assessment:

> "When we've a whole school approach to assessment for learning (formative assessment), I think what's meant there is teachers are introduced to it early…One full day was going through all these methods and then they're all there. We've videos so I was in a video of using lollipop sticks that we can show, or the teachers can look at and there's a whole load of those videos…I think the school does a good job in introducing teachers to all those different methods."

And the training he received from a colleague on using technology in teaching:

> "Getting to see that work and getting to see all of the stuff you can do with it (technology), I was really impressed with that and that's really benefited me."

However, the school had failed to amalgamate these techniques leaving both initiatives falling short of being effective for student learning. For Dylan, his intended practice did not match his enacted practice for formative assessment, and data gathered from his students confirmed this. These influences on Dylan's teaching, learning, and assessment practices are expanded in more detail below

Factors Influencing this Episode

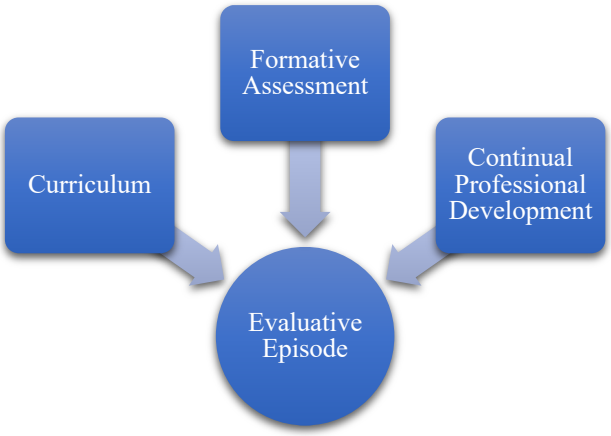

Figure 9: Factors Influencing Dylan's Practice

Within an activity system there are a variety of different factors that either hinder or facilitate the system. In Dylan's activity system there were three factors outside of his evaluative episode that had the potential to influence his activity system. They were curriculum, formative assessment, and continual professional development (CPD). In terms of the activity system triangle, curriculum, formative assessment, and CPD were considered as rules of the activity

system as they were the explicit norms enacted in Greenview. Additionally, CPD was considered as a tool as Dylan made use of what he learned in CPD during his evaluative episode. Furthermore, curriculum can be considered as a tool in an activity system however this was not the case for Dylan.

Curriculum

From analysing this episode, the enacted curriculum of Dylan's practice centred on checking student understanding using technology. At the time of data collection, a new junior cycle science specification (Department of Education and Skills, 2015b) had been implemented. This specification was considered as a rule of this activity system. The new curricular guidelines emphasised students being at the centre of their educational experiences and making their science learning relevant to their lives. *Force* in the Junior Cycle Science Specification comes under the learning outcome of *Physical World 2* that states students should be able to identify and measure/calculate force (Department of Education and Skills, 2015b). This learning outcome is short and open to interpretation by the teacher. However, the action verbs within the outcome help to specify to teachers what should be achieved by the students. In this evaluative episode, analysis showed that Dylan was focused on the first action verb *to identify*. According to the specification, to identify means that students should be able to recognise patterns, facts, or details, provide an answer from several possibilities, recognise and state briefly a distinguishing fact or feature (DES, 2015, p.25). During the quiz Dylan worked towards the following aims of the learning outcome: recognising facts, or details and answering from several possibilities. In addition, Dylan's technology used showed he was engaged with the key skills of the junior cycle where the use of technology is an integral part of seven of the eight key skills (Department of Education and Skills, 2015a).

To examine the evaluative episode in isolation, it could be concluded that Dylan was following the requirements of the science specification and enacted them accordingly, however interview data showed that Dylan didn't believe that the specification was having a significant influence on his teaching practice:

> "The curriculum change… I like the idea… the students should be more independent learners and less rote learning, and that sort of thing… I don't know if I can really comment that much because I haven't taught the old one (science course)."

Because Dylan didn't teach the former junior certificate science curriculum, he was unable to comment on whether the change in curriculum content was influencing his teaching practice. Although Dylan indicated that he liked the student-centred nature of the new specification, he could not attribute his teaching practice to that of the new curriculum alone. This provided insight into Dylan's teaching and learning philosophy. It was important for him that the students were actively involved in the learning process suggesting that he held strong constructivist beliefs about learning. However even though he agreed with the constructivist aspect of the new specification, Dylan made it clear that because the specification was new, he did not feel fully comfortable enacting it:

> "I would just pick a topic, pick an outcome, lets teach that. I think I did have to start with that anyway, I don't think I could have known the course well enough and I'm still not there yet.

Dylan signified here that he was unsure of his content knowledge with the new specification. He mentioned in interview that he was not familiar with the new content within the specification including the strand on Earth and Space:

> "I'm figuring out the course as I go, seeing what's new, all of this space and universe stuff trying to figure all that stuff out and I know no one would've really done that or taught that before. So, just trying to put all of that together."

So, Dylan was teaching the specification without having participated in professional development that would familiarise him with new content. This was in part due to the fast pace in which the specification was enacted. However, Dylan had not taken the initiative to inform himself on the intricacies of the new science specification therefore, the training he received was not entirely at fault for his lack of knowledge of the specification. He placed the onus on external sources i.e., policymakers and those involved with delivering CPD, while neglecting the agency he could have had over the specification. This gave an insight into his professional identity as a science teacher.

Analysis of school leader interview data from Greenview conveyed how the enacted curriculum of formative assessment had been well established in the school prior to the commencement of the new framework for junior cycle. The principal commented on the framework:

> "So, it's also more about learning how to learn, it's about the methodology that we use in classrooms, everyone here in this school is using those methodologies at the moment.

We will be very well placed to welcome in the new junior cycle and have been and are."

So, the curriculum enactment in Greenview was coming from the top down, i.e., a whole school initiative supposedly implemented effectively by all. Greenview was one step ahead of the framework in terms of enacting student-centred learning initiatives, however as the evaluative episode demonstrated even though Dylan was utilising formative assessment techniques through technology, both practices had fallen short of effectively enacting formative assessment to improve the learning of all and to adapt teaching to meet the needs of all students. The reason for this superficial adaption of formative assessment and technology became clearer with further analysis of the interview data discussed below.

Formative Assessment

It is important to note at this point that the staff at Greenview used the terms *formative assessment* and *assessment for learning* interchangeably. Their general understanding of formative assessment was as follows:

> "We are an assessment for learning (formative assessment) school so there would be a form of assessment happening in every class to see where kids are at, where students are at, so lessons can be tweaked and changed to meet the needs of the students throughout the lesson."
>
> (Greenview Principal)

Here the principal suggested that in Greenview formative assessment was about responding and adapting teaching, learning, and assessment practices to meet the needs of all learners. He cited how the school was a formative assessment school and had been since its inception. Therefore, as formative assessment was an explicit norm of the school, it was considered as a rule of Dylan's activity system. When probed further, the principal clarified how formative assessment was conceptualised in Greenview:

> "I suppose for a more democratic teaching environment, a more democratic classroom where the students have a lot of control of what is happening in the classroom, and they become very much in charge of their own learning. They can rely on their peers and on themselves in the skills they are developing to learn in the classroom. And the teacher is there to facilitate that or to help the student to learn the skills of learning rather than their imparting knowledge."

Looking at the principal's comments, through analysis of classroom observation and video, one would expect to see these processes being implemented effectively. However as made clear in this evaluative episode, these practices were adapted superficially. The reason for this became clearer in conversations with Dylan.

When asked about formative assessment in Greenview, Dylan's understanding of it was different to the principals. Dylan commented:

> "Assessment for learning (formative assessment). I don't know. If I'm checking if the students are learning it would mean that first of all I need to see what they don't know originally and then see if they've improved on that or see where they've come from that… I like to see if they can identify that they know more now than they did before. If we write all our stuff on a Padlet or something and say this is what we thought, is this now what we think...Just showing them their progression."

Dylan understood that formative assessment is about checking for learning and monitoring progression however he did not refer to the fundamental response and adaption aspect that follows the use of tools such as technology. This matched the data from the evaluative episode where the use of tools was to check for understanding but how they improved student learning and how Dylan responded and adapted his lessons based on the tools was unclear. Dylan was effectively setting up a formative activity where he would elicit evidence of student learning, however he did not follow through to complete the regulation of learning process where he used the data gathered to improve the learning of all students. In summary, the understanding of formative assessment from the top (the school principal and his predecessors) was precise and matched the formative assessment literature, but this was not the case when it came to the bottom (the teachers' actual teaching practices). It was summarised that Greenview's top-down model of enacting formative assessment was not effective; the next section will present the idea that the professional development experienced by Greenview teachers was contributing to a superficial adoption of formative assessment in the classroom.

Continual Professional Development

In Greenview teachers learned from other teachers in the school, through continual professional development (CPD). From the interview data it was ascertained that teachers received in-house training in Greenview in two main areas: formative assessment and technology. Additionally, teachers were subject to national subject specific training provided by the Junior Cycle for

Teachers (JCT)[10]. At the time of research Dylan had only attended one of the JCT sessions and said he found it useful, but he did not elaborate on the effectiveness of this training in preparing him for teaching the new science specification. For technology in Greenview, CPD took the form of a cascade model (Kennedy, 2005) where a teacher would attend training individually and disseminate the information to other colleagues in their school. Dylan spoke about this in interview when discussing his use of technology in science lessons:

> "in our school, we would've done a lot of different workshops and different things with colleagues, and they would've shown you what worked for them and what didn't work for them. That's where I've picked up things like *NearPod* and *Padlet* and all those sorts of stuff, the first place I saw them was through colleagues."

For formative assessment, the school utilised a transmission model for CPD. This came in the form of online videos made by the teachers, and CPD sessions on formative assessment (also delivered by teachers in the school). Dylan explained:

> "if new teachers come in, they will be shown methods that the school likes for assessments for learning…. So, using lollipop sticks, using whiteboards, using table mats, using the snowball, think pair share, all of these are introduced, and teachers can pick and choose what they like."

His comments above proved insightful in terms of the tools for formative assessment in Greenview. He conveyed how he reduced formative assessment to basic tools that were intended to be part of the regulation of learning process however as the evaluative episode demonstrated his tool used was ineffective in regulating learning. For example, using lollipop sticks helps to pick students at random to engage with teachers' questions, but the true value of formative assessment is using the student responses to identify gaps in knowledge and respond accordingly. Dylan also spoke of in-house training where teachers in the school were "showing those formative assessment ideas through the device so using *Quizziz* and using the *Kahoots* and all those sorts of things." In Greenview they had attempted (through CPD) to blend formative assessment practices with technology. Dylan credited his professional practice to the professional development he received when joining Greenview:

> "If I was in a different school and I wasn't introduced to all those things quite early I don't think I'd be teaching the way I'm teaching now."

[10] The Junior Cycle for Teachers (JCT) is a dedicated continuing professional development (CPD) support service of the Department of Education and Skills. Their aim is to support schools in their implementation of the new Framework for Junior Cycle (2015) through the provision of appropriate high quality CPD for school leaders and teachers, and the provision of effective teaching and learning resources (Kirk, 2017).

His comment above suggested that Greenview had a culture of teaching, learning, and assessment that they wanted teachers to engage with. Therefore, CPD was considered as a rule of Dylan's activity system because it was facilitated in-house and mandatory for new teachers. CPD could also be considered as a tool in Dylan's system as he had converted the rule of attending CPD into enacting what he learned during his teaching, learning, and assessment practices, be it not so effectively as per his evaluative episode in Table 7. The data suggested there was a range of professional development opportunities provided by Greenview for teachers, but analysis of the evaluative episode demonstrated that the two big initiatives (formative assessment and technology) were still not working in tandem to improve student learning. It was deduced that because the school was trying to promote two different whole school initiatives neither formative assessment or technology were given adequate time for meaningful engagement or enactment.

Conclusion

By analysing a single evaluative episode, the detail of a dynamic and interchanging activity system was explored to apply an analytical lens to the objects of the episode. With Dylan, the analysis demonstrated that there were several contradictions occurring in his activity system. The main contradiction was concerned with Dylan's intended and enacted practice: Dylan set up his formative assessment activity well but did not follow through in using the information gathered to help students move forward in their learning. This was due to several constraints including the training he engaged with in Greenview, and how he interacted with the students i.e., not all students were required to engage as whoever shouted the loudest was heard. Returning to the object|outcome dichotomy, the object which was used to elicit evidence of student learning and use the information gathered to teach about force, was not achieved in full. He effectively used *Quizziz* to elicit evidence of understanding however his follow up activity did not help students to improve their learning of force.

6. Case Study 2: Technology, questioning, and developing students' learning skills

Introduction

Matthew is a teacher of biology, chemistry, and junior cycle science in Ireland. At the time of data collection, he was teaching for 15 years, the past nine in Oakpark. He began his teaching practice in the United Kingdom where he had trained as a teacher, he then moved to the Middle East to teach and finally settled in Oakpark. Matthew was a high energy teacher and spent most lessons pacing the room, asking questions, and trying to keep his high energy class from getting distracted and misbehaving. Regarding formative assessment, during interview Matthew spoke about three techniques he used for enactment: technology, questioning, and what he referred to as "coaching" to develop students' learning skills. There was some evidence from fieldnotes and video only that Matthew was utilising what he referred to as "coaching" the students to develop their learning skills, however upon deeper analysis of the video and student data, his use of technology and questioning were limited in their effect on student learning. This was contradictory as in interview he conveyed a strong passion for using technology in his practice, however this was not observed during his lessons.

The purpose of examining Matthew's evaluative episodes was to uncover the factors that were promoting or inhibiting formative assessment enactment in his classroom. Analysis of the interview data revealed that Matthew wanted his students to develop their learning skills. This has a clear link with the formative assessment strategy of activating students as owners of their own learning (Wiliam & Thompson, 2007) however when all the data were pieced together, Matthew's practice was not facilitating this. There were several elements within his activity that were constraining formative assessment enactment including his approach to the division of labour (i.e., lack of student active involvement), low level misbehaviour in the classroom, parental influence, and timetable issues. Looking at what had the potential to promote his formative assessment practices, Matthew's biggest issue was keeping all students actively engaged with their learning. In addition to his use of technology, a more consistent approach to questioning had the potential to enhance his formative assessment practices. Matthew's activity system is presented in Figure 10. However, contradictions were evident that were constraining his formative assessment practices. Presented next are two evaluative episodes from Matthew's lessons which are intended to illustrate his practices in detail to determine the

level of formative assessment enactment. It is not uncommon to select more than one evaluative episode to communicate the object of an activity system as demonstrated in Hardman's work (2007).

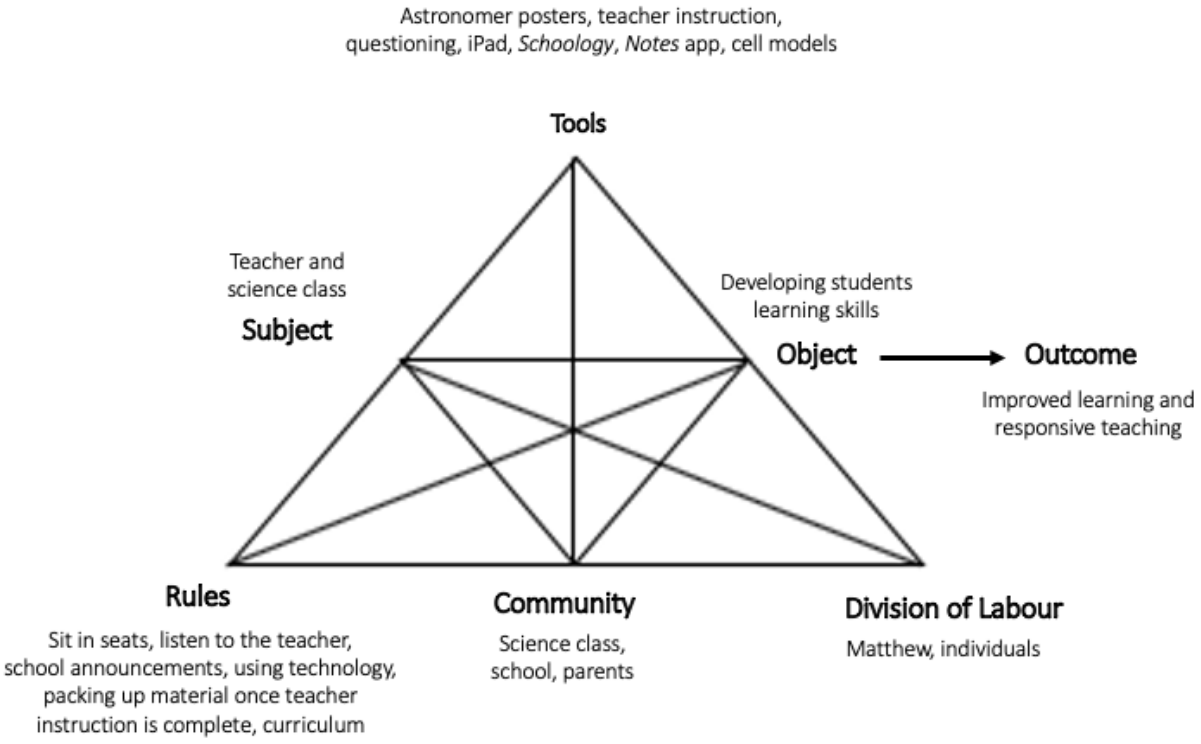

Figure 10: Diagrammatic representation of Matthew's Activity System

Matthew's Evaluative Episodes

The following two episodes are characterised by the teacher intending to "coach" the students' learning skills i.e., their self-regulatory skills. According to Nicol and MacFarlane-Dick:

> "self-regulation is manifested in the active monitoring and regulation of a number of different learning processes, e.g., the setting of, and orientation towards, learning goals; the strategies used to achieve goals; the management of resources; the effort exerted; reactions to external feedback; the products produced."
>
> (2006, p. 199)

Thus, these episodes were evaluated to ascertain if active monitoring and regulation of learning processes were enacted. Data for the evaluative episodes were based on fieldnotes and video. Additionally in the analysis of factors influencing the episodes sections, teacher, school leader, and student interview data were included to expand the picture of Matthew's enactment of formative assessment.

Episode 1: Reflecting on Earth and Space

In Episode 1 Matthew was conducting a recap of a lesson on *Earth and Space 1*[11]. Throughout this lesson students were tasked with researching and presenting on famous astronomers in pairs. Engagement in the task was mixed with some pairs working well and others disengaging due to the long-time frame set for the task (30 minutes). This episode began with Matthew getting students back to their seats and standing at the top of the room recapping the lesson. He spoke about what they had learned in the lesson and what they needed to complete for homework.

Time Stamp	**Action**	**Description**	**Teacher/Student Talk**	**Activity Theory Elements**
02:57	Students move back to their seats after project work.	Students are moving back to their assigned seats and chatting among themselves. Teacher tries to quieten the students down and settle them for the next task	**Teacher:** Are you done? *(Waits for students to return to seats)* So what I will do is I will take the pictures off you. *(the pictures are the astronomer posters the students have been working on in pairs).* So, you should have ten pictures of different astronomers. Your job now is this, are we listening? So, eyes and ears.	**Rules:** Students need to be in their seats. Students are to listen to the teacher. Low level misbehaviour by students **Tool:** Astronomer posters.
3:31	Teacher sets up homework tasks.	Teacher outlines that he wants the students to think about their learning in this lesson. Some students are paying attention, others are still chatting. He struggles to keep them engaged.	**Teacher:** Guys are we still listening? *(he is struggling to keep them engaged)* The other thing you have to do is on Schoology there is an assignment as well that should have popped up on the side on astronomers in history. So, your job for next week is to make sure you do the assignment, and you fill in that table. So, think about what we	**Object:** Student understanding of homework tasks. **DOL:** Teacher leading the instruction. **Rules:** Listening to the teacher.

[11] This learning outcome comes from the Science Specification for Junior Cycle (Department of Education and Skills, 2015b) and requires students to describe the relationships between various celestial objects including moons, asteroids, comets, planets, stars, solar systems, galaxies and space.

			have done, so think about you're learning in today's class. What do you think…can you sit down for me I just want to bring this together? So just have a look this way now please guys, let's bring everything together for this class. *(Students getting distracted)* just wait five minutes and we can call it quits then alright? Just focus on me now, thank you. So, what we have done in this class… think about where we started. We started with a picture or a video of people in space. So, we got from people in space to the theories of space. So, we have said yeah, the sun is what we believe to be in the middle and everything goes around it and what you guys should have learned by listening to the different presentations is the two common theories. One theory was that the earth was the middle and everything revolved it. Then a few scientists kind of said yeah that's the case then a few astronomers came along, observed stuff in the sky and said no this doesn't make sense, everything is kind of moving around, maybe it's the earth that's moving, that's what gave us the observations we have. So, the theory that is commonly accepted now is the planets, the earth, we all orbit the sun. So, your job is now to reflect on that…	Low level misbehaviour by students. **Tool:** Teacher instruction based on astronomer posters.

5:00	Intercom announcement.	Teacher is interrupted by an announcement by the principal on the intercom. The announcement is about general school news. Teacher looks visibly frustrated, he has his hands on his face, checks the time, and waits for the announcement to finish.		**Community:** Inform students of school news **Tool:** Intercom **Rule:** School announcements during lessons **DOL:** School principal reading out announcements.
6:38	Teacher restarts his explanation of homework tasks.	Teacher is anxious about the time left in the lesson to explain the homework; however, he is interrupted again by a student misbehaving.	**Teacher:** Okay guys we need to get this done. Just to wrap up then. So, the commonly accepted theory is then… *(A student then blows his nose loudly and gets out of his seat, the teacher is once again frustrated asks student to sit down while other students laugh)* So the common accepted theory is now everything goes around the sun. Your job is twofold for next week. Number 1: fill in the table, two scientists are missing, your job is to find out information and fill it in. Second job there is an assignment that has to be done as well so that you can do on word and submit, or you can type into the textbox and submit that way. So, the rubric tells you what I am looking for.	**Object:** Student understanding of homework tasks. **DOL:** Teacher leading the discussion. **Rules:** Listening to the teacher. Low level misbehaviour by students. Using technology. **Tool:** Teacher instruction. iPad, Schoology.
7:30 – 8:30	Students packing up their	Students cannot find the work to be completed on Schoology. Teacher and student discuss the	**Teacher:** I'll have a look now, look if it's not popping up, I'll put it up	**Object:** Student understanding of homework tasks.

	belonging to go home.	homework. Students pack up their belongings in preparation to go home.	**Individual Student:** Sir so we have three assignments for next week? **Teacher:** Yes, you have a lot of work because I see you only once a week so manage your workload in the week that you are off. Any excuse! *(he is laughing with the student, he then reminds all students about the tasks)* It's the table and the assignment on Schoology, it will pop up in a few minutes. *(Students start to pack up, teacher checks one student's iPad)* The assignment is there.	**DOL:** Teacher leading the discussion, one student asks a question. **Rules:** Asking teacher questions is acceptable. Using technology. Packing up material once teacher instruction is complete. **Tools:** Teacher instruction, iPad, Schoology.

Table 8: Matthew's Evaluative Episode 1

Episode 2: Reflecting on Specialised Cells

In Episode 2, students were asked to think metacognitively about what they learned from carrying out a project on specialised cells, based on the learning outcome *Biological World 1*[12]. In the lead up to this episode the students had taken a picture of their specialised cell model, uploaded it to a shared *Padlet*[13], this was displayed on the board so students could see each other's work. They were then asked to review and write a short synopsis about four other students work using their iPads. This evaluative episode began after they had completed these tasks.

[12] This learning outcome states that students should be able to investigate the structures of animal and plant cells and relate them to their functions (Department of Education and Skills, 2015b).
[13] Padlet is an application that is best described as an online noticeboard. Participants can add text and resources to share with a group, in this episode it was the science class and teacher.

Time Stamp	Action	Description	Teacher/Student Talk	Activity Theory Elements
37:40	Teacher sets a task of reflecting on a specialised cell project	Teacher is trying to get the students to think metacognitively about how they learned during the specialised cell project. He opens a discussion about specialised cells where he questions students both individually and as a group. The whole group is not engaged fully in the task, some behaviour issues are apparent. The teacher must clarify several times what exactly the task is he wants them to do now.	**Teacher:** Think about what I wanted you to learn, so Student A, what was my aim of that, we had about forty minutes there of stuff, what was my aim, what did I want you to learn? **Student A:** Other people's cells and what they do. **Teacher:** Other people's cells yeah, that is a good start, we wanted to learn about other people's cells. Student B what else did I want you to learn? **Student B:** The different *(pauses)* the different types no *(pauses)*. **Teacher:** Good you're getting there. *(Student B pauses, again several students have their hands up to answer)* Go on Student C, help him out. **Student C:** The different types of specialised cells and what they do. **Teacher:** Yeah, specialised cells, and all of you learned what Student D, that a specialised cell? *(Pause)* Think about everyday life, *(students reply is inaudible due to some chatting amongst the group)* so in our everyday lives how do we compare a specialised cell to our everyday lives? *(Student D does not reply, little wait time given until teacher intervenes next.)* So, what did I say, does everyone in the world do the same job that is what I am saying to you?	**Object:** Students are to reflect on their work. **DOL:** Teacher asks the questions, students reply. **Rules:** Listening to the teacher. Answering questions Low level misbehaviour by students. Using technology **Tools:** Teacher questioning, model of a cell, iPad, Notes app.

			Student D: Yeah **Teacher:** So, everyone in the world does the same job? **Student D:** No. **Teacher:** No, so give me some examples of jobs that are specialised. *(One student is trying to distract the group and the students laugh, teacher just looks at him and the student returns to his seat)* Sorry Student D you were saying? **Student D:** Doctors Teacher: Doctors would be one specialised job, another one for white blood cells? *(This question is directed at the whole class)* What did we say white blood cells were Student E? **Student E:** Army. Teacher: Army. Say we had to compare the poll *(pointing at a model in the room)* what would our nerve cells be like in our everyday lives? *(Students are thinking, again little wait time given.)* Who carries messages in our everyday lives? **Some Students:** Postman. **Teacher:** The mail basically. So that's…shh *(trying to quieten students)* alright so guys this is your final task, I am going to move on and go back to space. So, think about what you learned and how you learned it. So, you learned about specialised cells how did you learn about the different specialised cells, so think about the different activities	

			that you did. I will give you five minutes to do this starting now, off you go. **Student F:** Like on Notes *(referring to the iPad app)* **Teacher:** Yeah, on your apps like you normally would, and then we are going to go back to space alright let's go. *(He must clarify again where the students are writing their answers on the iPad.)*	
39:37	Tasks begins but is interrupted by an administrative job the teacher needs the students to complete.	Some students are working on their devices using the *Notes* app, others are chatting. He has an administrative task to complete so he interrupts this task for 5 minutes. Once he has this complete, he moves back to the reflection task.		**Object:** Complete administrative task and return to reflection task promptly. **Rule:** Low level misbehaviour by students.
44:27	Students return to the reflection task	The administrative task ends, and students begin to start asking the teacher about the reflection task. There is still some confusion about the task. Teacher uses questioning and an explanation to clarify the task. Some students are chatting amongst themselves and not working on the reflection task. He must keep talking to individual students to	**Student G:** Sir I can't really remember the activities we did to learn about cells. **Teacher:** So, what kind of stuff did you do to learn about specialised cells? *(Student G's response is inaudible due to other students chatting).* In this class what did you do? **Student G:** Oh today? **Teacher:** Yeah, just now. **Student G:** Okay. **Teacher:** *(To the whole group he repeats the instruction)* Think about what you learned and how you learned it. *(He also repeats*	**Object:** Students are to reflect on their work. **DOL:** Student G interacts with teacher. Teacher gives instruction. **Rules:** Asking teacher questions is acceptable. Low level misbehaviour by students.

		get them back to work and reiterate the task.	*this to some individual students, then directs a question to another individual student)* So you learned about specialised cells how did you learn it? What kind of stuff did we do? *(He gets the student to answer these questions on his iPad)*	**Tool:** Teacher questioning, iPad, Notes app.
47.56-48.22	Teacher ends reflection task	Teacher informs the students they are finished with the task, there is no more input from the students on their reflections. Teacher gives students instructions as to how their models will be assessed.	**Teacher:** We're going to move away now from cells and go back to E&S1. Cells is done now; we had a good review of peoples work and we've learned about specialised cells. Now if you made models for your cells guys, leave them on your desk at the side, I will collect them at the end of the day. Make sure your name is on there so I can then assess them for what I am looking for, and then on Schoology you will be given feedback.	**Object:** Move on to next section of the lesson. **Tools:** Student made models, Schoology**.** **DOL:** Teacher leading the instruction.

Table 9: Matthew's Evaluative Episode 2

Analyses of the Episodes

In terms of activity, Episodes 1 and 2 were about coaching students' learning skills by reflecting on learning:

> "I think I'm coaching, that's what I'm doing. I'm teaching don't get me wrong but I'm coaching them into how I want them to think… it's me driving the learning, saying this is what we're doing, here's the activity, here's a way of solving it. So, they have some skills to then solve problems down the line. So, it would be kind of coaching I suppose is what I'd be doing." (Matthew)

His comments in interview were considered as his intended formative assessment enactment. Now the analysis of the evaluative episodes examines if his intended and enacted practices were in line, or if contradictions existed among them. In terms of formative assessment, in both episodes he was trying to enhance their self-regulation skills through the formative

assessment strategy as activating students as owners of their own learning (Wiliam & Thompson, 2007)

Object

In Episode 1 there was one main object: students' understanding their homework (3:31, 6:38, 7:30). At 3:31 Matthew began to explain what the students need to complete for homework which included a reflection task. Reflection tasks link to the formative assessment strategy of activating students as owners of their own learning (Harrison, O'Hara, & McNamara, 2015), tie in with Matthew's approach of "coaching" and present a constructivist view of teaching, learning, and assessment, where knowledge and understanding is constructed step by step (Piaget, 1971). However, it became apparent throughout Episode 1 that Matthew did not successfully reach this object due to several constraints including an interrupting school announcement (5:00) and an array of classroom rules that hindered Matthew effectively explaining the homework.

Episode 2 illustrated three objects, the first and main object was student self-reflection (37:40), the second object was Matthew completing an administrative task and returning promptly to the reflection task (39:37), and the final object was to move on to the next section of the lesson (47:56). At the beginning of the episode Matthew began explaining how the students would reflect on their work by discussing this with them, however his attention was pulled in a different direction when he realised, he had an administrative task to complete. Analysis of the episode showed that Matthew's object was students' self-reflection however the introduction of a conflicting object (completing an administrative task) meant that the initial object was not achieved. Because of this interruption, like Episode 1, Matthew had to reiterate the task once again he set for students. The incidences beginning at 39:37 were exemplary in demonstrating how two different objects cannot run simultaneously in an activity system and reach the intended outcome. Changing the object mid task was detrimental to student learning as it led to the students being confused about what needed to be completed. The main object of this Episode 2 was to develop students' self-regulatory skills but like Episode 1 this was not achieved. What follows now is a careful examination of the rules, tools, and division of labour (DOL) of Matthew's activity system to explain why these episodes did not reach their intended objects and outcome.

Tools

In the above episodes Matthew made use of both physical and mental tools to reach the object of the activity. Tools are employed as a means for the subject to reach the intended object, and even if the object of activity is not actualised, the tools still need to be analysed in terms of how they enable or constrain activity. Like Dylan in Greenview, the physical tools in Matthew's episodes consisted of the teacher and students' device (iPads), the whiteboard at the top of the room, internet access and a device application. In Episode 1 the device application was *Schoology*, a social networking service and virtual learning environment that allows users to create, manage, and share academic content. The use of the application was limited in Episode 1 where Matthew explained that the homework was on *Schoology* and students checked *Schoology* for the homework. There was limited evidence for the extent to which the technology was helping to achieve the object of activity in this incidence. More information on the school's use of *Schoology* is uncovered later in the factors influencing the episodes.

Matthew made use of models of as physical tools in his two episodes. In Episode 1 the posters the students had created on famous astronomers were intended to scaffold their homework activity as they were to complete a similar activity at home. Scaffolding (Bruner, 1976) is a key premise of both formative assessment and social constructivism whereby tasks be first undertaken together then separately to expand on student learning. This tool (the models) can be considered as promoting the object of the activity as it was a basis for student reflection as seen at 3:31. The posters created by students described the key ideas of famous astronomers on the structure of the solar system. Matthew based his discussions at 3:31 onward on this work that they had completed in class however he was then interrupted by a different tool that constrained the effectiveness of the posters.

In addition to the physical tools observed in the evaluative episodes, there existed two mental tools intended to reach the outcome of these episodes, these were teacher instruction and questioning. In Episode 1, teacher instruction was used extensively to help students understand their homework task. However, it was extrapolated that there was instruction overload by the teacher leading to student disengagement. This was evident at 3:31 where Matthew gives instructions for about a minute and a half as to what is to be completed for homework. This kind of instruction overload can be detrimental to student learning as too much information in a short period can cause disengagement and confusion (Rosenshine, 2010).

The other mental tool analysed was teacher questioning. Effective questioning is a key technique for formative assessment (Black & Wiliam, 1998b; Leahy et al., 2005; Wiliam, 2013). Implemented correctly, questioning can help to elicit evidence of student understanding, actively involve students in the learning process and hep to reconcile problems or misconceptions students may have. Questioning was frequently spoken about by Matthew in interview:

> "But like…so what I would do is I would …I would go away from putting hands up now, it's more …you do differentiated questions depending on the ability of the child. So obviously once I get to know the students better you could really prod in and go more specific with the questions. So, it would be just a …you know Jamie what you think of this and then you could ask a more critical level question to somebody who has a bit more ability. So, you kind of then…everyone is pushing each other by the way they answer."

Taking his comments into consideration, there was a contradiction between Matthew's intended use of questions and his enacted questioning techniques. His use of questioning as a tool in the activity system was most apparent in Episode 2. At 37:40 he used questioning to ascertain what students learned from the specialised cell project. Although his questions were low order i.e., did not require deep thinking on the part of the student, he was effective in getting students to answer questions by randomly calling on students and getting them to expand on their peers' answers. This is referred to as basketball questioning where students are building on other students' answers (Wiliam, 2009). In total he involved six different students in this questioning activity, about one third of the class. The logic of basketball questioning is that all students are engaged in case they are randomly asked a question, but the episode showed that there was still disengagement in this activity. However, he used no hands up demonstrating that he tried to get students engaged in the lesson. No hands up is a questioning technique used by teachers to randomise who answers their questions. It requires the students to not put their hands in the air to answer questions. This ensures that all students must think about answers rather than waiting for some students to put their hands up to be picked by the teacher. Looking at the qualitative data from Matthew's students, they were split on their opinions on their teacher's questioning techniques. For example, Oakpark Student 5 spoke about Matthew's basketball technique and randomisation:

> Oakpark Student 5: He never asks us questions that we all answer. He just picks us individually.

Interviewer: What happens if you don't know the answer to a question and he asks you?

Oakpark Student 5: He just says is anyone else able to help him?

Interviewer: Does he ask the same students all the time questions or does he change it up?

Oakpark Student 5: No, he changes it up all the time.

Whereas others spoke about how they had to put their hands up to answer questions and often it was the "smarter" students who got selected to answer:

> "Sometimes he picks people in particular but most of the time he just asks us to put up our hand. Then if someone answers he asks the rest of the class, do you agree with them and if we do, he just says if it is right or wrong."
>
> (Oakpark Student 1)

Interviewer: Why do you disagree with the statement: *the teacher asks questions that we can all answer*?

Oakpark Student 2: Because some people might be at a different level than others and some people might be smarter than others and maybe don't understand it as well.

These comments illustrated how Matthew was not consistent with his questioning techniques and needed more consistent questioning approaches to help students actively engage with their science content.

In another incidence at 44:27, Matthew was observed breaking down a task to help student understanding. He challenged students to think metacognitively about the lesson by asking the group "how did you learn it" and "what kind of stuff did we do"? This was a good example of Matthew coaching the students' learning skills through the reflective task, however as there was low level chat among students throughout, this signified that not all students were fully engaged with the questions asked. At 47:56 Matthew suddenly called an end to the task by telling the students they were moving on to a new topic. This was an opportunity missed to expand on the metacognitive task by engaging in a discussion about their learning. So, in this episode Matthew set out to activate students as owners of their own learning but fell short of enactment by not allowing enough time for the task. This was in line with student interview data where Matthew's students did not speak about how Matthew coached their self-regulation skills when they were discussing self-assessment:

Oakpark Student 4:	When we have exams, I study and I kind of create mini tests for myself so then I can learn. I look through all the information, I read out all the questions that would probably be on the exam and then get it right.
Interviewer:	Where did you learn to do that? Did you come up with that yourself?
Oakpark Student 4:	Yes.
Interviewer:	Did anyone in school help you?
Oakpark Student 4:	No, I came up with it myself.

Like the students' views on questioning, Matthew's coaching of self-regulation skills was not fully embedded in his practice.

Rules

Rules mediate the relationship between the object and the community (Hashim & Jones, 2007), the implicit or explicit rules set forth by a community will either promote or inhibit the effectiveness of the object. In Oakpark there were several basic classroom rules that were observed including listening to the teacher, sitting in seats, and packing up materials once teacher had finished with instruction. These rules would be commonplace in second level classrooms in Ireland. Additionally, there were school specific rules observed in Oakpark that were mediating the relationship between the object and the school community. These rules included the use of technology, asking and answering questions on the part of the student, principal announcements, and low-level misbehaviour.

In terms of what was observed in the evaluative episodes, the rule of using technology to enhance learning was minimal. A full discussion of Matthew's use of technology as a tool was discussed previously in the tools section (p. 171) however it is important to remember from Chapter 2 that the elements of an activity system can exist twice, in this case technology was both a tool and a rule. Like Greenview, technology was central to teaching and learning in Oakpark. It was a one-to-one device school where each student had an iPad and access to the learning platform *Schoology*. The principal commented how the school was a part of a national digital strategy trial which was gathering data on technology use in the classroom. Therefore, not only was technology a tool for formative assessment in the school, but it was also a rule as it was brought in on a whole school basis to replace textbooks. The principal spoke of

technology use to move away from textbooks and of it being a focus of their school's self-evaluation[14] initiative that year. However, it was not an easy integration of technology as a lack of cohesion before the use of *Schoology* meant that teachers were using different platforms for resources and because of this the parents were unhappy with the introduction of devices in the school:

> "So, we didn't really think it through…we didn't know what to do. So anyway, people started using their own means of storing information and uploading this and all the rest of it. We ran into problems in the November because it came to the first set of house exams and the first years had nothing to study because they had no books, they had no notes anywhere because different teachers had done different things and the parents went bananas and said what's going on here and we said ok this can't work, and some people had been using different platforms."
>
> (Oakpark Principal)

This demonstrated the influence a community can have on the teaching, learning, and assessment practices in a school. Once they began using *Schoology* throughout the school the principal believed that it was beneficial to student learning:

> "once we put it in place and gave the staff some training on it, it just transformed everything because students now could access notes and stuff, so revision all that type of thing. It was a relief for the parents and for the teachers and for the students"
>
> (Oakpark Principal)

Although the principal began by explaining formative assessment in the school through technology, the above quotation did not explain how the iPads and *Schoology* were helping students to improve their learning beyond giving them access to resources at home. For the principal, the technology was just a substitute for a textbook. This was also evident in the student data where they referred to their iPads and *Schoology* to access resources at home:

Interviewer:	Do you think that *Schoology* is beneficial to your learning?
Oakpark Student 3:	Yes, because if you forget something in science then you can go back onto the app and do that and you can look through the notes of what you have learned.

[14] "School self-evaluation is a collaborative, inclusive, and reflective process of internal school review. An evidence-based approach, it involves gathering information from a range of sources, and then making judgements. All of this with a view to bring about improvements in students' learning" (Department of Education and Skills, 2021)

Interviewer:	Do you find having Schoology helpful for science?
Oakpark Student 4:	Yes.
Interviewer:	What is helpful about it?
Oakpark Student 4:	You can put down all the work that you have to do on it because some of the folders say you need to do this and get the work done, because we don't have that much time to do science during the week, so on Tuesdays, we have to do some notes on videos or some work that he puts on Schoology.

Interviewer:	Do you like using the iPads in class?
Oakpark Student 6:	Yes, I do because it is easier than just giving out loads of books and then collecting them all up. You can just say ok it is on Schoology, and you can just go into it. Say if your teacher was stuck on something, if he didn't know what the answer was, he could say can one of you look up the question on the iPad and tell me. "

With Oakpark Student 6 there was some evidence to suggest that Matthew was putting the division of labour for learning back on the student and this demonstrated good student-centred practice i.e., activating them as owners of their own learning, however the data collected did not clearly link the rule of technology with improving student learning. The students commented that having an iPad and access to *Schoology* was helpful for them to source material however, the data suggest that within the activity system, the rule of technology and the outcome of improved learning were in contradiction with one another.

In Episode 1 the school rule of principal announcements was observed. This rule hindered the object of the activity as it disrupted the learning and caused the students to disengage in the task they were being set. When examining formative assessment practice and the factors that promote or inhibit it, this rule was an emergent factor not foreseen by the researcher. Interestingly, a study concerned with organisational practices in schools found that in schools where student achievement was above expectations the school was much less likely to use intercom during lessons (Stringfield & Teddlie, 1991). Additionally other research cites how intercom announcements are the third most common type of interruption in classrooms and they occurred most frequently in the afternoon, particularly during the last period (Kraft & Monti-Nussbaum, 2020). In the case of Oakpark, this school rule was hindering formative

assessment practices by interrupting teacher instruction. Of note also was that Matthew only had this class once a week at the end of the day and announcements during the last period meant that his teaching was disrupted for some time during every science lesson with his first-year group. However, it was ineffective planning on Matthew's part as he was aware that there would be this same interruption to his lesson each week but did not prepare for it.

Division of Labour

Within an activity system, the power and tasks of the system are divided among the different subjects of the activity system, this is referred to as the division of labour. As Matthew's technique for formative assessment was about getting students to self-regulate their learning, it was expected that the division of labour in Matthew's evaluative episodes would be distributed among individual students, groups of peers, and the teacher. This was not the case. Although in each episode the intended division of labour was to lie with the individual student and their reflections on their learning, this was not clear. For example, in Episode 1 at 3:31 and 6:38, it was the teacher who was guiding the learning by instructing the students on their homework task. It was not until 7:38 that one of the students got involved in this activity. Matthew's intention in interview was to take a step back from controlling lessons and providing time for students to take ownership of their learning:

> "like I try and reduce my talking time to a maximum of 10 minutes and then it should be them working and then reflecting and getting better. So that would be what I would like to do ideally."
>
> (Matthew)

However, the observation data illustrated that he was the person taking control of the learning in his lessons. Similarly in Episode 2 at 37:40 it was Matthew who was asking all the questions and the students were replying to him. Additionally, at 44:27 only one student took control of his learning to ask the teacher a question, and the teacher took control of answering this student's question. This was a missed opportunity for Matthew to put the division of labour back on his students and encourage them to develop their learning skills by helping each other answer questions. However, in Episode 2 at 37:40 Matthew did get Student C to help Student B when Matthew asked them what he wanted them to learn in the specialised cell task, yet this isolated incidence was not enough evidence to show that the division of labour was more student focused than teacher centred.

The purpose of analysing Matthew's evaluative episodes through the lens of activity theory was to ascertain whether the techniques he used for enacting formative assessment were being enacted in his lessons. To recap, Matthew cited three techniques for formative assessment in his lessons: technology, questioning, and what he referred to as "coaching" to develop students' learning skills. Of these three techniques, the evaluative episodes highlighted Matthew's intention to coach his students' learning skills. Technology and questioning featured in these episodes also. Looking at the bigger picture as to whether Matthew was effectively "coaching" his students' learning skills, it was concluded from the episodes that there were several factors inhibiting successful enactment, namely ineffective teacher instruction and lesson interruptions. In general, it was noted that technology did not play a defining role in formative assessment enactment in Matthew's lessons and although he spoke about the importance of questioning:

> "That's what formative (assessment) would be for me, it's just asked the differentiated questions at different levels and then just identify areas of weakness and then do something about it."

There was a contradiction between his intended and enacted questioning practices. The next section will look at factors external to the evaluative episodes that had an influence on the teaching, learning, and assessment practices in Matthew's science classes, and in Oakpark in general.

Factors Influencing the Episodes

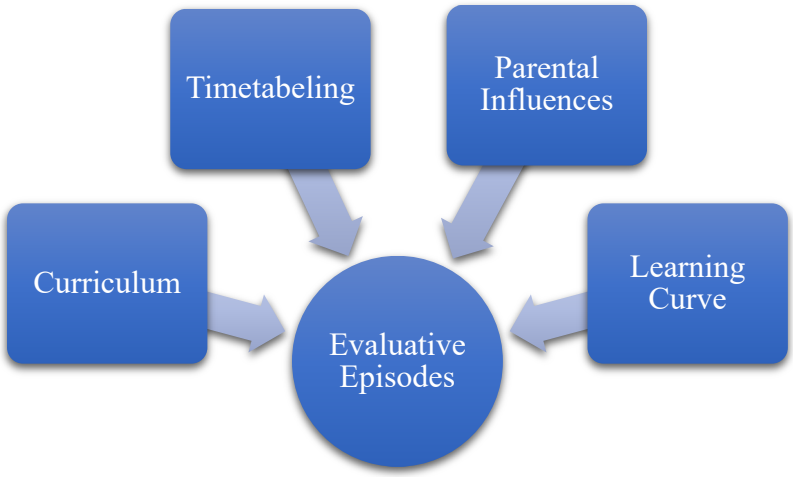

Figure 11: Factors influencing Matthew's Practice

For Matthew's activity system there were three main factors influencing his practices that had the potential to influence his activity system. These were curriculum, timetabling, parental influences, and a module taken by first year students in Oakpark known as *Learning Curve*.

Curriculum

At the time of research, Matthew was implementing a revised science specification as part of the Junior Cycle Framework (Department of Education and Skills, 2015a). This specification was considered as a rule of this activity system. From the specification, Matthew's class were covering two different learning outcomes, Episode 1 centred on Earth and Space 1: *describe the relationships between various celestial objects including moons, asteroids, comets, planets, stars, solar systems, galaxies and space*, while Episode 2 focused on Biological World 1: *investigate the structures of animal and plant cells and relate them to their function* (Department of Education and Skills, 2015b). For Episode 1 the action verb required students to be able to develop a detailed picture or image of, for example, a structure or a process; using words or diagrams where appropriate; produce plan, simulation or model (Department of Education and Skills, 2015b). Looking at this episode, it was clear that Matthew was working on helping students develop an understanding of the structure of the solar system and students were using words (through poster) to reach this Learning Outcome.

In Episode 2 Matthew was extending the boundaries of the Learning Outcome Biological World 1 that required the students to investigate the structure of basic animal and plant cells. According to the specification, teachers are allowed to "employ a variety of teaching strategies depending on the targeted learning outcomes, the needs of their students, and their personal preferences" (Department of Education and Skills, 2015b, p. 13). Matthew enacted this by getting students to complete project work, thus linking to the Nature of Science Strand of the specification. It was the intention of the specification for strands to overlap and for teachers to exercise a level of freedom on class content not previously accommodated in the previous science curriculum. Having a new specification to work with allowed Matthew the freedom for students to complete a project and upon completion reflect on their learning. Even though it was concluded from the episodes that Matthew was not reaching the intended outcomes of his activity system, the fact that there was a new specification in place allowed for him to express more agency when teaching the topic of cells.

Timetabling

The duration of science lessons and the frequency at which Matthew saw this first year science group were affecting formative assessment enactment in a negative way. This was because Matthew was constrained in his practice by the long duration of lessons (100 minutes) and because he only saw this group once a week. He explained:

> "I only see them once a week and personally I think that's not …. it's not good. I would like to see them twice a week for 50-minute blocks but like it's just the way the timetable is worked out."

When asked how this was affecting his formative assessment practices he stated:

> "the problem with the first years is I've only seen them seven times. So, I don't even know all their names yet, you're kind of learning the names compared to if I saw them twice a week, you'll use their names more. So that's a big disadvantage I have at the moment is I don't know all their names."

The comment above from Matthew was in connection with him using questioning as a formative assessment technique. As he didn't know the students' names due to only seeing them once a week, he found it difficult to challenge his students to think more deeply with his questions:

> "So obviously once I get to know the students better you could really prod in and go more specific with the questions."

However, Matthew could have expressed more agency over his formative assessment practice and made more of an effort to learn his students' names. Like Dylan in Greenview, Matthew was not taking the initiative to enhance his practice.

In addition to only seeing them once a week Matthew commented in that he had only seen them seven times and data was gathered at the end of November after 13 weeks of term time. This was due to missing classes for a variety of reasons. Rachel (the other science teacher from Oakpark who participated in this research) explained:

> "Like we had a Thursday off then we had a Thursday for sports day, then there was a Thursday with Student of the Month on it and then you're just…. you see you've only got …like I've three learning outcomes covered"

While Rachel was concerned with getting content covered, Matthew was more concerned with getting to know his students and structuring his questions to suit their needs. Because he only

saw them once a week the timetable was inhibiting the formative assessment outcome of responsive teaching to meet the students' learning needs.

Parental Influences

The community in which an activity system is situated can have a profound influence on the organisation of the system. This was evident with the parents in Oakpark. Oakpark prided itself in having a focus on formative assessment practices in the school that included a learning module developed in-house (*Learning Curve*) and in the school ethos that acknowledged students' effort over academic achievement (as cited by the principal in interview). However, both the principal and Matthew conveyed in interview that the parents of Oakpark were strongly opinionated on teaching, learning, and assessment practices and as a result did not approve of formative methods over traditional summative ones. The principal began by speaking about the high expectations' parents had for their children:

> "You'd have parents with very high expectations. You have students with high expectations. They have good financial stability for the most part which is challenging for the school because if we…. if parents feel we're not performing, they'll send their students to the institution they can afford to and we're within distance for them to be able to do it."

She believed that they appreciated the effort the school was making with formative assessment practices, but they insisted on a focus on exam-based teaching and learning methods:

> "they'll appreciate the different learning strategies, but they want it to be exam focused you know…many of them are well aware that we take a holistic approach to education, and I will say to them sometimes, if you're looking for a grinds school[15], this is not the place to be."

So, there were clear tensions between the school community and the enactment of formative assessment in Oakpark. This contradiction played a role in the level of engagement teachers had with formative assessment:

> "There's always teachers who don't want to engage and there are parents who may kind of think it's a waste of time and there's students who won't see the relevance of it so if all three happens we have the perfect storm…so that's kind of a constant struggle."
>
> (Oakpark Principal)

[15] Grind schools in Ireland are schools that are focused on getting the best possible state exam results for students. Teaching to the test would be prevalent and fees would be charged by the school.

Matthew had similar opinions to share on the influence of parents on the types of teaching, learning and assessment practices taking place in Oakpark. He stated:

> "The demographic of this area is parents value education. So, they want their kids to do that as well. So, it's ….and parents would have gone to university. So, there's an expectation there that you're going to go to school, you're going to do your Junior Cert, you're going to do your Leaving Cert, you're going to go to college and whether every child is able for that, that's a different question…But that's the attitude of the parents, they want their kids to go to college."
>
> (Matthew)

Again, from the data gathered from Matthew and the principal, there arose a clear contradiction between the formative assessment ethos of Oakpark and the type of assessment practices the parents wanted from the school. The principal attributed this to the socioeconomic status of many families in the area surrounding Oakpark; many parents had been to third level and wanted the same experiences for their children. The comments that Matthew and Rachel had to make suggested that the parents preferred exam focused teaching, learning, and assessment practices over more formative methods:

> "That's the attitude of the parents, they want their kids to go to college. So, it's kind of engrained in them to …. that they must go to college and in order to do that, they have to study."
>
> (Matthew)
>
> "Like in this school, if you were to do loads of fun activities in biology like what I would have done in England, like you'd probably have parents complaining because you're not doing notes, notes, notes, notes."
>
> (Rachel)

However, Oakpark was not making a strong effort to educate parents on the benefits of formative assessment for their children's lifelong learning and self-regulation skills:

> Interviewer: So how then do you promote the different learning and assessment strategies with the parents and the guardians?
>
> Oakpark Principal: To be honest with you not very proactively…I mean we don't kind of make big announcements.

Increased information being available to parents on formative assessment may have helped to bridge the gap between the school's assessment focus and the parents' assessment focus. So there existed at the offset a contradiction among the community of Oakpark that was impeding

effective formative assessment practices in the school even before Matthew began to teach there.

Learning Curve

Matthew intended to coach students in self-regulation, yet the analysis of his evaluative episodes demonstrated that this intention was not actualised. Although this coaching was not effective in the science classroom, students had the opportunity to develop their learning skills through the *Learning Curve* module. This module was developed in Oakpark and all students in first year took this module over 33 weeks. This module had its foundations in the research and professional development on *Building Learning Power* (Claxton, 2002). The principal of Oakpark explained this in interview:

> "*Learning Curve* is what we've developed from our Graham Powell experiences. So, Graham speaks about building learning power and that's students' understanding their learning. So, we have decided to adapt that to our situation, and we call the module learning curve and it's a 33-week programme for all of first year covering their transition into secondary school. We use the junior cycle key skills as well so they will learn about managing themselves. So, we will explain to them what we mean by managing myself and they'll be given exercises to do."

The principal made explicit links between the module and the junior cycle key skills framework (National Council for Curriculum and Assessment, 2014). This was viewed as a positive aspect of the school's formative assessment practices as the key skill of *managing myself* is about helping learners to:

> "understand themselves both as individuals and as learners so that they can develop personal goals and plans. It also helps them develop strategies to make considered decisions, to take action and to reflect on their progress."
>
> (National Council for Curriculum and Assessment, 2014, p. 4)

This skill links strongly with the formative assessment strategy of activating students as owners of their own learning as it is concerned with aspects of this strategy such as goal setting and student reflection (Wiliam & Thompson, 2007). Formative practices via *Learning Curve* are central in Oakpark, however even though Matthew draws similarities between his practice and what the students learn in the module:

> "It's like a module where…. it's about how you learn. Basically, what kind of techniques are you using to learn, to make students reflect on the learnings or ….at the

moment they're still new to it like, so you're kind of …. I think I'm coaching, that's what I'm doing. I'm not…. I'm teaching don't get me wrong but I'm coaching them into how I want them to think."

Matthew was still not enacting formative assessment effectively in his lessons. This lack of coherency between what the students were learning and how Matthew was teaching was not due to a lack of training for teachers. The teachers in Oakpark had experience of professional development on *Building Learning Power* (stated by the principal in interview) and the principal believed that its principles not only existed in the module but were inbuilt into other mainstream lessons:

> "They'll be asked at the end of a lesson, every teacher has a poster in their room, we just reviewed this yesterday, when to say to the first years you know, what did we learn there? How did you learn it you know and what skills or what habits were you using to….so that they're conscious of the process of learning?"
>
> (Oakpark Principal)

From the principal interview data, it was anticipated that the principles of *Building Learning Power* would be observed and enacted in science lessons, however analysis of Matthew' episodes showed this was not the case.

When Matthew spoke about *Learning Curve,* he aimed to adapt its principles into his own teaching, learning, and assessment practices, but this was not observed in his practice. However, the module was influencing student learning as evidenced in interviews with students:

> "my dad sort of gave me a few tips on how to study and how he studied for his exams. In tutorial, my Caomhnoir (tutor), was asking everybody how they studied for an exam and then just putting the ideas out there to give us an idea of what we should do."
>
> (Oakpark Student 1)

Interviewer:	Where did you learn to set goals? Did you get that in school or come up with it yourself?
Oakpark Student 3:	You sort of get it in school because when you are doing SPHE and tutorial you are always taught to ask if you need help.
Interviewer:	What kind of techniques did they give you (in the module)?

Oakpark Student 6: Say like don't listen to music or anything because it is distracting. Have a bottle of water and banana if you get hungry or thirsty. Just revise over all your notes and spend a good bit on them don't just scan over them and say you are finished.

Examining the student comments above, it was apparent that what they were learning in the module was more based on revision skills and exam technique rather than their formative learning skills. For example, Student 1 said that their tutor was asking them about how they studied for exams while Student 6 mentions revising over notes. These comments are more strongly linked to preparing for summative exams than developing learning skills. Although Student 3 cites asking for help, there was not sufficient evidence from Q to suggest this module was improving learning skills. So again, the practices in this school were falling short of enacting formative assessment. The school had created a module to develop learning skills and had trained teachers in this area however as the analysis demonstrated they failed to fully embed formative assessment into the teaching, learning, and assessment practices within the school.

Conclusion

The aim of analysing Matthew's evaluative episodes was to examine his techniques for formative assessment (technology, questioning, and developing students' self-regulation skills) to examine enactment and to determine what factors were promoting or inhibiting implementation. Analyses conveyed that there were a myriad of factors influencing how teaching, learning, and assessment played out in Matthew's science lessons. Of interest in the analyses were the contradictions that presented themselves even before Matthew began a lesson. From the offset there were tensions among the parents and the school over appropriate assessment practices and timetabling meant that Matthew only saw his students once a week. However, Matthew still tried to develop his students' self-regulatory skills. He set up tasks to accomplish this but like Dylan in Greenview his follow up was ineffective and often focus was lost. This was due to many reasons including Matthew taking on most of the division of labour in the class, students disengaging, and a lack of focus in teacher questioning and instruction. Students were for the most part passive actors in Matthew's lessons and therefore it was difficult for them to take on self-regulation without being actively involved in the learning process. A diagrammatic representation of how all these factors tie together is represented in Matthew's activity system, see Figure 10.

7. Case Study 3: Activating students as owners of their own learning

Introduction

Nora is a teacher of science and physics from Milltown in Scotland. At the time of research, she had 17 years of experience working as a second level teacher, some of that time was spent teaching in Malawi. Nora is a chartered teacher and holds a Master of Education in Professional Enquiry with a focus on the language of learning. Nora enacted formative assessment in her classroom by focusing on activating students as owners of their own learning, a key strategy for formative assessment (Wiliam & Thompson, 2007). She aimed to develop learning skills by getting students to take control of their learning. In terms of activity, the outcome of Nora's system was to improve learning, while the objects of the system: clarity of goal setting, student self-assessment, building on prior knowledge and student led learning outcomes, were intended to activate students as owners of their own learning (depicted in Figure 12). This chapter outlines two of Nora's evaluative episodes that highlight how she was effective in enacting formative assessment. Two episodes were chosen to demonstrate that her formative assessment practice was continuous throughout the lessons observed. Interestingly, Nora was the only teacher observed in this research who demonstrated the formative assessment aim of adapting her practice and responding to learning to improve the learning of her students, was exemplified in Episode 2.

Nora's activity system was the most effective of all teachers in this research for enacting formative assessment i.e., she had successfully embedded formative assessment into her teaching practice so that she could improve the learning of her students. There were several factors contributing to this including her extensive use of tools that allowed her to respond to students in real time. In addition, professional identity, personal beliefs, and self-efficacy about her practice signified her commitment to embedding formative assessment in her practice. Nora's professional identity conveyed a practical-evaluative agency in over her practice (Priestley, Biesta, & Robinson, 2015) that was not commonplace with other teachers participating in this research. She had achieved cultural agency through her own ideas, beliefs, and values about learning, and structural agency through her relationships with staff, her role as a professional development facilitator and the trust the school management placed in her to

lead learning in Milltown[16]. Although Nora was the most effective at embedding formative assessment in her practice, there were some discrepancies with actively including all students in her lessons. Figure 12 presents a diagrammatic representation of Nora's activity system that depicts the different elements in her activity system that enabled her to embed formative assessment into her classroom practices.

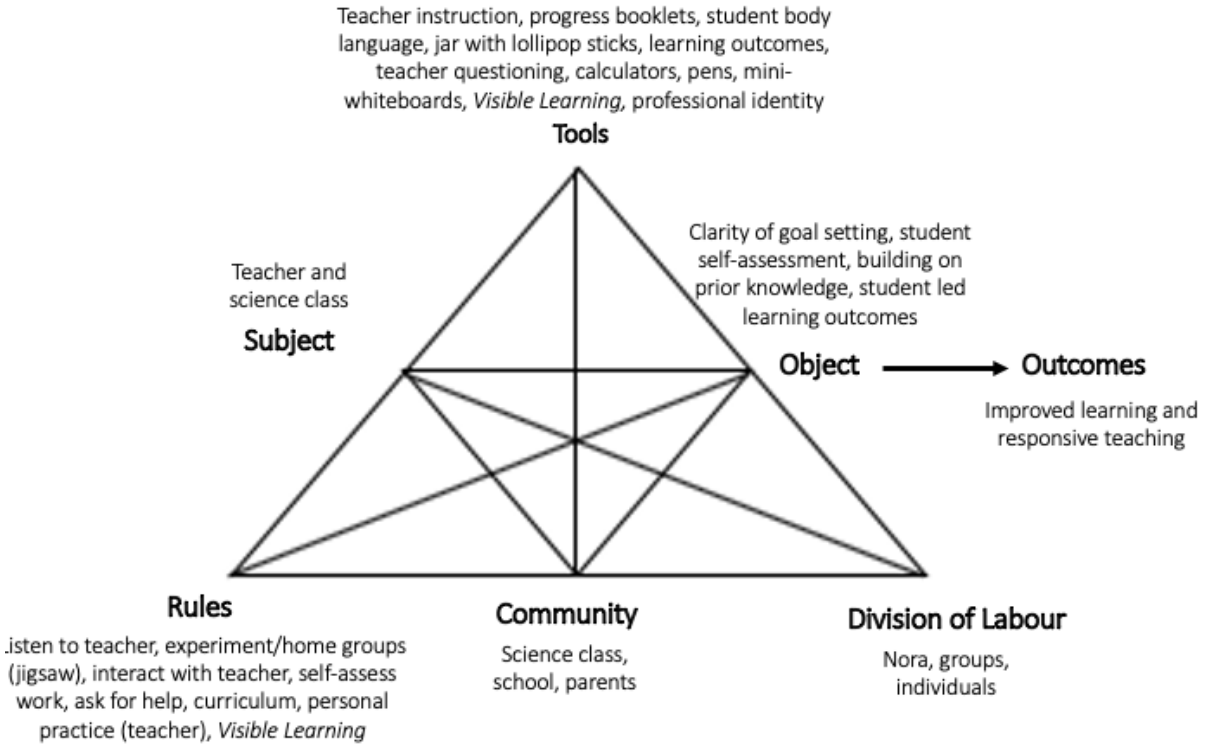

Figure 12: Diagrammatic representation of Nora's Activity System

Nora's Evaluative Episodes

Episode 1: *Progress Booklets*

This was the first observation period with Nora. The class were completing a module titled *Tour de France* that was designed by Nora and utilised by all teachers teaching S2 science in Milltown. The intended experiences and outcomes for this module were for students to:

- contribute to investigations of energy loss due to friction
- suggest ways of improving the efficiency of moving systems
- work collaboratively
- make appropriate use of technology

[16] More information on agency can be found in Chapter 2.

- source information presented in a range of ways, interpret what it conveys and discuss whether they believe the information to be robust, vague, or misleading

(paraphrased from Scottish Government 2006, 2010) The lesson started with Nora greeting each student at the door and giving them the instruction individually that they were to sit in their experiment groups when they entered the room. The students had begun an experiment with a different teacher in the previous lesson as Nora was ill. She had set up the experiment for this lesson so that it could be completed via a *Jigsaw* activity (Aronson, 1978) where students worked in experiment groups then returned to their usual seats and informed their nearby peers of what they learned in experiment groups. Although Nora had left instructions for the previous lesson to the supervising teacher, before this episode got underway Nora asked each group as to what they had completed in the previous lesson. From doing this she found out that they had not completed what was asked. Because of this she adapted her lesson (a key outcome of formative assessment enactment) so that they gathered more data from their experiments, this is where Episode 1 begun. The overall aim of this evaluative episode was to demonstrate Nora's enactment of formative assessment through the strategy of activating students as owners of their own learning to help them develop their self-regulation skills.

Time Stamp	**Action**	**Description**	**Teacher/Student Talk**	**Activity Theory Elements**
4:40	Teacher outlines class plan.	Teacher has been ill, so her voice is weak. There was a different teacher (Mr. Smith) teaching her previous lesson and she is frustrated that he didn't follow her instructions for that lesson. She clarifies to the students that she wants to get the data collection process right so explains that they will continue with data collection today. Students are sitting in	**Teacher:** Okay right guys look this way for me. There are a few things here, like first of all I have to tell you that I have got a really sore throat. I don't know if it sounds like that, but this is the loudest I can manage. So, I will do my best, but I might sound a bit strange at times. Okay so, I know it's a while since I saw you because last time you had Mr. Smith. Mr. Smith didn't quite do what I asked him to do. I asked him to get you to plan the experiment and not quite go on to the results. Some of you have got the results but from a quick tour	**Object:** To assess where the students are with their learning. **Tools:** Teacher instruction with a focus on prior learning. **Rules:** Listen to teacher instruction, sit in experiment groups.

		experiment groups (part of a jigsaw[17] activity) and paying attention to instruction.	around I don't think anybody has quite enough results, so I think we are going to have to start by taking a few more results.	
6:20	Teacher instruction and checking for understanding. Students filling in their Progress Booklets.	The teacher wants the students to fill in more sections of their progress booklets (see Figure 13). They began these booklets with their previous science teacher from S1 and they focus on getting students to self-assess their work on experimentation. The teacher gives detailed instruction as to what she wants the students to do and checks that they are following her instruction by getting them to give her a thumbs up or nod their heads. What were the students doing – there is not much commentary on the behaviour of students	**Teacher:** In your folders on your desk, I want you to take out your assessment folder that had from Dr. Moore. And the sections that we are going to try deal with today are starting on page 7 okay. Student G can you take this and put out your folder on page 7 for me? *(Pause)* Okay right guys look this way for me. Mr. Smith told me that he got you to only do aim and that he got you to put your date for just the row that's aim. Can you give me a thumbs up if that information is correct, a thumbs down if that information is wrong, a thumbs sideways if you are not sure? *(Some students give a thumbs up, the remaining students do not engage)* Okay so I am going to miss out the hypothesis and safety section, that is what I had asked him to do but I think he got a little bit overenthusiastic with the experiment *(laughs)* okay so I'm going to skip that bit we'll come back to that later. I want you just to deal with page 7. Okay so I want you to do what we have	**Object:** Students to self-assess their work on the experiment so far. **Tools:** Progress booklet, teacher questioning, student body language feedback. **Rules:** Interact with the teacher e.g., Thumbs up/thumbs down, nod/shake head. Asking group members for help. **DOL:** Both teacher and students involved in this activity

[17] A *jigsaw* activity (Aronson, 1978) is where the *expert groups* (all the students carrying out the same experiment) were divided up amongst other groups to perform an experiment and collect data. In the subsequent lesson the students returned to their original seats and informed their *home groups* of what they achieved in their experiment.

			done before, please look this way. I want you to decide this row where are you at and then I want you to put today's date. Put your hand up if you can tell me what todays date is so we are all doing the right thing. *(One student puts his hand up, she waits for others, and repeats the instruction)* Only three people know the date? *(More students put their hands up)* Okay Student G what is the date? *(Student gives the date, she repeats it and writes it on the whiteboard and uses the progress booklet to show theme exactly where to date their progress)* Okay look at me, nod your head if you understand this task, shake your head if you do not. Okay so there is at least one nod per group so that means if you don't know what to do you can ask the people in your group. This is between you and me what you put in this book so if you don't want other people to see that's okay, it's just a communication between you and me where you put the date. Right do that now.	
8:30-10:30	Students are working on their Progress Booklets	Students working individually to complete a self-assessment on their work so far. The teacher is helping individual students and some students are	**Teacher:** *(Talking to an individual student)* Read each of these boxes and see which box you are in. Possibly if you don't know what repetition means is…what box would you go for?	**Object:** Students to self-assess their work on the experiment so far. **Tools:** Progress booklet, help

		helping each other. Once they are finished their self-assessments, they begin to gather equipment to collect more data.		from teacher, experiment equipment. **Rules:** Self-assess work, ask teacher/group members for help **DOL:** Individual student

Table 10: Nora's Evaluative Episode 1

Episode 2: SOLO Taxonomy

Data for the second episode were gathered from the third and final observation period with Nora. The students were still completing the module *Tour de France* and shared the same intended experiences and outcomes as the first episode. The lesson begun by Nora once again greeting each student individually at the door. She instructed to each student that they needed to gather a mini whiteboard from her desk and have a pen and calculator ready for the class. Once students were all seated (in their original seating plan) she explained to them that she would be absent for the following lesson and apologized for missing another class. She rationalized to them that she was going to a training course on getting more girls involved in physics. Once she had finished speaking, Episode 2 commenced. The focus of this lesson was for students to understand the concept of air resistance and its effect on moving objects. Like Episode 1, the overall aim of this episode is to demonstrate Nora's enactment of formative assessment by activating students as owners of their own learning.

Time Stamp	**Action**	**Description**	**Teacher/Student Talk**	**Activity Theory Elements**
5:35	Teacher instruction followed by students working on an introduction question.	Teacher gives clear instruction as to what the students need to do with the introduction question. She outlines that they will be picked at random to answer the question. Students are engaged and	**Teacher:** So, this is our intro question before I go through what it is that we are going to learn, and I think based on what you told me in the introduction lesson this relates to what you are doing in technicals *(she is referring to technical subjects here)* stuff okay	**Object:** Elicit evidence of student understanding. **Tools:** Whiteboard, PowerPoint

		listening to her instruction.	so I am going to get you to discuss in your group there and be ready to answer because I am going to pull your name from the pot. So 'how had bicycle design helped cyclists go faster?'. Right, you discuss I'll do the register.	presentation, jar with student names on lollipop sticks, group members for discussion. **Rules:** Listen to instruction, work in groups, be prepared to answer the question aloud. **DOL:** Teacher instruction followed by group work.
6:02	Student thinking time.	Student are discussing their thoughts on the question. They are given 30 seconds. They are engaged as they can be heard talking about factors such as wind and tyre thickness.	*Student talk is undistinguishable as they are working in groups. However, field notes denote that the students were speaking about factors such as wind and tyre thickness.*	**Tools:** Group members **Rules:** Work in groups, be prepared to answer the question aloud. **DOL:** Group work
6:32	Randomised questioning by the teacher. Class discussion on bicycle design.	The teacher stops the discussion and uses a pot containing each student's name on a lollipop stick to choose someone at random to interact with. She involves many different students and gets them to engage by reminding them that they might need to comment.	**Teacher:** Right guys stop for me then. Stop for me. Okay let's see, first out of the pot is Student A, what is your group saying about how bicycle design has helped cyclists go faster? **Student A:** The wheels are smaller. **Teacher:** The wheels are smaller now than they used to be. Okay do you want to pick someone	**Tools:** Teacher questioning, jar with student names on lollipop sticks, student answers. **Rules:** Answering questions.

		She also gets them to build on other students' answers. Students are engaged in this task. More detail on what the students are doing/how they are behaving, particularly given that they are in groups?	from a different group and see if they agree with you or not for me? **Student A:** Student B. **Teacher:** *(To Student B)* I know you might not have discussed that, but I want you to think about what he said. **Student B:** The wheels are thinner, so they don't block as much wind. **Teacher:** The wheels are thinner, so they don't block as much wind. That's what you are going for. Do you want to pick someone else from a different group and see if they agree with you? **Student B:** Student C. **Student C:** Ah yeah. **Teacher:** You would go with that? Okay I think that a good thinking what we have done there. So, you're thinking sort of narrower, less blocking of the wind as you go through. Student C are you happy with that? **Student C:** Yeah. **Teacher:** Yeah, okay right Student D you are out from the pot, can I get another suggestion from your group? *(A small group of students are chatting*) Hang on a second guys, listen in case you are asked to comment. *(the small group of students stop talking and pay attention)* **Student D:** It's like streamlined so it's like sort of not against the wind so it will go easier.	**DOL:** Many students and the teacher involved in this activity.

			Teacher: Streamlined, not pushed against the wind so it will go easier. Right do you want to pick someone from one of the other groups and see if they agree with you? **Student D:** Student E. **Student E:** Yeah, I agree. **Teacher:** You agree. Do you have anything else you can add to that? **Student E:** The handlebars are down lower so the cyclist can be like more streamlined going down. **Teacher:** More streamlined going down. Okay I'll go and I'll pick one more. Student F, do you have anything else to add? **Student F:** Increased areas of friction on the bike, like on the tyre and stuff to prevent slipping and like on the seat and handlebars to like to prevent you going off.	
8:25-10:30	Teacher shares the learning outcomes for this lesson using SOLO taxonomy.	Teacher explains that the students will pick the learning outcome for the lesson and gets them to contribute by putting their hands up to choose a learning outcome. She provides the students with a variety of learning outcomes each varying in cognitive difficulty. The students are given 12 seconds thinking time to decide on the learning outcome they would like	**Teacher:** Right, it's a bit safer on the bike okay, good, good. Right so I was asking you there because I wanted to see what you knew before I decided where we are going to go next with the lesson, but I am going to show you what it is that you are learning today so if you can look this way. Okay so a reminder, we are working on our five levels here, level 5 is where I don't really know anything about this topic at all. Level 4 is where I know one thing, that's what you have been	**Object:** Students are to decide the learning outcome for this lesson. **Tools:** Whiteboard, PowerPoint with learning outcomes, teacher instruction, student body language feedback,

		to complete for the lesson. The episode ends with students gathering their materials to join the teacher for a demonstration on air resistance at the top of the room.	filling in in your snapshots *(these are in the progress booklets)* as you have gone along with Dr. Moore. So, for one thing I would be looking for, you know what is meant by the term air resistance which we didn't mention in our discussion, or you know what is meant by the term streamlining which I did hear you mention in your discussion. Level 3 that is where I know multiple things so you would know what both of those things mean. Level 2 is where you are starting to connect ideas together, so this is 'carry out calculations for streamlined and non-streamlined objects to compare them'. And then the last one is where you have level 1 where you 'apply your ideas and your understanding to solve problems'. So that's going to be about estimating time savings. Okay so let me give you a few seconds to look at the board and just read back through those because I am going to ask you to tell me what level you think you are at the start here. So, look at the board, think through. *(Students are given 12 seconds to think).* Okay right so, show me fist to five, show me what level you think we are at the start of this lesson. (*majority of students show her with their hands in the air that they are at level 3, some students did not participate*).	calculator, mini-whiteboard, pen, seat. **Rules:** Listen to instruction, 'fist to five' hand gestures from students, gather equipment. **DOL:** Teacher instruction followed by individual student task (self-reflection).

			Okay good right okay, so here is what I am going do then, I am going to go straight to this one which is 'carry out calculations to compare the speeds of streamlined and non-streamlined objects'. So here what I am going to need is, you are going to need your board, you are going to need your pen, stop. *(She is stopping the students from moving so they listen to her instruction).* You are going to need your calculator and we are going to be at the front for a while, so I want you to bring your seat and gather. So, board, pen, calculator, seat and gather.	

Table 11: Nora's Evaluative Episode 2

Analysis of Episode 1 and 2

In terms of activity, Episodes 1 and 2 were intended to reach the outcome of improved learning by activating students as owners of their own learning. Nora cited this in interview when discussing her observed lessons:

> "I'm asking them self-regulation type questions. So, I do spend a lot of time trying to talk to them all individually. I am letting them self-assess with their whole one to five thing (SOLO taxonomy)."

Therefore, both episodes were analysed together through the elements of the activity system (Engeström, 1987) for key features that exemplified this formative assessment strategy to ascertain if it was embedded in Nora's practice.

Object

In summary, the objects of Nora's activity system were to set goals for learning, facilitate student self-assessment, build on prior knowledge, and student led learning outcomes. These objects were operationalised through the various self-regulation techniques Nora employed including the Progress Booklets (Episode 1) and SOLO taxonomy (Episode 2). She discussed her motivation to improve learning and respond to her students' learning needs in interview:

> "Would that not be the purpose of learning, to improve and move forward? Well, how would I move them forward if I didn't know where they were, and how would they move forward if they didn't know where they were?"

Episode 1 contained two objects, the first was for Nora to assess where the students were with their learning and the second was concerned with the students self-assessing their work on the experiment. The first object showed Nora's skill in using prior knowledge to plan for her lesson. At 4:40 she explained that what she wanted covered in the previous lesson was not sufficiently completed. She learned this information from a quick chat with students at the beginning of the lesson. If Nora had not checked in with the students to see what exactly they had completed while she was absent, she would not have found out that they did not collect enough data and she would have moved on to the next section of the module with insufficient or inaccurate experiment data and gaps in student understanding. This was consistent when talking with Nora during interview:

> "I try to be very clear with them about what we're doing and why we're doing it. and I know that sometimes I don't do that because you get kind of caught up in what's happening, but I try to remind them…I mean, obviously you can't be consistent all of the time, sometimes you forget and sometimes you get rushed. But as a general practice, that's what I try to do."

In terms of formative assessment, this was a moment of contingency, or responsive teaching (Leahy et al., 2005) as Nora adjusted her instruction i.e. her plan for the lesson, so students had the opportunity to gather more data on their experiments. They gathered this data in the class time following Episode 1. The purpose of Nora responding to her students like this was to enhance their data collection skills and meet the experiences and outcomes of this module which were to investigations of energy loss due to friction, and suggest ways of improving the efficiency of moving systems (Scottish Government, 2010, p. 7).

One of the objects in Episode 2 also contained a moment of contingency (Leahy et al., 2005) where Nora got the students to pick the learning outcome for this lesson based on where they were at currently in their learning. She accomplished this using SOLO taxonomy (Collis & Biggs, 1982) whereby an array of learning outcomes (usually numbered 1-5 depending on their difficulty) is placed on the board and students have to decided what level they are at in their learning and then the teacher uses this to adapt the lesson accordingly. Nora presented the learning outcome of the lesson to the students in the SOLO format phrased as follows:

4. State what is meant by the term air resistance or streamlining

3. State what is meant by the terms air resistance and streamlining
2. Carry out calculations to compare the speed of streamlined and non-streamlined objects.
1. Carry out calculations to estimate time savings due to streamlining

At 8:25 Nora read each outcome aloud, gave students time to think and by indicating their prior knowledge using their fingers (fist to five), much of the class felt their learning was at level 3, some students did not indicate their level of learning. Nora did not address that some students in the class had not indicated where they were at in their learning and simply went with what the majority were showing her. This was a missed opportunity to probe the students who did not participate and for Nora to learn if this was perhaps due to them being at a different learning level to their peers. The opportunity was missed here for Nora to really help students who were disengaged with the content. As most students felt confident that they could achieve outcomes three and four but needed help with one and two, Nora structured the lesson so that it focused on calculating speed and examining air resistance through modelling. She discussed this incidence during interview:

> "The students were already telling me that they were already on level 3, and they knew what air resistance was and streamlining was. So, I wasn't going to spend 10 minutes going through what that was, but I still wanted to check that they did really know what that was. So, I went on to level 2 which was doing the calculation, right, because they were telling me that, but while I was doing that, it was still about the calculation, but I was deliberately questioning them, trying to get them to tie in what was at level 3 and 4."

From this incidence it was demonstrated that the object was reaching its intended aim of activating students as owners of their own learning as they were choosing the level of learning for the lesson. Although some students did not respond to Nora when she asked them what level they were at, Nora mentioned in interview how she helped individual students who were having difficulties:

> "they were all doing fine apart from that one girl Luna, I went round to the back to speak to her about what was happening… Because I would suspect with Luna and the one up at the back there (referring to another student) they are really struggling, I could ask them if there's something missing from this column (an answer to a speed calculation) and what is it and they might not know so then I'd go down a level to, where I suspect (they are at).

So even though she pitched the learning at the level most students chose, she still gave time to students who were having difficulties. She spoke of how she responded to her students in interview:

> "I always try to respond to what they tell me and do what the next thing is based on that that."

However, as was observed in Episode 2 other students were ignored when they did not participate in choosing the level of learning. This presents a problem with activating all individual students as owners of their own learning yet, Nora was the only teacher in this research to demonstrate clear moments of contingency that reached the formative assessment outcomes of improved learning and responsive teaching.

Tools

Nora used a variety of both physical and mental tools in her evaluative episodes with the aim of activating students as owners of their own learning to help them self-regulate their learning. The physical tools included the progress booklets, a jar with students' names on lollipop sticks, calculators, pens, mini whiteboards, and seating plan. The mental tools were teacher instructing and questioning, learning outcomes, and student body language. In Episode 1 the main tool of use was the Progress Booklet which Nora designed and was used by all science students in Milltown. Nora had developed this booklet herself and this showed how she had the agency to

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Repetition and range	I can follow instructions to take the correct number of measurements for each variable in an experiment	In discussion with others I can decide how many values of the independent variable should be used and how many times the measurement of the dependant variable should be repeated	I can decide what the best number of repetitions is for an experiment and can calculate the mean value of these. I can also ensure that I have a large enough range for the independent variable that a clear pattern can be seen in the results
Recording results	I can record my results in a table I have been given	I can use previous versions of tables to construct a table to record my results	I can construct a table to record my results including the correct headings (including an average column) and units without any help
Processing and presenting results	With help I can process the results of an experimental investigation into the type of graph/chart that my teacher tells me to	I can select the correct type of graph/chart to present my experimental results and can complete this graph/chart with some help from others	Independently I can select and produce the correct type of graph/chart for my experimental data
Conclusion *(numeracy skill)*	I can select an appropriate conclusion for an experimental investigation from a choice given to me	With help from others I can come up with a conclusion for an experimental investigation which is based on my experimental results	On my own I can come up with a conclusion for an experimental investigation which is related to my aim and based on my experimental results
Evaluation *(numeracy skill)*	I can select from a list suggested ways to improve an experimental technique	In discussion with others I can come up with ways to improve an experimental technique	On my own I can make suggestions to improve an experimental technique and explain why these changes would improve the experiment

Figure 13: Progress booklet developed by Nora in Milltown

design and implement formative assessment tools that were incorporated into the teaching, learning, and assessment practices of the science department. From speaking with Alice, the other science teacher from Milltown involved in this research, she conveyed a sense of trust in Nora's expertise in assessment and illustrated that the entire department felt this way. Nora gave instructions for filling in the Progress Booklet at 6:20 and at 8:30 students were given roughly two minutes to work on this task. At this time Nora was observed helping individual students and clarifying the task for them.

The Record of Progress Booklet was a student-self assessment tool used inform milestone events and student reports. A sample page from this booklet is depicted in Figure 13. Nora developed this booklet to promote assessment consistency across the science department. She discussed this during interview:

> "The purpose of the booklet is to support pupils in making progress. So, it's called record of progress…There's a studies skills section, a writing a lab report of an experiment type section, and a writing a report which involves research on the internet … So, for each of those three sections in the booklet, there's two parts to it. The first part is the rubric where it breaks down each of the sections that are needed for that particular report or whatever, and then gives them the different levels for 1, 2, 3 smiley faces, and that's very much meant to be a self-assessment tool, so they can see how they're supposed to improve. Although once they've done a piece of work, I would definitely talk to them. I'll have a look through that and if I think they're not up there, I'll have a chat with them and I'll explain to them why and see if we can negotiate moving them down a level and I'll get them to move themselves".

Rubrics such as this progress booklet are a valuable self-assessment tool as they help students and teachers define quality and require teachers to reflect carefully on subject specifications (Organisation for Economic Co-operation and Development, 2011) such as the science experiences and outcomes of the Curriculum for Excellence (Education Scotland, n.d.)

In addition to Nora discussing the Progress Booklet, qualitative data from Nora's students who took part in the Q methodology showed that they were aware how the Progress Booklets would help them improve their learning:

Milltown Student 7: You do them (assessment booklets) every so often and you mark the date and which box you think you are. It is like three stars, two stars and one star.

Interviewer: Do you like doing them?

Milltown Student 7: Yes, I do. It shows your progress because if at the start of the year I have only got one star for that then at the end you have got three and you say, 'ah I did well in that'.

Interviewer: So, you can see your progress?

Milltown Student 7: Yes.

Interviewer: In science, is the way that Nora teaches different from other teachers do you think?

Milltown Student 8: Yes.

Interviewer: What do you think is different about Nora's teaching?

Milltown Student 8: She lets you kind of grade your own work like 5 to 1 so you know where you are for yourself.

The second excerpt from the interview with Student 8 also showed that this type of self-assessment was not common among other teaching departments in Milltown. As the student voice demonstrates, the students were able to quantify how their learning had changed due to completing the Progress Booklets and this validated that Nora's enactment of formative assessment was more developed than other teachers in her school. Reasons for this will be explored in the factors influencing the episodes section later in this chapter.

A mental tool of interest in these episodes was Nora's use of feedback signs from her students. This tool was how Nora's students gave her updates on their learning using their body language i.e., thumbs up, nodding, etc. Using a tool like this showed how she checked for student understanding consistently in her lessons. The use of this tool was observed in both episodes. In Episode 1 at 6:20 Nora asked her students to give her a thumbs up/down/in the middle when getting them to clarify what they had covered in the previous lesson. Like the discussion of SOLO taxonomy from Episode 2, not all students engaged with Nora at this time leading to Nora not being aware of where all the students were at in their learning at that time. However, later in this section (6:20) she asked students to "nod your head if you understand this task, shake your head if you do not". She then determined that at least one student per group had nodded so students could ask each other for help in their groups if needed. This was a better approach by Nora to make sure each student was able to understand the task as she was activating students as instructional resources for one another rather than her just looking around to see if students were giving her a thumbs up or not. This was observed later again in Episode 2 where students were put to work in groups and encouraged to discuss an introductory

question. Body language was a tool again in the second episode when Nora elicited evidence of student understanding. At 8:25 she got the students to show her using their fingers where they were on the SOLO taxonomy scale (discussed in detail the object section on 179), however as discussed earlier, not all students got the opportunity to share their thoughts with Nora as they did not participate. By Nora consistently checking in on her students' learning she elicited evidence of student understanding, responded to her students, and planned her next steps accordingly. This she commented on in interview:

> "Well, how would I move them forward if I didn't know where they were and how would they move forward if they didn't know where they were? My job is to understand where they're at and to understand how to move them forward. And to make sure that they understand where they're at and make sure they understand how to move forward."

A final tool of note in Nora's practice was her formative use of questioning (Leahy et al., 2005; Wiliam & Thompson, 2007). For Nora this tool was both mental and physical as in addition to asking questions, she used a jar containing lollipop sticks with the student names to randomise who answers her questions. With all teachers in this study, questioning was of focus due to its strong links to a variety of formative assessment practices. With Nora, she employed a technique similar to Matthew where she passed questions among students i.e., like a basketball (Wiliam, 2009). However, her practice was elevated as she also got students to expand on their peers' answers therefore probing for their understanding more than was evident in Matthew's practice. This was observed in both of Nora's episodes, especially in Episode 2 (6:32) where six different students were "picked from the pot" to answer the introductory question or add to a previous answer. Nora rationalised why she used randomised questioning during her interview:

> "The lollipop sticks are so quick to choose different people and it holds them to account. Because once they get used to it, they know they need to be ready to answer."

In addition, her students said they liked this randomised method of discussion, believing that it was leading to more fairness in the classroom:

Milltown Student 12:	She will pick names out of the pot so that she doesn't have to ask for volunteers because some people would never volunteer.
Interviewer:	Do you like when she picks things out of the pot?
Milltown Student 12:	Yes.
Interviewer:	Why is that do you think?
Milltown Student 12:	Because it means that everybody has to prepare an answer.

Interviewer: Does she give you enough time to think about it before you answer?

Milltown Student 12: Yes.

This student was not alone in their thoughts on randomised questions. Two of Nora's other students also illustrated that the randomised questioning was contributing to fairness in their learning. This implied that the opportunity to share learning was distributed equally among Nora's class. By getting students to expand on previous answers, Nora challenged the students to think deeper about the introductory question and to be prepared to answer a question even if it was not something discussed by the group previously (see 6:32 and the interaction with Student B). Finally, from asking a variety of students for their responses, Nora could gauge their current levels of understanding on this topic.

Rules

Cited earlier, the elements of the activity system can exist more than once. In terms of rules (the explicit and implicit norms of the activity system), many have been discussed already through different elements. The rule of interacting with the teacher was explored through discussions on mental tools and the rule of self-assessment was explored in the Progress Booklet section. What has yet to be examined in the activity system was the expectations of students in science class, particularly how they learned in groups and responded to their teacher.

Working in groups is an aspect of formative assessment that is interpreted in many different ways with varying levels of effectiveness (Clark, 2010). For example both peer assessment (Black & Wiliam, 1998b) and co-operative learning (Johnson et al., 1989) are considered as aspects of working in groups where students are activated as instructional resources for one another. In Nora's classroom students were put to work in groups in both episodes. In Episode 1 the students were already part of a *jigsaw* activity, ready to gather extra data by working in experiment groups. After this, groupwork appeared as a rule or implicit norm of classroom practice when students were working individually. They were encouraged by Nora to ask each other for help, and they were observed doing this in Episode 1 (8:30-10:30). Moreover, students worked in groups discussing the introductory question in Episode 2. It was evident from observation that the students were familiar with this type of activity as fieldnote data denoted how they stayed on task and were sharing ideas with one another. Likewise in interview,

students had positive comments about the benefits of groupwork conveying that it was something that they got to do often in science class:

> "When you have other people there that like can help you and stuff which is really good."
>
> (Milltown Student 9)

> "If I know what they are stuck with then I can help them sometimes."
>
> (Milltown Student 10)

Milltown Student 11: I like doing group work.

Interviewer: Why do you like doing group work?

Milltown Student 11: Because you can get feedback on work.

Interviewer: Do people explain things well in your group?

Milltown Student 11: Yes… we do quite a bit of group work. It is good because if you are stuck people in your group can help you.

Getting students to act as instructional resources for one another can be a difficult task to achieve as they must be open to sharing and listening to other opinions. If these students were new to groupwork they would not have engaged in discussion so quickly and been ready to answer the question based on the groups ideas. This showed that this was a recurring practice in Nora's classroom and could be considered as embedded within Nora's formative assessment practices. It is important to consider the reliability of student voice concerning the comments above. The students' answers are vague in terms of how exactly group work was improving their learning so the extent to which this was effective is not fully actualised in this data.

In Episode 2 there was a long sequence following the introductory question where Nora elicited evidence of understanding through questioning (6:32). This has already been discussed as a tool for formative assessment however the student responses can be considered as a rule of the system as they openly shared their answers with the teacher and did not hesitate to answer her. Again, it was clear that students were familiar with this type of engagement with the teacher and therefore it was considered as a rule. During Q, some of Nora's students were able to articulate how their teacher asks questions demonstrating their familiarity with her questioning methods:

Milltown Student 8: We are kind of like all asked equal questions or it is hands up kind of thing.

Interviewer: How else does she ask questions in class?

Milltown Student 8: We use the lolly pop sticks.

Interviewer: What do you think of the lollipop sticks?

Milltown Student 8: They are alright.

Interviewer: Is there anything good about using the lollipop sticks do you think?

Milltown Student 8: It is completely random, so you have to think of the answer even if you don't get picked. The evidence from classroom observations and the Q methodology showed that by Nora having questioning rules for formative assessment embedded in her practice, she was creating equal learning opportunities for all students in her lessons therefore actively involving them in their own learning, a key strategy of formative assessment (Wiliam & Thompson, 2007).

Division of Labour

The final element of the activity system to be discussed through the evaluative episodes is the division of labour in Nora's science lessons. The division of labour considers how power is distributed through the subjects in an activity system, in this case the students and the teacher. From analysis of the episodes, it was seen that at different times either the teacher, individual students, or groups of students were in control of different learning tasks. For an activity to be formative there should be an emphasis on the students holding the power in learning and this is explicitly linked to activating students as owners of their own learning. Additionally, students sharing the power among themselves shows how they can be activated as instructional resources for one another. Episode 1, the control in learning began with Nora as she was giving students instruction (6:20) but she then handed over control by getting students to complete their Progress Booklets (at 8:30) with help from their peers if needed. In Episode 2, at 8:25 Nora began in control by explaining the learning intentions but soon relinquished control by getting the students to choose the learning outcome of the lesson by showing with their fingers where they felt they were in their learning. Although Nora did not explicitly speak about who had control over the learning in her interview, her evaluative episodes illustrated how students were actively involved in their own learning through self-assessment (Progress Booklets) and reflecting on their learning to set the level of the lesson (SOLO taxonomy).

To summarise the analysis of the evaluative episodes Nora's intention was to activate students as owners of their own learning through a variety of different methods. Throughout the episodes she got students to self-assess their work, ask, and answer questions, work with their

peers, and decide on the level of learning for a lesson. Adding to the data from observation were quotations from interviews with both the teacher and her students that exemplified Nora's effectiveness of embedding formative assessment in her practice. Unlike the teachers from Ireland, analysis of Nora's activity system did not uncover a clear contradiction between her intended and enacted practices that would inhibit her formative assessment enactment. Although there were some incidences where students did not get to participate fully in giving Nora feedback and issues with reliability of student voice, The tools she used in her practice along with the rules, community, and division of labour in her activity system all helped to reach the objects of her activity system which were to clarify goal setting, student self-assessment, building on prior knowledge and student led learning outcomes. By reaching these objects the outcomes of improved learning and responsive teaching were actualised and these outcomes are fundamental in a formative assessment activity system. The next section explores data outside of classroom observation that were influencing and perhaps moulding Nora's practice. By looking at factors external to the classroom, we get an idea of how to promote formative assessment enactment in second level science classrooms.

Factors Influencing the Episodes

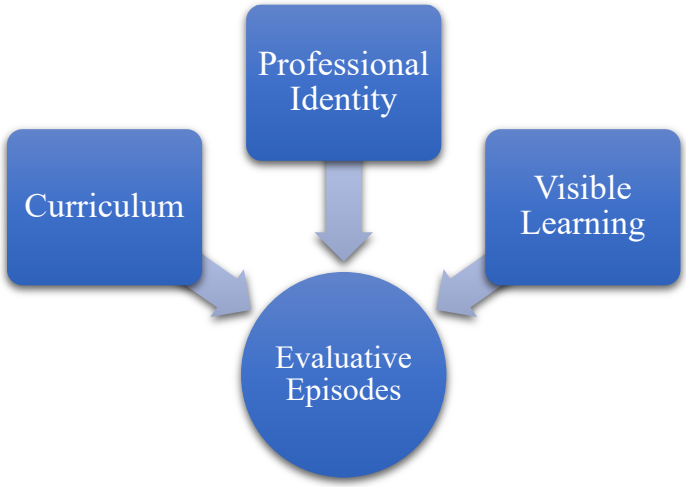

Figure 14: Factors influencing Nora's Practice

Nora was an interesting case in this research. She was committed to embedding formative assessment in her practice and making sure she provided effective learning experiences for her students. Considering this, data beyond the evaluative episodes i.e., interview and Q methodology data, were explored for factors outside the classroom that were having an influence on her practice, either positively or negatively. Upon analysis, it emerged that there

were three main factors that had a significant impact on how Nora enacted teaching, learning, and assessment at Milltown. Those were curriculum, professional identity, and *Visible Learning* (Hattie, 2012). *Visible Learning* was a whole school approach to improving students' attainment by teachers engaging in professional development on how students learn rather than what teachers taught. All three factors were considered as rules of Nora's activity system, influencing her practice in different ways. Professional identity was also considered as part of the subject of the activity system as it consisted of Nora's personal preferences for teaching and past experiences that helped to shape her as an educator, i.e., her person and context (Beijaard et al., 2004). Moreover, *Visible Learning* was considered as part of the community of an activity system, the reasons for which are discussed on page 192.

Curriculum

At the time of data collection, Milltown was enacting the Curriculum for Excellence (Education Scotland, 2006) intended to serve students from early childhood to upper second level education. Nora commented on the Curriculum for Excellence during interview:

> "Well, I think one of the things about CFE is they have quite broad outcomes. It's a little bit challenging for staff to understand what that is but it is designed to allow for flexibility in the local context. So, for example, it's supposed to allow us if we want to take the kids down to the beach to do sampling, because we live by the beach…I think, when it came in it was good, because it required more of teachers. It would be very difficult to get away with as many very old-fashioned practices, you know, get away with just giving them the textbook and read from that and just give them the question…I think maybe the teaching profession on the whole maybe wasn't quite ready for that. I was ready. I do also like the space it gives us for development of skills, skills of learning. It's not just … It's moved away from just memorising things."

From the above comment it was clear that Nora appreciated the openness of the curriculum that allowed for a broader range of teaching, learning, and assessment methods. Specifically, the comments showed how Nora understood the importance of a sociocultural approach to enacting curriculum by suggesting she could take the students to the beach as that would be relevant to the context, they lived in. In addition, with the Curriculum for Excellence Nora valued how she could express agency over what she taught her students due to its "broad outcomes" and the "space it gives us for development of skills of learning".

It was interesting that Nora felt she was ready for implementation of the new curriculum, however she suggested other teachers were not. This was in part due to her professional identity discussed in the next subsection. Because of the freedom afforded by the Curriculum for Excellence, i.e. the practical-evaluative dimension of teacher agency (Priestley, Biesta, & Robinson, 2015), Nora was in a position to undertake detailed module design that was introduced in Milltown. Nora mentioned in interview that she had a passion for cycling and therefore designed and implemented the *Tour de France* module that was observed in this research. Having a broad set of experiences and outcomes to be met by the students meant that Nora had the freedom to intertwine many different science concepts into one module focused on cycling while still giving attention to assessment, especially using the Progress Booklet. However, Nora herself cites how she is an anomaly among other teachers, so this raises the question as to why she felt prepared, and others did not? Again, this demonstrated her commitment to a sociocultural approach to her teaching practices by bringing what she felt passionate about (cycling) into the classroom and combining it with how she assessed her students.

Professional identity

In this thesis professional identity was considered as how teachers construct their own ideas of "'how to be', 'how to act' and 'how to understand' their work and their place in society" (Sachs, 2005, p. 15). How professional identity fits in an activity system can interchange and in Nora's case it was part of the subject (how to be) and was shaped by her community (how to act and understand).

Beginning with the subject (Nora), to recap she is a teacher of science and physics from Milltown. At the time of research, she had 17 years of experience working as a second level teacher, some of that time was spent teaching in Malawi. These aspects can be considered as forming her professional identity through past experiences (Beijaard et al., 2004). Nora has very high self-efficacy when it comes to her pedagogy. She is a chartered teacher and holds a Master of Education in Professional Enquiry with a focus on the language of learning. Data obtained from the interview with Nora yielded interesting findings about her dedication to teaching, learning, and assessment. To begin Nora chose to become a chartered teacher rather than progress into management as her passion was in teaching. She explained:

> "So, I'm a charter teacher. I'm at the top of the charter teacher scale. So, I get paid almost the same as him (the principal teacher of the science department), for doing a job that I love which is being in the classroom. And then trying to help learning, improve learning in the school rather than managing staff and dealing with bad behaviour."

In a bid to recognise outstanding teacher pedagogy, the Scottish chartered teacher programme (Scottish Executive, 2001) was introduced in August 2003. It offered pay awards for teachers who could demonstrate their exceptional teaching practice by participating in professional development and/or compiling a portfolio of their work. This programme was aimed at teachers who wished to be recognised for their pedagogy and stay in the classroom rather than moving to a managerial role within a school. This suited Nora as although she wanted to progress in her career, she did not wish to take on a managerial role as her passion and love was for teaching, this was an aspect of her identity where she signified who she wanted to be as a teacher. The chartered teacher programme is no longer operational but it being available to Nora meant that she was appreciated for her dedication to teaching and she was provided with an outlet to share her practice and gain from it. This became apparent in interview when Nora discussed how she had presented at many educational conferences both in Scotland and Ireland.

Nora expanded her knowledge on "how to act" (Sachs, 2005, p. 15) when she gained a Master of Education prior to teaching at Milltown:

> "So, my MA, it was really about using the language of Blooms Taxonomy as a language of learning to help leaners understand about what you are being asked to do here. Would you move to the next level? That kind of thing. So since then, I've moved through into this, moved towards the SOLO (taxonomy) and that's good, because that filters into what's happening now with the language of learning."

Her use of SOLO taxonomy was discussed earlier; however, it was interesting to note that she was very focused on how to move student learning forward, and how they self-regulate their learning. Building on this, when asked what motivated her to use formative assessment practices in her lessons she commented:

> "Would that not be the purpose of learning, to improve and move forward? Well, how would I move them forward if I didn't know where they were and how would they move forward if they didn't know where they were? I don't know, it just sits very comfortably with my fundamental beliefs about the purpose of learning. I mean, even before Shirley Clarke and even before Dylan Williams inside the black box, a lot of

these things are the kinds of things that I was doing when I had a class of 50 boys in the middle of the African bush in Malawi."

Here she explained that she was committed to improving student learning for many years. So even before she became a chartered teacher or conducted her Master of Education, her beliefs about the nature of learning were ingrained in her pedagogy. Her past experiences, combined with her teaching characteristics showed how Nora had strong pedagogical content knowledge when teaching science. Her evaluative episodes demonstrated her ability to adapt her practice in real time to suit the needs of her students, while her formative years as a teacher meant that she had an in-depth knowledge of the science curriculum.

Data obtained from Nora's students via the Q methodology demonstrated some other facets of her professional identity. In relation to how she acted in the classroom, her students cited her how she was dedicated improving their learning:

> "She is going to help me if I am struggling. She is not just going to say, 'ah no work it out yourself'. She is going to help."
>
> (Milltown Student 7)
>
> "The teacher always explains it very well like what we are doing, and it is always clear what we are going to be doing in that lesson.
>
> (Milltown Student 9)
>
> "You can ask a question if you are stuck, and she will help you"
>
> (Milltown Student 11)

So, the different aspects making up Nora's professional identity were helping her students to improve their learning and they were aware of how she was doing that by helping them with work, answering questions and explaining concepts.

Visible Learning: a whole-school initiative

Visible Learning (Hattie, 2012) is an evidence based initiative about promoting teaching, learning, and assessment practices in the classroom that have the biggest impact on student achievement. Many of these practices incorporate formative assessment techniques, for example, Hattie cites the importance of feedback, success criteria, and modifying teaching and learning so that student learning in class and teacher instruction can maximise learning. Moreover, *Visible Learning* draws on the idea that sociocultural factors including parental involvement and teacher student relationships are fundamental in improving student learning.

This linked to the learning community (Engeström, 1987) in which students were situated so it was deduced that *Visible Learning* was not only concerned with Milltown's school rules but the community at the bottom tier of the activity system.

Visible Learning was being implemented on a whole school basis at the time of research. This came about after an inspection report (Education Scotland, 2015) noted how students in Milltown needed to be more involved in and take responsibility for their own learning. Although much of the report cited positive learning experiences for students, the head teacher in Milltown was very conscientious about student learning and therefore the leadership team had invested money to implement *Visible Learning* to bring about improvements over a three-year cycle. During the year of this research (2017) the school were focusing on learning intentions and success criteria (a key strategy for formative assessment) while the following year they had planned to extend that to SOLO taxonomy, interestingly already being implemented by Nora. Nora was fundamental in the implementation of the *Visible Learning* program in Milltown, she commented:

> "Okay, so there's a group in the school called the guiding coalition who basically make the decisions about how we're taking visible learning forward in the school in terms of what's happening with the staff, in terms of what's happening with the pupils. In terms of what's happening with the pupil council, pupil learning council. In terms of coordinating with ASIRUS. That's the company that is basically branded to do John Hatti's visible learning in the UK…liaising with them and deciding what the Monday night session, what the end set will be for staff, what CPD will be for staff, how we will support that, what learning lunches there will be, what the whole program is, how it's all going, how it all ties together, what data we're collecting, how we're summarising the data., what data we'll get at the end, of that kind of stuff. So that's what we do."

Here she illustrated the commitment she and the guiding coalition (also referred to as the think tank) had made to make *Visible Learning* a success in the school. Nora was considered to be leading the *spirit* of formative assessment (DeLuca et al., 2019) in Milltown. She had taken on a leadership role in her school to promote *Visible Learning* and used her knowledge of formative assessment to support her own and other teachers' learning in her school. This was enacted through continual professional development (CPD) for the teachers conducted within the school by various members of staff. The staff took part in afterschool sessions and learning lunches. They demonstrated their agency in choosing to take part in the learning lunches. This was important as research has found that professional dialogue among teachers is important for

school improvement (Harrison, 2005). However, this agency also meant that teachers could choose not to participate in professional development. Although data were not gathered on how many teachers actually attended the school CPD, it is important to remember that professional development is most effective when it is engaged with by all teachers, focused on a specific area and consistent over time (Crichton & McDaid, 2016; Lysaght & O'Leary, 2017). Nora noted in interview that one of the upcoming initiatives the school was to create a language of learning. Interestingly this was the topic of Nora's Master's thesis. Summarising this section on *Visible Learning* as a factor influencing Nora's activity system, it was deduced that there was strength in the link between Nora's pedagogy and intentions of *Visible Learning*. It was Nora's formative assessment pedagogy that was contributing largely to the school rules of Milltown; yet it cannot be wholly assumed that her practices were being completely adapted on a whole school basis as data were not gathered on this

Conclusion

A detailed analysis of Nora's practice was necessary in demonstrating how formative assessment can be embedded in practice. Nora had the most advanced formative assessment practices of all the teachers participating in this research. Looking at her evaluative episodes and the factors influencing her practice outside of these episodes, it was clear that Nora's embedment stemmed from several different sources. The evaluative episodes illustrated that she was successful in activating students as owners of their own learning to self-regulate and actively engage in learning processes. Moreover, Nora's commitment to checking in on student learning meant that she was able to adapt and respond to her students in real time so that learning was optimal, this demonstrated her strong pedagogical content knowledge in terms of formative assessment enactment The factors outside of Nora's evaluative episode indicated that Nora held agency over her practice, and this was both influencing her own practice and the practices of others in her school. She engaged fully with the principles of the Curriculum for Excellence and used her experience and professional identity to design modules that would make learning more engaging and relevant to all students in Milltown.

8. Case Study 4: Lesson starters to recap prior knowledge

Introduction

Amy is a science and physics teacher from Scotland with five years teaching experience at the time of research. She worked in Woodhill for the past three years and prior to that she worked in two different schools, each for one year. She completed her teaching probation year in Inverness. A main point of interest from observing Amy's lessons was that student behaviour was inhibiting her intended formative assessment practice, this was a focal point of her evaluative episode. In interview Amy spoke at length about her intended formative assessment practice: questioning. Amy explained in interview how asking questions was a key facet in her teaching practice. Moreover, she believed it was important for her students to be actively involved in her lessons by asking questions:

> "They kind of like to ask questions and I give them loads of opportunities to do that, because I think that's the best way for them to learn, always going and asking the questions…I'm just trying to explain to them in a way that they understand it and then ask them questions based on what I've told them…I think it enhances their learning and if they're asking questions, then they're kind of more engaged in the lesson as well."

However, a contradiction arose between what was observed in Amy's lessons and the formative assessment practices she discussed in interview. From interview and observation data it was apparent that Amy was trying to utilise two tools in her practice to enact formative assessment: lesson starters and questioning.

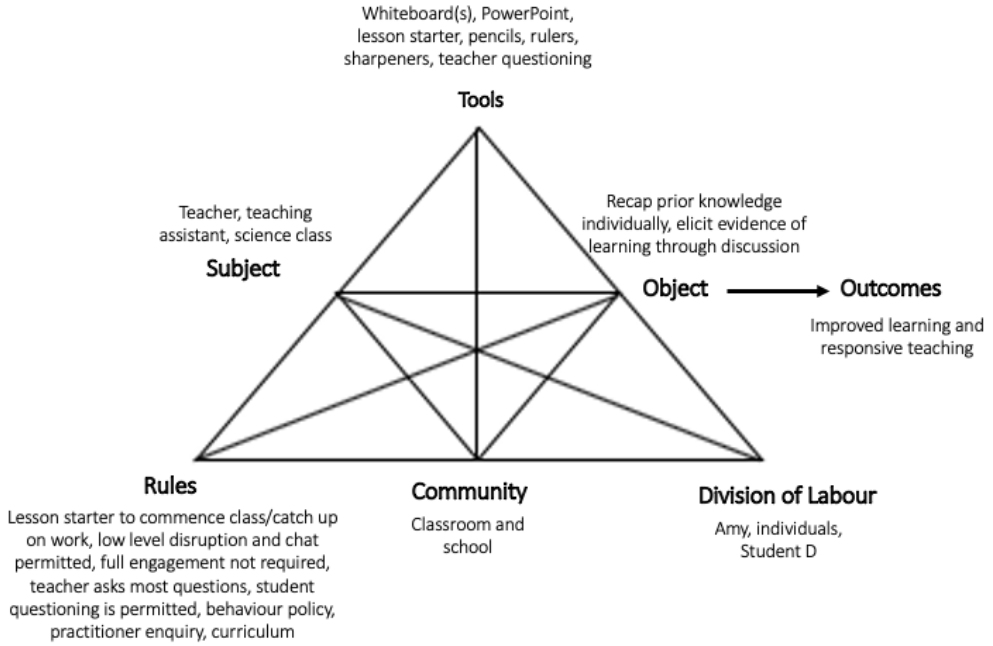

Figure 15: Diagrammatic representation of Amy's Activity System

By focusing on singular evaluative episode, it was uncovered that the biggest factors impeding Amy's formative assessment enactment were her division of labour and classroom management. However not all of Amy's activity system demonstrated insufficient enactment. An interesting finding was that her students found her approachable and open to helping them when needed. Analysis of the school community through Amy's activity system revealed that it was the schools' positive culture that was helping students to interact with their teachers like Amy. Amy's activity system is presented in Figure 15.

Amy's Evaluative Episode

The evaluative episode analysed in Table 12 explored Amy's use of lesson starters to build on students' prior knowledge and elicit evidence of their understanding of current content. Amy made use of lesson starters at the beginning of the four observation periods with her. The evaluative episode came from lesson 2 and was chosen based on its capacity to outline Amy's use of lesson starters and her questioning techniques. At the time of research, the students were working on the topic of biodiversity which linked to the science experience and outcome of:

> "I can identify and classify examples of living things, past and present, to help me appreciate their diversity. I can relate physical and behavioural characteristics to their survival or extinction."
>
> (Scottish Government, 2010, p. 2)

This episode opened at the beginning of the lesson. Prior to students entering the room Amy had lesson starter questions already displayed on an interactive whiteboard via a PowerPoint presentation. This was common in all her lessons. The episode began with students settling into their seats and the intention was that they started the lesson starter as soon as they entered the room.

Time Stamp	**Action**	**Description**	**Teacher/Student Talk**	**Activity Theory Elements**
0:00	Students are supposed to complete lesson starter questions individually.	The three lesson starter questions are on the board. Majority of students are chatting and not engaging with the task while Amy tries to take attendance.	**Student D:** Miss can I go to the toilet? **Teacher:** Can you do the lesson starter for me first please? **Student D:** I don't want to do it. **Teacher:** Try the lesson starter for me please? **Student D:** I don't want to do it.	**Object:** Recap prior knowledge individually. **Tools:** Interactive Whiteboard, PowerPoint with

		Student D leaves his seat and approaches the teacher's desk.	**Teacher:** But I do **Student D:** (*Returning to his desk)* I'm not writing anything I am just going to sit here.	lesson starter questions. **Rules:** begin lesson starter once you are sit-down, low-level disruption and chat is permitted, full student engagement not required. **DOL:** Teacher planned activity with students in control of engagement with task.
0:50	Students are to complete lesson starter questions individually.	Students are still not fully engaged in the task. Student B is late to class and starts chatting to student D. Teacher hands out pencils, sharpeners, and rulers to students who don't have them. She then has a short discussion with the teaching assistant about Student D (*inaudible*) and hands her his jotter. Some students are completing the lesson starter. Student D is speaking aloud trying to distract the teacher. The teaching assistant	*(This conversation begins after the teaching assistant has approached the teacher for the second time, the teaching assistant asks the teacher to come and speak with Student D)* **Teacher:** Can you sit in your place please Student D, you can't sit up there (*he is sitting on the desk at the back of the room*). **Student D:** Miss can I go to the toilet? **Teacher:** You do this for me please. You do this for me, and you get to go to the toilet. Student D you do not get to make the decisions in this class. **Student D:** I'm not writing. Teacher: That's not my decision, that is for you to make. You're here to learn, that is why you are in school.	**Object:** Recap prior knowledge individually. **Tools:** Teacher talk, lesson starter, pencils, rulers, sharpeners. **Rules:** Low level disruption, full student engagement not required. **DOL:** Power struggle between teacher and Student D.

		approaches the teacher again about Student D. The teacher goes down to his desk. She remains very calm while speaking with Student D.	**Student D:** I can decide if I use my energy in writing something I don't care about. **Teacher:** Right enough, can you come off that please *(he is sitting on the desk),* and can you sit in your seat thank you *(pause)* Student D can you do the lesson starter? I've asked you to do the lesson starter, I'm not going to ask again. You have asked to use the toilet; I have asked you to do the lessons starter so as soon as you do the lesson starter *(she is interrupted by Student D).* **Student D:** I'll write it out, but I won't do any of it. **Teacher:** As soon as you do then you can go to the toilet.	
3:30	Students are supposed to complete lesson starter questions individually.	Majority of students have now quietened down, and the teacher is handing out more resources. She has a chat with a student who was absent in the previous lesson. She tells him to answer whatever questions he can and that he will be able to catch up in this lesson. Student D is finished with his work, and he is permitted to go to the toilet. He tries to distract other students by saying goodbye to them	**Student I:** Miss what's a paired statement key? **Teacher:** You weren't here for it so what to do is *(pause)* you do 1 and 2 right and we will go over what that is. Hopefully you'll catch on to it today.	**Object:** Recap prior knowledge individually. **Tools:** Lesson starter, asking the teacher questions is permitted. **Rules:** use lesson starter to catch up on content missed.

		individually as he leaves the room.		
5:40	Teacher prepares her separate whiteboard to write the lesson starter answers on	The teacher is at the top of the room at a whiteboard adjacent to the interactive whiteboard. She rewrites the lesson starter questions. Students continue with the lesson starter task.		**Tools:** Lesson starter, separate whiteboard for writing. **Rules:** Teacher writes the lesson starter on the whiteboard. **DOL:** Teacher in control.
6:04	Discussion following the lesson starter task	The teacher is at the top of the room and begins a discussion on the answers to the lesson starter. As students give her answers she writes on the whiteboard. She engages with a variety of different students during this period. There is still some disengagement and distractions going on during the question-and-answer discussion. The teacher has difficulties with the behaviour of some students.	**Teacher:** Okay so we have finished. Question number 1, what is a population, what is a population *(she points at a student in the front row).* **Student A:** the total number of organisms in one place. **Teacher:** Excellent, *(writes on board)* the total number of one type *(stops writing and turns around).* Student B you have a bad habit of turning around you need to stay in your place *(continues writing on board)* In a habitat, is that what you said yeah? **Student A:** Yeah. **Teacher:** Perfect. And so, what's a habitat? Who can tell me what a habitat is? *(She ignores some hands up)* Student C can you remember what a habitat is? **Student D:** *(Entering the classroom after returning from the toilet)* I don't. **Student C:** No. **Teacher:** No, Student B, what is a habitat?	**Object:** Elicit evidence of student understanding through class discussion. **Tools:** Lesson starter, teacher questioning, seating plan, whiteboard, and marker. **Rules:** Low level disruption and chat is permitted, full student engagement not required, teacher asks the questions. **DOL:** Teacher controls the questioning but

			Student B: Somewhere someone lives. **Teacher:** Excellent, it is the place an animal lives *(writes her answer on the board, simultaneously Student D is taking aloud trying to distract other students at this point).* **Student B:** Miss what is number 3? **Teacher:** Those are paired statements remember? This has this, that has that. *(Low level of chatting among students is continuous at this point)* Shhh. So, a paired statement key for the birds on the board. So, we got a duck, a budgie, a swan, and a magpie. Who would like to start? *(No hands go up; she waits one second)* Whose got a paired statement key for this? *(She looks at her seating plan)* Student E. **Student E:** If it has black on it it's a magpie *(Student D continues to speak loudly to the people around him).* **Teacher:** (*Writes Student E's answer on the board)* Excellent so if the animal is black and white it's a magpie. So, what we do for those of us who were off, we pick a distinct feature of one of the animals and we start with that, so if the animal is black and white it is a magpie right. So, we have three statements, or six statement. One statement and a leading statement. So, Student B what could be the leading statement be then? **Student B:** For the magpie? **Teacher:** So, if the animal is black and white it is a magpie *(waits for his response).*	students in control of their level of engagement.

			Student E: Am. **Teacher:** *(Interjects)* So if it's not black and white. **Student E:** *(Initially inaudible as Student D is banging on his desk)* If the animal is white, go to number 2. **Teacher:** Fantastic, if the animal is white *(she writes the rest of the answer on the board).* So here is number 2. Shh *(Student D is still talking and banging on his desk, she ignores him).* So, if the animal is black and white it is a magpie, if the animal is white go to 2. *(She glances at seating plan again)* So Student F what is your leading statement for number 2? **Student F:** Am, I think it was for that one *(Student is unsure).* **Teacher:** no, not yet, who can help, whose got something *(glances at seating plan again)* Student G you got something? **Student G:** No. **Teacher:** No *(Student B puts his hand up),* Student B what do you think? **Student B:** If the animal has an orange beak it is a swan. **Teacher:** Excellent, well hold on *(she is unsure of his answer).* **Student C:** The duck kind of has an orange beak. **Teacher:** The ducks got an orange beak, well spotted. **Student C:** Miss the swans got a big, long neck. **Teacher:** Shhh, right okay don't shout out but put your hand up. Student H what do you think.	

			Student H: If the animal has a long neck, it is a swan. **Teacher:** Excellent if the animal has a long neck *(writes on board)* it's a swan. *(Student C says something inaudible to Student H)* Student C can you stop shouting out. **Student C:** I'm not shouting out. **Student D:** *(Shouts out)* Its where an animal lives. **Teacher:** *(Ignores Student D and continues writing)* So our leading statement if the animal what? What's our leading statement for the next one? *(No answer from students, little wait time given)* So we have already established black and white is a magpie, if its white go to 2 because we have three birds that are white. Student F *(her hand is up)* go for it. **Student F:** If the animal doesn't have a long neck, then it's not a swan. **Teacher:** If the animal doesn't have a long neck go to 3. *(Student D is trying to distract other students again by shouting out).* Shh *(she continues writing on the board and ignores him).* Right and then number 3, our leading statement, what is the difference between the duck and the budgie *(Student D is now banging something loudly on his desk once more)* what is the difference. *(Student B puts his hand up*). Can you see Student I what is the main difference between the duck and the budgie *(he begins to speak but she interrupts him)* the something? Shhh *(Student I is inaudible due to Student D banging on the desk.)* Shhh *(she repeats what*	

			he says) the budgie is slightly a different colour, but some people might still think its white. **Student J:** *(Shouts out)* It doesn't have a beak. **Teacher:** It's got a really short beak, doesn't it? So, you could say if it's got a short beak, it's a budgie. What do you think Student J? **Student J:** Isn't like a budgie small? Miss I've got that exact budgie that's on the board. **Teacher:** So, what we are going to say *(interrupted by Student D)*? **Student D:** Whose Student J? *(Again, trying to distract others)* **Teacher:** *(Writes on the board)* if the animal has a short beak, it's a budgie and our final statement is going to tell us that it's a duck. Student B *(has his hand up)* what is it? **Student B:** If the animal has orange feet it goes to number 4. *(Student C is now making popping noises with his mouth to distract Student B)* **Teacher:** Good has webbed orange feet. Can you stop that Student C? **Student D:** So, has my cat. So has my dad. **Teacher:** Shhh. Student C enough *(she is ignoring Student D).* **Student D:** So, has my dog. **Teacher:** Shhh. (*Moves on to the next task)*	

Table 12: Amy's Evaluative Episode

Analysis of Evaluative Episode

Amy's evaluative episode focused on building on students' prior knowledge through an individual lesson starter activity and subsequent class discussion. Of most interest in this episode was the division of labour. In Amy's science class there were significant classroom management issues at play putting the division of labour at times in the hands of the students in a way that was not conducive to learning. Analysis of her activity system explored this, while also considering how the object, tools, and rules of this Amy's activity system interplayed to enact formative assessment.

Object

The focus of this evaluative episode was to complete a lesson starter activity at the beginning of class. Lesson starters are a formative way of assessing students' prior knowledge and using that information to address issues and plan subsequent learning. This was to be achieved through two main objects. The first object was concerned with students recapping their prior knowledge individually through engagement with the lesson starter. The second object was to elicit evidence of student understanding through discussion using the lesson starter answers. Before looking at these objects it is important to understand what exactly a lesson starter is. It was considered as a tool of the activity system but for clarity it will be explained at this point. Lesson starters were used at the beginning of every observed science lesson in Woodhill (Scotland), with both Amy and Sophie. It was a whole school initiative aimed at to recapping prior knowledge among students especially in the science department. According to Amy:

> "A lesson starter is a really good way of questioning what they have done before… and you can see who's good at doing that and who's not good at doing that. Who needs a bit more help in doing that? And they are also kind of probes discussion, depending on what the questions are. It may be something like, what do you think this is? And then that probes discussion, you know?"

Amy explained it was a series of short lower order questions (normally three) based on prior learning intended to ensure that all students were up to date with content before moving on to new content. The first object of recapping prior knowledge was implemented through the lesson starter. Beginning at 0:00 and ending at 6:02 the first object saw students answering three questions into their science jotters (notebooks). At 6:02 the object moved on to eliciting evidence of student understanding through a discussion on the answers to the lesson starter. Both objects were intended to enact formative assessment, however, as is evident in the next

sections, the rules and division of labour hindered the objects being achieved and therefore the outcomes of improved learning and responsive teaching were not met.

Tools

Cited earlier, the main tool used in this activity was the lesson starter, shared with the students via a PowerPoint presentation on the interactive whiteboard at the top of the classroom. This lesson starter contained three questions based on learning from the preceding lesson:

1. What is a population?
2. What is a habitat?
3. Write a paired statement key for the following samples: duck, budgie, swan, magpie *(photos of birds were included on the PowerPoint)*

From examining the questions, question one and two were of a low order, they required basic recall on the part of the student and did not require deep cognitive thinking. Question 3 challenged the students more by creating a paired statement key based on photographs of birds. In the previous lesson Amy had covered paired statement keys comprehensively so this question was perhaps the most appropriate for Amy to ascertain if the students understood the content from the previous lesson. Formative assessment techniques that focus on questioning call for students to think deeply about what they are asked, and this was not the case with questions one and two. Perhaps because the lesson starter was used as an opening task for the lesson the questions were kept short and only required one specific answer on purpose to allow more time for new content, however by changing the questions to challenge students, Amy would have uncovered more about the students' current learning and the students would have been driven to engage more in the task. Conversely, when speaking about lesson starters with Amy's students during Q they commented that they found them useful:

Interviewer:	And what do you think of lesson starters, do you like them?
Woodhill Student 6:	Yeah, I like them because it gets you on task rather than just sitting chatting at the start.
Interviewer:	And do you think they're useful things to do?
Woodhill Student 6:	Yeah.

Interviewer:	What do you think of the lesson starters?
Woodhill Student 10:	Some of them can be quite difficult but most of them they are okay.

Interviewer: Do you find them useful?

Woodhill Student 10: Yes, because it reminds you what we have done from last period and tells you about the next period, so you know what you are going to be doing if it is the same topic.

Interviewer: What do you think of the lesson starters that you guys do in class?

Woodhill Student 12: They are easy because you have learned about it in previous lessons, so you know what the answer is all of the time.

Interviewer: Do you find it useful to do them?

Woodhill Student 12: Yes, because it is kind of like reflecting on what you have done. Like it acts as a reminder of what you have done in the class.

The student comments illustrated that they had contrasting opinions about the difficulty of the questions. Nonetheless, they expressed how useful lesson starters were in reminding them of previous learning. This was a positive outcome of the lesson starter for student learning even though the students were not greatly challenged by the questions.

In addition to the lesson starter there were other tools utilised in this episode. The physical tools included resources handed out to students including pencils, rulers, and pencil sharpeners. The main mental tool observed in this episode was the use of teacher questioning. The episode illustrated that there were different ways that Amy asked questions in class. Sometimes she used a printed seating plan to randomise what student she would ask, other times she expected students to put their hands up to answer her questions leading to confusion on their part. It was deduced that students weren't sure how to respond when Amy asked a question. This was compounded in interview where some students were unhappy with Amy's questioning techniques:

"Normally she will ask someone who does have their hand up. But if she feels someone has not answered for a while then she will try and get them to have an idea."

(Woodhill Student 8)

"People that are better in science they get asked questions much more… they don't put their hand up as well and just get asked.

(Woodhill Student 9)

"It is just like if Amy asks a question, we try to think about it and get the answer. Some people will put their hand up and answer it."

(Woodhill Student 10)

The students believed that Amy's questioning practices were not inclusive of all students in the class. This could be part of the reason why there was consistent low-level chat and disruption (discussed in the rules section) throughout this episode and other observations with Amy. However, in interview, Amy presented herself in interview as a teacher with advanced questioning skills. She believed her effective use of questioning played a fundamental role in improving student learning:

> "It (questioning) enhances their learning and if they're asking questions, then they're kind of more engaged in the lesson as well. It also shows me who is going to need more support. Who's not getting it yet, you know. Who's not reaching the learning outcome, and basically what else can I do to help support their learning."

She suggested that her questions served two purposes. She believed her questions kept students engaged in her lessons and provided her with the opportunity to help those who are having issues. However, the approach that Amy took the evaluative episode did not keep students engaged or helped her to find out who was having issues as there was low level disruption throughout the evaluative episode. This meant that not all students had to actively engage with her questions and could sit back and allow other students to do the work. Students being passive in their learning contradicts the fundamental outcome of formative assessment that if students are to improve they need to be actively involved in all learning processes (Wiliam & Thompson, 2007). Like Dylan and Matthew, Amy could not have identified issues that the passive students were having in class as they were not encouraged to engage with the task due to Amy's inconsistent questioning methods.

Another interesting finding about questioning from analysing Amy's evaluative episode was how she made use of student answers. From 6:02 onward, Amy engaged several individual students to answer the lesson starter questions. However, it was often the case that answer a student gave was not what she wrote down on the board. This was exemplified in two incidences where she wrote her preferred answer on the board:

Teacher: Okay so we have finished. Question number 1, what is a population, what is a population *(she points at a student in the front row).*

Student A: The total number of organisms in one place.

Teacher: Excellent, *(writes on board)* the total number of one type *(stops writing and turns around).* Student B you have a bad habit of turning around you need to

stay in your place *(continues writing on board)* In a habitat, is that what you said yeah?

Student A: Yeah.

Teacher: No, Student B, what is a habitat?

Student B: Somewhere someone lives.

Teacher: Excellent, it is the place an animal life.

The above excerpts from the evaluative episode illustrated that Amy was looking for a specific answer, and if the students did not provide that then she wrote up the answer she wanted anyway. This links to the concept of who is controlling the learning which is discussed under the heading of division of labour. It also discouraged students from engaging with Amy's questions as even when they answered her, their responses were not used. This did not encourage students to actively engage with Amy's lessons.

Rules

In this evaluative episode it was clear that the unspoken classroom rules were directing how the learning proceeded. For example, the rules of *low-level disruption*, and *full engagement not required from students*, showed that Amy was having classroom management difficulties with the students. This was evident when speaking with her in interview:

> "Well actually that class is very difficult to even get them to sit in their seats, some particular pupils to sit in their seats and actually answer questions, they just want to get up and they want to shout out all the time. So, there's a lot of behavioural issues most of the time."

The behavioural issues took up a lot of Amy's time, especially in this episode. At 0:00 the issues began with Student D unwilling to co-operate and engage with the lesson starter, this continued at 0:50. Then at 6:04 the dialogue showed Amy having to quieten down students to get them to pay attention. From analysis of the episode alone it was unclear why such classroom management issues existed in this class, however subsequent analysis of factors influencing this episode it was deduced that Woodhill's behaviour policy was at play when it came to the kinds of behaviours that were acceptable during lessons.

Other rules that were evident in the episode included those that were concerned with questioning. Amy preferred to be in control of who was asking questions in the class. This was

exemplified at 6:04 where it was Amy that was asking all the questions and some students were responding to her. There have been different techniques of questioning through all analysed episodes in Ireland and Scotland, so to repeat a previous analogy: Amy was playing ping-pong rather than basketball with the students (Wiliam, 2009) i.e., the questions went from Amy to a student and back to Amy without the opportunity for other students to contribute to given answers or refute an answer. This style of questioning was not challenging the students to think deeply about the previous class content, nor was Amy probing for understanding; if a student didn't have the correct answer, she just moved onto another student. This was evident with Student B who did not know what a habitat was (6:04).

What was conducive to learning with Amy's questions was that students were able to ask her questions if they were unsure of what they were doing. At 3:30 a student asked Amy for help as he was absent in the previous lesson. Although the question was logistics based rather than to do with the content of the lesson, it showed that this student felt he could approach his science teacher with difficulties. This was not uncommon with Amy's students. In interview many of them commented on her positive traits as a teacher that made her approachable and willing to help them:

> "She kind of makes you like science (laughing)…she does fun stuff…she doesn't really care what you ask she always tries to help you; she won't get you in trouble and stuff if you don't know the answer."
>
> (Woodhill Student 6)

> "If you are stuck on anything you can just ask her or if you don't know what to do. if you don't get something then you will ask the teacher…Then she will explain it to you the best she can and if you still don't understand it then you can just keep trying and she will keep explaining it to you until you get it."
>
> (Woodhill Student 7)

> "If I need to, I can ask the teacher a question."
>
> (Woodhill Student 8)

> "if I am struggling, I can ask the teacher and that."
>
> (Woodhill Student 9)

> "if you are stuck on something she won't just ignore you. If you have your hand up, she will come over and help you."
>
> (Woodhill Student 12)

So even though the evaluative episode demonstrated that the questioning skills that Amy employed were not in line with formative methods, her professional identity meant that students were not afraid to approach her with problems or questions they may have had. These findings suggested that when Amy controlled the questioning it was not conducive to improved learning but when students took control and asked questions, their learning benefited from engaging with Amy (see conversation with Student I at 3:30). This was an interesting finding in relation to the division of labour in Amy's activity system. As the next section outlines, Amy was largely in control of her lessons, but her students indicated that it was more beneficial to their learning when they asked the questions. Amy had a one direction only view of formative assessment practices whereby she controlled the learning, when in fact if she let them be more actively involved then they would be more engaged with their learning.

Division of Labour

The most insightful finding from Amy's evaluative episode was how the division of labour within the class was significantly impacting the quality of teaching and learning. Giving students shared control of learning in a lesson is important for learning, however in incidences where Amy relinquished control in this episode (0:00, 0:50, 3:30) and students needed to work individually, some students saw this as an opportunity to disengage and distract others. This raised the question as to why students disengaged when they needed to work alone? Analysis illustrated that when students were working alone (Student D had a teaching assistant however he was still required to complete the task individually) they were not challenged enough by a task, and the lesson starter questions were a clear example of this. Furthermore, previous sections discussed how students did not feel they needed to actively engage with tasks as Amy often did not involve everyone in discussions and sometimes disregarded student responses. Even though in interview Amy cited classroom management issues as a contributing factor to lack of engagement, if she had taken the time to reflect on her own teaching, she would have realised that active engagement by all would improve the learning in her science lessons. To link this to formative assessment, Amy was not adapting her teaching to respond to the needs of her students. There is a lack of research on formative assessment and student behaviour or classroom management, this was an emergent factor that was constraining formative assessment enactment in this research.

A difficult division of labour in Amy's class concerned her interactions with Student D. In interview she made specific reference to him when speaking about her relationship with the group:

> "There's quite a few that are good, putting their hands up and answering questions. There's a couple where their behaviour's a problem, and they're trying to spur others on. But there's not much you can do with that, that pupil as well, because it's just like how he is."

The evaluative episode showed numerous occasions where Amy interacted with this student with the intention of getting him to engage with the lesson starter. This was aided by the teaching assistant present in the lesson who approached Amy (at 2:08) so she would get him to complete his work. The engagement difficulties with Student D started at the very beginning of the episode (0:00) and reoccurred throughout (0:50 and 6:04) the episode. Additionally in other observed lessons with Amy this student continued with disruptive behaviour showing that it was not uncommon for him to act out in class. It was of interest that although Student D had a teaching assistant to help him stay on task, her influence on his learning did not go beyond her asking Amy for help with his behaviour. The teaching assistant was unable to keep Student D on task and this was inhibiting his learning and as seen in the evaluative episode, Amy had to intervene. Throughout the episode Amy was in a constant struggle with Student D for control over his learning, she wanted him to engage with some of the tasks students were completing. It unfolded in the episode that Student D did not know the answers to the lesson starter and felt he needed to remove himself from the class by asking to go to the toilet. This suggested that Student D did not want his peers knowing he was not able to answer the questions and acted out as a result. However, he had a teaching assistant for these reasons, but she was unable to manage his behaviour alone and get him to complete work. The interplay between Amy and Student D had an impact on the overall learning in this episode as a lot of Amy's time was dedicated to speaking with this student and convincing him to do his work. However, as the episode illustrated, Amy's interactions with Student D were very calm and focused on his work not his misbehaviour. She managed to get him to complete a small amount of work before letting him leave the room. She did well in negotiating with the student to do some of the work ahead of going to the bathroom. She was giving him options and focusing on the task completion. The easy option would be to just let him go out to the toilet, but she managed to get him to do a little work. This linked to Amy's professional identity whereby staying calm, ignoring distractions, and reasoning with the student she was in a small way able to promote his learning.

Factors Influencing this Episode

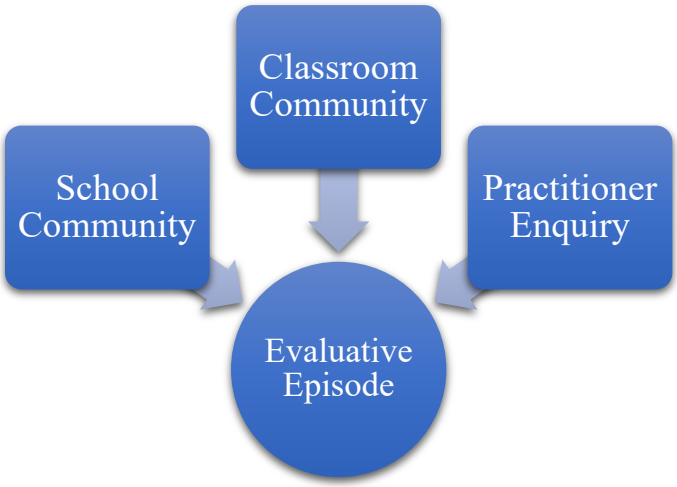

Figure 16: Factors influencing Amy's Practice

Amy's evaluative episode highlighted how student behaviour and division of labour were affecting her formative assessment enactment. Amy discussed in interview the importance she placed on questioning in her lessons but due to other constraints this was not strongly evident in her evaluative episode or her other observed lessons. Therefore, it was important to examine why such a discrepancy existed between Amy's intended formative assessment planning and her actual classroom practices. These factors are now examined to determine how they were shaping what was happening in Amy's classroom.

School Community

Considering Amy's evaluative episode as part of her activity system, the school community formed part of the base of the activity system and influenced her teaching, learning, and assessment practices. To begin, conversations with the head teacher of Woodhill suggested that the school was a caring place where strong relationships were built among members of the school community:

> "I think we are a very welcoming school…I think that's why young people are doing so well because young people are known, they're known well, they're cared for and they're seen as being their whole person not just, you know, what percentage they are in terms of our achievement and attainment and all of that, it's about that child as a person and that real dignity for each other as well and I think's a strength of the relationships between staff and staff, staff and pupils, pupils and pupils, it's that real sense of the dignity of it and the worth of everybody."

The head teacher painted a positive picture of Woodhill and its surrounding community. The school was known to "buck the trend", and this was commented on by both the head teacher and Amy. This meant that although the students were from a socio-economic disadvantaged area, their attainment record was very good. Amy was very aware of the students' socio-economic backgrounds in interview:

> "I don't see the point anymore in shouting at a pupil because they'll just shout back, especially in this area, because again quite a few of them who might be misbehaving in the class, it's most likely that they've not had a great day. They haven't had a great morning. And it's their background. So, having that kind of calm, being like right, this is what you're doing, stop doing it, that kind of thing. Just being a bit blatant about it."

Woodhill had created a positive learning culture in their school and were very proud of their relationship with the community. This linked to a sociocultural understanding of formative assessment where societal factors such as culture, interaction, and collaboration influence learning. This was evidenced in the interview with the head teacher:

> "there's a number of events put on for parents to keep them in and around about the school and because they feel invested in this school they want to come to them and they turn out, we don't have an issue over turn out at parents' information evenings or parents' nights…We have other things where the maths department are really good at putting on home learning events so they bring the parents in to show them how we teach maths these days so they can support their young people with their homework, all these kinds of things that schools do."

Classroom Community

A common thread in the analysis were the behaviour issues Amy was having with this group. The classroom community were considered as part of the subject of the activity system as well as the community at the bottom of the triangle, see Figure 15. In interview Amy commented that she had to arrange the class according to behaviour so she could optimise the learning. This is not favourable for lessons that incorporate formative assessment practices. When students are arranged by mixed ability, where both high achievers and low achievers share the same desk space, they can act as instructional resources for one another and improve learning (Boaler, 2008; Boaler & Staples, 2008). This classroom community was inhibiting formative assessment to the extent that Amy commented in interview that it was the main reason she was

unable to enact formative assessment with her tools (lesson starters and questioning). Because of this Amy's lessons were often teacher focused with little time given to active, student led activities because of difficult behaviour. This was felt by her students who commented that the constant disruptions were impeding their learning in science class:

> "There is a lot of disruption all the time, so it is kind of holding up your learning."
>
> (Woodhill Student 8)

> "Working on my own is better because sometimes if nobody is around me, I can concentrate more, and they might be like talking about something else and it makes me want to talk about it and puts me off."
>
> (Woodhill Student 10)

This links back to the tension in the division of labour of Amy's activity system discussed earlier. Because students often got distracted in her lessons it meant that she was the one leading the lesson and getting students to complete individualised work to minimise disruption. This showed a disequilibrium in Amy's activity system: she was caught between a rock and a hard place in relation to student activity. Because she was in control and students were therefore passive in their learning, they disengaged, however if she had relinquished some control and given the students the opportunity to engage more with their learning, they would have improved learning and perhaps behaviour. However, Amy was unable to do this because she was not confident in her classroom management skills with this group.

Practitioner Enquiry

So far, the factors influencing this evaluative episode have been negative and as a result formative assessment enactment was diminished. However the situation was not all negative as there existed one positive school rule that was acting on Amy's practice that was enhancing her formative assessment practices: practitioner enquiry (Menter, Elliot, Hulme, Lewin, & Lowden, 2011). This type of individualised professional development was ongoing in Woodhill and the head teacher discussed its implementation in interview:

> "We have moved to an approach where every member of staff is now going to undertake a practitioner enquiry, and that practitioner enquiry will be related to a learning and teaching intervention that is evidenced to close a gap and use attainment for all. So, they are all in the process of identifying what they might be taking forward, some it's metacognition, self-regulation."

In Woodhill there was an option for teachers to use their 35 hours of mandatory continual professional development to undertake a research-based practitioner enquiry. It meant that teachers had a certain level of agency over their preferred methods for professional development. The head teacher believed it had been welcomed by her staff:

> "people choose whether to sign up for it or not, but everybody has embraced it, and everybody is doing it, which is great."

This was evident with Amy when asked about the professional development she had experienced and what she felt was good for her practice:

> "I really like questioning as well. I mean that was one thing that I did a practitioner enquiry on as well…It was like uses of questioning and how it benefits people's learning ... Because I just thought, well they need to ask questions. If they don't ask the questions, I don't know if they've understood it. If they ask a question, or their partner can explain it, then I know that they'll explain it in a different way from me."

The quotation from Amy regarding practitioner enquiry suggests she is committed to gaining knowledge on student learning i.e., knowing where students are at in their learning. Amy was somewhere between learning and practicing the *letter* of formative assessment in her practice (DeLuca et al., 2019; Marshall & Drummond, 2006). She had taken the initiative to engage with professional learning on formative assessment however as discussed in the tools section above this was not observed effectively in her lessons. This once again links back to the behaviour problems that appear to be encapsulating the rules, tools, division of labour, and the community of Amy's activity system.

Conclusion

By focusing on Amy's evaluative episode as part of the activity system, her practices were analysed in detail. The analysis uncovered a disequilibrium in Amy's activity system that was stemming from the division of labour in learning. Amy stated this was due to classroom management issues however a deeper analysis showed that by Amy being in control of the lesson, the students felt they were not actively involved in their own learning and as a result did not engage fully with class activities. Looking at object|outcome dichotomy, and the purpose of lesson starters to recap prior knowledge, it was concluded that Amy did not reach the intended outcomes of a formative assessment activity system: improved learning and responsive teaching. This was partly because Amy did not involve all students in her class discussions and sometimes got distracted by behaviour problems. There was a teaching

assistant in Amy's lessons to help with one student's additional learning needs however she did not have any effect on this student acting out in class. Although in terms of a formative assessment activity system, the data showed enactment was ineffective, the school community was a positive aspect of Amy's activity system that held the potential to improve teaching, learning, and assessment practices in her lessons. Practitioner enquiry and the positive school culture meant that the resources were there for Amy to engage more with formative assessment but at the time of research this had not yet been actualised.

9. Student Beliefs about Teaching, Learning, and Assessment: A Q Methodology Analysis

Introduction

This chapter expands the fourth objective of the research: to examine students' beliefs about the teaching, learning, and assessment practices enacted in their school and science classes. Data for this chapter arose from the Q methodology conducted with students on a one-to-one basis. To reiterate on what was discussed in the methodology chapter, there are five main steps in carrying out a Q activity (McKeown & Thomas, 2013).

1. *Creating the Q samples:* 48 statements were chosen from a concourse of 73.
2. *Selecting the research participants:* 6 students from each lower second level science class were chosen, 48 students in total took part in the Q methodology.
3. *The Q sort activity:* Each student ranked 48 statement cards onto a placemat in a forced normal distribution of strongly agree (-4) to strongly disagree (+4).
4. *Factor analysis:* Quantitative data were analysed using factor analysis facilitated by PQMethod software (Schmolck & Atkinson, 2002).
5. *Factor interpretation:* The statistically significant factor arrays from each country were interpreted. Qualitative data were coded thematically using MAXQDA.

This chapter is presented in two main parts. Firstly data, both qualitative and quantitative from both countries are presented separately. Then the data were examined for their similarities and differences both within and between countries. The qualitative interview data were analysed through the lens of activity theory, with key elements of the activity triangle forming part of the coding process (Engeström, 1987). The chapter concludes by summarising the key learnings from carrying out the Q methodology with students.

Findings from Ireland

24 students in Ireland participated in the Q activity, 12 from each school. Of those students 13 were female and 11 were male. In Oakpark, student 1-6 were in Matthew's class and student 7-12 were in Rebecca's. In Greenview, students 1-6 were in Dylan's class and 7-12 were in Lilly's class. Table 13 outlines the factors that had a defining sort greater than 0.37 (meaning the result is significant at $p<0.01$). X indicates a defining sort.

Student	Factor 1 Loading	Factor 2 Loading
Oakpark Student 1	0.7460X	0.1467
Oakpark Student 2	0.6299X	-0.1362
Oakpark Student 3	0.6728X	-0.0300
Oakpark Student 4	0.2739	-0.5373X
Oakpark Student 5	0.5663X	0.1445
Oakpark Student 6	0.6512X	-0.3087
Oakpark Student 7	0.6993X	-0.3607
Oakpark Student 8	0.7381X	0.3337
Oakpark Student 9	0.6722X	-0.0099
Oakpark Student 10	0.5121X	-0.1994
Oakpark Student 11	0.5902X	-0.0207
Oakpark Student 12	0.7949X	-0.0552
Greenview Student 1	0.7537X	0.1799
Greenview Student 2	0.7025X	-0.3811
Greenview Student 3	0.7273X	-0.1547
Greenview Student 4	0.7126X	-0.1229
Greenview Student 5	0.6566X	-0.1143
Greenview Student 6	0.5860X	-0.0137
Greenview Student 7	0.6829X	0.3617
Greenview Student 8	0.4904X	-0.0110
Greenview Student 9	0.6100X	-0.1929
Greenview Student 10	0.6829X	0.3617
Greenview Student 11	0.7701X	-0.1559
Greenview Student 12	0.5714X	-0.3548

Table 13: Factor loadings for students from Ireland

23 out of the 24 students loaded on the same factor know as Factor 1, categorised based on their preference for teacher-led learning. The remaining student had their own factor, Factor 2 which was about being an independent and exam focused learner. Having 96% of the students contained in one factor demonstrated their similarities in opinions on teaching, learning, and

assessment in their schools. Obtaining consistency like this is important in the Q methodology where the objective is to gather the shared viewpoints of the participants. However, it is not uncommon to have an anomaly i.e., the Factor 2 student. These special factors can add richness to the data and demonstrate contrasting opinions by participants. There was minimum correlation between the two factors. Statement rankings (+4 to -4) and Z-scores[18] were used to analyse the level of disagreement or agreement the students had toward a statement. A negative rank/Z-score indicated agreement, while a positive rank/Z-score indicated disagreement.

The two factors were interpreted, and qualitative interview data added to the richness of the findings. Table 14 outlines each Q statement with its factor ranking and Z-score for the students from Ireland.

Statement Number	Statement	Ireland Factor 1 Rank	Ireland Factor 2 Rank	Factor 1 Z-Score	Factor 2 Z-Score
1	Doing well in science depends on having a good science teacher	1	-2	0.53	-0.90
2	I learn science best when I work on my own	1	-4	0.68	-1.81
3	In science classes, there is no room for expressing your own ideas	4	1	1.84	0.45
4	I am aware of what I have learned in science	-3	-3	-1.18	-1.36
5	I like exams because the results show me how I am doing	-2	-3	-0.75	-1.36
6	I help other members of my group if they are stuck	-4	-1	-1.18	-0.45
7	I understand how to improve my learning using feedback	-1	-4	-0.62	-1.81
8	The purpose of science class is to prepare for exams	2	-2	0.75	-0.90
9	The teacher always grades our work	0	2	-0.26	0.90
10	My parents/guardians check my homework is done	-1	4	-0.42	1.81
11	I am good at studying science outside of school	1	-1	-0.07	-0.45
12	In science, we're always doing the same exercises repeatedly	4	1	1.91	0.45
13	My parents/guardians help me with my science work	0	4	-0.23	1.81
14	There is no point in doing science homework	3	1	1.72	0.45
15	A lot of the time I am unsure of what I am learning during a science lesson	3	2	1.59	0.90
16	When other students ask questions in class, I get the opportunity to answer them	1	0	-0.03	0.00

[18] Z-scores indicate the number of standard deviations from the mean a data point lies.

17	I enjoy working as a team	-1	3	-0.71	1.36
18	I am not responsible for the learning of others during group	2	-1	0.69	-0.45
19	I am the only person responsible for my learning	1	0	0.23	0.00
20	I check over a piece of work once it is complete	0	-3	0.26	-1.36
21	The teacher asks questions that we all can answer	-1	2	0.58	0.90
22	I feel I can ask questions in class	-4	-1	-1.60	-0.45
23	I have enough time to think before answering a question	0	0	-0.38	0.00
24	At the end of most science lessons, it is clear to me what I have learned	-2	0	-0.73	0.00
25	Science lessons are different from other lessons	1	0	-0.02	0.00
26	The teacher lets us know what we will learn in a lesson	-3	0	-1.16	0.00
27	I know exactly what is expected of me when I work in small groups	-1	-2	-0.42	-0.90
28	I feel I can't ask the teacher if I am struggling with science	3	1	1.75	0.45
29	I am aware of what I need to revise in science	-4	-1	-1.41	-0.45
30	My teacher is the best person for describing concepts in science	-2	-2	-0.97	-0.90
31	I often give my classmates feedback on their work	0	0	-0.18	0.00
32	I think that the feedback we receive from the teacher is fair	-3	-1	-1.09	-0.45
33	It benefits my learning of science when we work in small groups	0	3	-0.29	1.36
34	Exams are boring	2	1	0.88	0.45
35	The class shares their ideas about a topic with the teacher	-1	-1	-0.54	-0.45
36	I feel safe when answering questions in class	-3	-3	-1.10	-1.36
37	I never reflect on how I am doing in science	2	2	1.44	0.90
38	Working in groups means that everyone in the group learns something	0	3	-0.40	1.36
39	I value feedback my classmates give me on my work	0	2	-0.25	0.90
40	I set goals for my learning	-1	-2	-0.52	-0.90
41	The teacher is the only person in the class that gives feedback	2	1	1.25	0.45
42	Mostly I feel happy in my science classes	-2	2	-0.78	0.90
43	The teacher’s feedback to me is unhelpful	4	1	2.01	0.45
44	Certain students are asked more questions in class than others	2	0	0.86	0.00
45	Doing exams motivates me to work harder in science	-2	-4	-0.76	-1.81

46	The pace of most science lessons is too fast	3	3	1.56	1.36
47	I often ask other students in the class questions	1	4	0.04	1.81
48	If I don't understand something in science, I work on it until I get it right	-2	-2	-0.88	0.90

Table 14: Statement rankings and Z-scores from Ireland

Factor Interpretation

Factor 1: Teacher-led Learning

The students making up this factor had strong opinions on the division of labour in their science lessons and the variety of tools that were promoting and/or inhibiting their learning. Teacher feedback, the teacher clarifying learning intentions and sharing criteria for success, and homework were valuable tools for these students to improve their learning. Table 15 displays these 23 students' shared viewpoints on the statements. Positive values (in brackets on the table) indicate disagreement and negative values indicate agreement with the statement.

Strongly Agree	**Neutral/Not Sure**	**Strongly Disagree**
22.I feel I can ask questions in class (-4)	9. The teacher always grades our work (0)	43. The teacher's feedback to me is unhelpful (4)
29.I am aware of what I need to revise in science (-4)	13. My parents/guardians help me with my science work (0)	12. In science, we're always doing the same exercises repeatedly (4)
6. I help other members of my group if they are stuck (-4)	20. I check over a piece of work once it is complete (0)	3. In science classes, there is no room for expressing your own ideas (4)
4. I am aware of what I have learned in science (-3)	23. I have enough time to think before answering a question (0)	28. I feel I can't ask the teacher if I am struggling with science (3)
26. The teacher lets us know what we will learn in a lesson (-3)	31. I often give my classmates feedback on their work (0)	14. There is no point in doing science homework (3)
36. I feel safe when answering questions in class (-3)	33. It benefits my learning of science when we work in small groups (0)	15. A lot of the time I am unsure of what I am learning during a science lesson (3)
32. I think the feedback we receive from the teacher is fair (-3)	38. Working in groups means that everyone in the group learns something (0)	46. The pace of most science lessons is too fast (3)
	39. I value feedback my classmates give me on my work (0)	

Table 15: Ireland Factor 1 student viewpoints

Division of Labour

Arising from the student data were some interesting findings regarding who was in control of teaching, learning, and assessment practices (the division of labour) in science classes. The evaluative episodes from Ireland (Dylan and Matthew) suggested that division of labour was

largely in the hands of the teacher with little opportunity for students to actively engage with their peers in learning tasks. This was echoed through Q where the Factor 1 students were unsure if working with others was benefitting their learning (statement 33: It benefits my learning of science when we work in small groups, statement 38: Working in groups means that everyone in the group learns something), if the feedback they receive from their peers helped them to improve (statement 39: I value feedback my classmates give me on my work) or if they took part in peer assessment (feedback) at all (statement 31: I often give my classmates feedback on their work). However, they strongly agreed that they would provide help to their classmates if they needed it (statement 6: I help other members of my group if they are stuck). This was interesting as it showed the students were willing to get involved with peer learning but were not provided the opportunity to do so in class. They were divided on the benefits of learning with their peers. Some students were positive about the process:

> "I feel like when you're doing group work the other people in your group can help you and you can also help the people in your group so you can learn new things and they can help you or you can help them."
>
> (Greenview Student 1)

> "if they are stuck and you know the answer then you could help with that. Then if you are stuck on an answer, they can help you".
>
> (Oakpark Student 8)

> "When I work with others, I learn some things that I might not know before."
>
> (Greenview Student 6)

While others did not see the benefit of learning from one another:

> "I'll help them if they need help but like the teacher would probably explain stuff better than me, I'd just confuse them."
>
> (Greenview Student 9)

> "It doesn't always mean that everyone learns because there are some people that don't care and there's other people that don't want to do work whatsoever or make you do the work. There's people like that so it doesn't always mean someone learns, there could just be one or two people doing all the work because others won't".
>
> (Greenview Student 10)

One student felt that it was subject and/or topic dependent whether they benefited from group work:

> "it depends on the subject sometimes if it's something that I feel like I just work better at by myself and then other times I feel like it's probably more of people together to help each other. Then it depends on the topic."
>
> (Oakpark Student 9)

Field notes and video from observations of all the participating teachers from Ireland showed that they often put students working in groups, but the benefit of this for student learning was not significant. In interview Matthew was the only Irish teacher to elaborate on group work activities. However, his rationale for peer learning was to break up long science lessons[19]. Therefore, it was not surprising that the Q data suggested that group work was not having a significant effect on learning as the elements needed for groups to function formatively[20] were not being enacted. There was a clear mismatch between teachers setting up group tasks and the extent to which they were functioning formatively to improve student learning. This represented a surface level enactment of peer learning where peer learning served the purpose of giving the teacher a break from direct instruction rather than promoting learning skills and student autonomy. Additionally, this linked to the duration of science lessons in Oakpark where the teachers felt that the 100 minutes of instruction once a week for first year students was unsuitable to meet the needs of the science curriculum. Lesson duration and timetabling were considered as school rules in an activity system that the subject of the system cannot change without other members of the school community being involved, e.g., school leaders.

The students in Ireland had differing viewpoints about the benefits of working in groups, however they were clearer on how they felt about peer feedback. In Oakpark a strong reliance on the teacher for *the right answer* was very much engrained in these students. This was in line with data from Matthew's evaluative episodes where division of labour remained largely in the hands of the teacher, even though Matthew insisted he coached students' self-regulatory skills and the school had a dedicated module for first year students to work on these skills. However, it is not uncommon for students to resist peer assessment (Gielen et al., 2010; Harris & Brown, 2013) and rely on the teacher for help. The students explained:

> "If you are just wondering how to, let's say if you have to do an experiment and you are not sure how to do the step you could just ask the person beside you but if you have

[19] 1st year science lessons in Oakpark were 100 minutes in duration, a double lesson once a week.
[20] These elements are positive interdependence, individual accountability, face-to-face promotive interaction, appropriate use of collaborative skills, and group processing (Johnson et al., 1989)

a question about science most of the time you should ask your teacher because your friends are not qualified as a teacher."

(Oakpark Student 2)

"I do value the feedback my classmates give me but if it is not useful feedback I just kind of ignore it."

(Oakpark Student 6)

"Sometimes if you are friends with the person, they might not give proper feedback."

(Oakpark Student 10)

The comments from Oakpark Student 2 and Oakpark Student 10 are presented hypothetically, they are not considering actual learning events that took place around peer learning. Therefore, these comments suggest that peer feedback was not the norm in their classrooms as they couldn't list specific examples of when it occurred. Interestingly, when peer feedback practices did occur (these were not observed in practice), many students commented on the type of peer feedback they were familiar with:

"If they give you your work is really neat then I'd be really proud and say that is my work there. I will continue to do that work because that is what people expect of me because they are always saying that is lovely handwriting or that is a great project or whatever they are saying…if we are doing projects and stuff with our pairs, we go around the classroom and say that is a good project or that is nice handwriting."

(Oakpark Student 3)

Interviewer: And what kind of feedback did they give you?

Greenview Student 2: They said that it was good but like next time like make the writing bigger on the poster.

This feedback was focused on what the students could identify without much cognitive effort: neat handwriting and font size. This type of feedback is not focused on improving learning and was interpreted as *evaluation* in the behaviourist view of learning. This suggested that teachers had not provided their students with guidance on how to use feedback to improve learning. Matthew indicated in interview that he was planning on getting students to peer assess projects using success criteria. However, it was clear from the data that students were not familiar with this process in their science lessons. Again, this circles back to a surface level interpretation of formative assessment, students were *doing* peer assessment but the formative benefit of it helping them to improve their learning was not evident.

Tools

Positive Teacher Student Relationships

The relationship between science teachers and their students was identified by the students as a tool that contributed to their learning. This factor can be considered as part of the subject element of an activity system. The students in Ireland noted that their science classrooms were safe learning spaces where they could actively participate in classroom activities. The quantitative data indicated that students were comfortable with asking a question (statement 22: I feel I can ask questions in class, statement 28: I feel I can't ask the teacher if I am struggling with science) and were not afraid of getting an answer wrong or not knowing an answer when asked a question (statement 36: I feel safe when answering questions in class). The qualitative data added some significance to this finding:

> "I don't feel like someone is going to laugh at me if I answer a question wrong. It is just Matthew will just tell me why I got the question wrong and tell me what the right answer would be."
>
> (Oakpark Student 1)

> "The teacher says no matter what we can always ask a question."
>
> (Oakpark Student 9)

The interview data above also suggest that students had positive learning relationships with their teachers. Research in the Irish context has found that positive teacher student relationships have a significant effect on student performance (Smyth, 1999). The students in Greenview had very positive viewpoints to share about their science teachers:

> "He's very nice and he's helpful as well."
>
> (Greenview Student 6)

> "He's just very open and very nice about how he answers questions."
>
> (Greenview Student 4)

> "She's (Lilly) nice, she's friendly, so she won't shout at you or anything, and she'll make you learn lots of stuff…with all her fun exercises and her fun tone…so if you're around her you want to learn…she has a fun vibe you could say."
>
> (Greenview Student 12)

Linking this back to data from evaluative episodes, analysis showed that Dylan's enactment of formative assessment through tools was weak, however the student data uncovered a different tool of Dylan's that was helping them to improve their learning: being approachable. The students in Dylan's class made it clear that by him being approachable, he was able to ensure

a positive learning experience for students. From the Q data it was ascertained that the students believed that improved learning came from Dylan being approachable when they required direct attention and guidance to support their learning. Qualitative data exemplified this finding:

> "If I'm struggling, I'll always ask the teacher and I always feel like I can ask a teacher a question that I'm struggling on so I can get the answer."
>
> (Greenview Student 1)

> "He'd explain it like really nice like to you and he won't make you feel like stupid in a way… It's just that like he's really understanding about things and it's just like I feel comfortable around him."
>
> (Greenview Student 2)

Although the quotes above are vague on the specifics of how Dylan's approachability was helping them to improve their learning, they did feel comfortable to openly ask the teacher questions as they felt he was approachable. Yet, in the three observation periods with Dylan, students asking Dylan questions in this way was not observed. Furthermore, in interview Dylan did not comment on his creation of a positive learning environment in his lessons and did not make the link between his approachability and improving student learning. Teacher approachability is considered as a tool for formative assessment based mostly on the quantitative student data however this was not evidenced in the video or teacher interview data.

Feedback

Students in both schools from Ireland felt strongly about teacher feedback. The statement *the teacher's feedback to me is unhelpful* held the highest Z-score of 2.013 indicating strong disagreement. This statement, along with another concerning feedback (statement 32: I think that the feedback we receive from the teacher is fair) being included in the strongest opinion sections showed that the students believed that their teachers were using feedback as a tool in their classroom to improve their learning. Curiously, this was not observed in evaluative episodes or other classroom observations in this research. This raised a question about students' understanding of effective feedback. Formative assessment literature defines feedback as anything that might strengthen the students' capacity to self-regulate their own performance (Nicol & Macfarlane-Dick, 2006). In total there were 82 comments from the students in Ireland about feedback. 22 out of the 24 students in Factor 1 had a comment to add on how their teachers' feedback was helpful to them. In Oakpark comments concerning feedback fell into

two main categories: feedback on generic concepts that had little to do with strengthening student self-regulation:

> "I was doing a graph and I had only done in the dots, and he just said maybe next time to make it clearly do the line through it and I don't that and I found it much easier."
>
> (Oakpark Student 1)

Interviewer:	Can you give me some feedback that you got in an assessment?
Oakpark Student 3:	That you need to add more colour or stuff like that. You need a bigger diagram or anything.

Interviewer:	What kind of feedback would you get in class or in a test or an assessment?
Oakpark Student 4:	To put bullet points when I am explaining, when we are doing experiments and if you are explaining how to do an experiment then he said to put bullet points beside it.

And feedback based on summative exams:

> "She gave us a bit of both when we got back our exams. She gave us a grade and she told us what we might need to work on and then told us what we are strong at."
>
> (Oakpark Student 9)

> "When we are getting our exams, she would come up to us individually and there is a little box underneath our exam where we would write down our goals and feedback and our teacher would look over it. In case of the stuff that we don't know the teacher would tell us what we need to work on and the stuff that we did really well. The stuff that we need to work on sometimes she would revise that over again with me."
>
> (Oakpark Student 11)

The final comment showed some potential for students to use feedback for self-regulation by writing their own feedback. This was a positive aspect of the type of feedback students were receiving, even if it was at the end of a summative examination. The formative use of summative tests was an early technique for promoting feedback and a good test can be considered as an opportunity to improve learning (Black & Wiliam, 1998b). When discussing feedback with the students in Oakpark, peer feedback (a technique for formative assessment) was not a common topic of conversation, with quantitative data suggesting that students were lacking information on how to utilise peer feedback as a tool for learning.

In Greenview, students relayed that teacher feedback was vague and not focused on improving learning:

> "Well, my teachers usually give me feedback like you need to study a bit more of that or that, or if you just practice more or learn your key words more often. That would usually like help me because they're telling me what to do in order to get better at that specific subject."
>
> (Greenview Student 3)

> "if I do experiments and write in my copy, she looks over it and she tells me what I can add even if I've reached all success criteria, she looks at my work and then say I could do this to make it even more better."
>
> (Greenview Student 10)

The type of feedback that students in Greenview were discussing was not considered as helping them to self-regulate, it was too vague for them to draw meaning and use it to improve. In addition, like Oakpark, the feedback was always coming from the teacher. This signified that the division of labour for this tool was with the teacher. The students participating in peer feedback was undervalued in Ireland. To revisit the question posed about feedback, the data from Ireland suggest that students understand feedback to be from the teacher, include comments about presentation of work, and come at the end of a summative assessment.

Clarifying Learning Intentions and Sharing Criteria for Success

The quantitative data showed that students valued that their science teachers were clarifying learning intentions and sharing criteria for success in lessons. They were satisfied that they were kept informed about what they will learn in science (disagreement with statement 15: A lot of the time I am unsure of what I am learning during a science lesson, agreement with statement 26: The teacher lets us know what we will learn in a lesson) and what they need to know in order to achieve success in science (statement 4: I am aware of what I have learned in science, statement 29: I am aware of what I need to revise in science). This was a positive finding as sharing learning intentions and criteria for success is a useful tool to direct students' learning (Leahy et al., 2005; Wiliam, 2014). Students in both schools demonstrated an awareness of knowing what they will learn and what they are doing in their science lessons:

> "Lilly is usually really clear with what she says because at the start of the class she always tells us what we're going to learn and she writes on the board what we're going to cover…she always summerises the class at the end as well… they're like at the end

of this lesson you should know how to do this, you should know how to do that, stuff like that."

(Greenview Student 10)

"We do learning intentions before we start a new topic. At the start of every class, we do what we are going to learn in the class so that kinds of tells us what we are going to learn" (Oakpark Student 12)

They further commented on how their teachers sometimes set them variations of success criteria to guide them through different tasks:

"We are given a thing on Schoology that is telling us what we can do to get a distinction, merit, pass or fail. Then it tells us what we need to have and it's just handy to have."

(Oakpark Student 9)

"She gives us a few lines of what it should look like and what standards you should meet." (Greenview Student 10)

The main benefit of utilising learning intentions and success criteria in the classroom is that it can lead to greater student autonomy in learning (Crichton & McDaid, 2016). Some students were even able to make the link between sharing learning intentions and success criteria and how it can help them to improve their learning:

"It is easier when you are studying for an exam you know what you have done so you don't have to keep asking the teacher what we are doing."

(Oakpark Student 5)

Interviewer: Do you find those (learning intentions) helpful?

Oakpark Student 12: Yes, because you just know. Say if you are going back to study you are able to tell which lesson you did it from.

Homework

Homework was considered a common learning tool used by students in science lessons. This was evident in the quantitative data (by strongly disagreeing with statement 14: There is no point in doing science homework) and from numerous comments during interview. In total there were 245 comments about students' learning outside of school. Many students discussed their experiences with homework and its significance in their learning:

> "there is point in doing it (homework) because it is like revision. If you understand it, you can do it quite easily but if you don't you have a chance to have a go at it again."
>
> (Oakpark Student 3)

> "the science homework can help you revise on the previous lesson you have done, and it will be easier for you to learn when you are coming back into school. You know the information because you did your science homework, and it would help you revise."
>
> (Oakpark Student 11)

> "Science homework is how you do it at home when there is no one to help you. So, if you go… see how well you work yourself."
>
> (Greenview Student 12)

The student data showed that some students were using homework as a self-assessment tool that let them take ownership of their learning. However, evidence of students' homework being used to guide teacher feedback was lacking in the student data. One student mentioned that with homework they can:

> "revise it on your own and then when you bring it in the next day the teacher can help you with what you've done wrong."
>
> (Greenview Student 9)

When probed as to what the teacher's feedback might be on a homework task, this student said:

> "Like she'll tell you what you can work on… (for example) use a pencil when we're drawing diagrams."
>
> (Greenview Student 9)

This student then commented that they had taken this feedback into consideration with their work. This data is supported though observation where in one of Lilly's lessons it was observed that she did check homework at the door and gave written feedback in student copies such as using a pencil when drawing a diagram. But this was an isolated incidence, effective feedback on homework tasks (i.e., to move learning forward) was not observed in any other lesson in Ireland.

Looking at the involvement parents had with science homework there were clear differences between the students in Oakpark and in Greenview. Interestingly, students from both schools said they would ask one of their siblings for help rather than approaching their parents. Differences existed in the schools when it came to getting help with homework. This demonstrated the effect that community can have on a formative assessment activity system. Although many students commented that their parents check the work is done by signing the

journal, the students in Oakpark suggested that they had a higher level of support from their parents. They commented:

> "If I am at home and they know about it they would try to teach me. They wouldn't give me the answer straight away because otherwise I wouldn't learn. They would try to get me to think about it and give me hints. Then I would work it out myself."
>
> (Oakpark Student 2)

> "My parents helped me with it. They told me that I should set goals for myself, so I know what to learn and when I improve. So, if I get cells wrong or something wrong in my exams, I would study on that more."
>
> (Oakpark Student 11)

Whereas in Greenview students mentioned that their parents were often busy or too tired to help them with work:

> "Sometimes my parents check when my homework is done and sometimes, they don't because I don't know they're tired or something."
>
> (Greenview Student 3)

> Interviewer: And do they check that your homework is done?
>
> Greenview Student 4: No not really because there's like four people in my house so to check everyone's homework would be two three hours long."

> "Because my parents are really busy, and I only have one parent so… she's really busy but she helps me a lot if I need help."
>
> (Greenview Student 11)

Examining the socio-economic contexts of both schools the students' comments were not surprising. Oakpark was situated in an affluent, middle-class area where academic expectations from both teachers and parents were high for students. At the time of the research 98% of the students were White, Irish, and Catholic. According to census data almost 50% of the population of this area were from social class 1 or 2 which is well above the national average for Ireland. The area had very low unemployment with the number of non-nationals lower than the national average (Central Statistics Office, 2013). In contrast, Greenview had students from over 50 nationalities and ranged from middle to lower middle class. It was a large co-educational school with a culturally diverse population many of whom were multilingual and did not speak English as their first language. The number of non-nationals living in the area was almost double the national average with unemployment in line with it. Just under 38% of people living in this area were from social classes 1 and 2 (Central Statistics Office, 2013). The

student data suggested that the completion of homework and monitoring by parents was an implicit rule that the students from Oakpark had acting on their learning whereas this was not the case in Greenview where there was a different socio-economic context.

Factor 2: Independent and Exam Focused

This student loaded significantly on their own factor meriting further exploration. In Q, it is not uncommon to have a factor with only one participant if that person is different yet important, and can perhaps serve as a special interest factor (McKeown & Thomas, 2013). This student was in Matthew's science class in Oakpark. Table 16 summarises their beliefs on teaching, learning, and assessment while her comments in interview convey her personal experience of learning.

Strongly Agree	Neutral/Not Sure	Strongly Disagree
I learn science best when I work on my own (-4)	When other students ask questions in class, I get the opportunity to answer them (0)	My parents/guardians help me with my science work (4)
I understand how to improve my learning using feedback (-4)	I am the only person responsible for my learning (0)	I often ask students in the class questions (4)
Doing exams motivates me to work harder in science (-4)	I have enough time to think before answering a question (0)	My parents/guardians check my homework (4)
I am aware of what I have learned in science (-3)	At the end of most science lessons, it is clear to me what I have learned (0)	The pace of most science lessons is too fast (3)
I like exams because the results show me how I am doing (-3)	Science lessons are different from other lessons (0)	I enjoy working as a team (3)
I check over a piece of work once it is complete (-3)	I often give my classmates feedback on their work (0)	It benefits my learning of science when we work in small groups (3)
I feel safe when answering questions in class (-3)	Certain students are asked more questions in class than others (0)	Working in groups means that everyone in the group learns something (3)
	The teacher lets us know what we will learn in a lesson (0)	

Table 16: Ireland Factor 2 student viewpoint

Division of Labour: Individual Learner

Oakpark Student 4 was characterised as someone who disliked working with others and saw exams as an essential part of her learning journey. In interview she conveyed her frustration at her classmates for not completing homework exercises:

Interviewer: Why did you move that one (statement card) "mostly I feel happy in my science class"?

Oakpark Student 4: Because I am usually bored.

Interviewer: Why are you bored?

Oakpark Student 4: Mainly because you know how I was saying you have to take down notes (for homework) or something? Then I take down the notes but then no one else does just me. Then he does it in school, then he does it in class but then I thought that you were meant to do it for homework because he put it up (on *Schoology*).

This is one of the many reasons she disliked working with others. She illustrated how her classroom environment was not suited to her learning needs as other students not engaging meant that exercises were often repeated or completed incorrectly. She believed that it benefited others when they worked with her, but she did not find groupwork conducive to her own learning:

Interviewer: What about doing groupwork in class? How do you find doing those kind of activities in class?

Oakpark Student 4: Not helpful. I would rather do it (research task) on my own. I practically did the whole thing by myself anyway…

Interviewer: What about this one (statement card): working in groups means everyone learns something? Why is that in strongly disagree?

Oakpark Student 4: Because if you don't want to learn anything you are not going to learn.

Interviewer: Do you think it benefits your learning to work in groups?

Oakpark Student 4: No.

She conveyed how the division of labour in her lessons was not suited to her learning as she was preferred to work separately from her peers. She was considered as an individual learner (away from her peers) rather than an independent learner (self-regulating) as she still relied on the teacher for guidance:

Interviewer: If you were stuck or happen to have an issue would you ask someone in your class or would you ask the teacher?

Oakpark Student 4: Teacher definitely.

Interviewer: Why would you do that?

Oakpark Student 4: Probably they are not going to know the answer (other students), or they probably wouldn't give me the right answer.

Additionally, she conveyed a lack of confidence in her classmates' ability to help her with her work.

Tools: Examinations

Looking more at the statements that were contributing to her learning, a discourse on exams was a focal point of her Q data. She strongly agreed with two statements about exams (statement 5: I like exams because the results show me how I am doing, statement 45: Doing exams motivates me to work harder in science). Her fondness for exams linked to her strong intrinsic rule of working individually:

Interviewer:	Can I ask you about this one (statement card) "I set goals for my learning"? How do you do that?
Oakpark Student 4:	When we have exams I study and I kind of create mini tests for myself so then I can learn. I look through all the information, I read out all the questions that would probably be on the exam and then get it right.
Interviewer:	Where did you learn to do that? Did you come up with that yourself?
Oakpark Student 4:	Yes.
Interviewer:	Did anyone in school help you?
Oakpark Student 4:	No, I came up with it myself.

Likewise, she noted in interview that she did not need her parents to help with her homework as she always had it completed to a high standard, and when asked if she relied on the teacher for support, she said:

Interviewer:	If you had an issue do you think you could go to your science teacher and ask?
Oakpark Student 4:	Yes, but I would probably just figure it out on my own instead.

Oakpark Student 4 was a special factor case as her views were different to those of her peers. She gave the impression that she was a high achieving student, and this matched the socio-economic context of her school. However, this cannot be inferred from this data alone but could perhaps be the reason she rejected her classmates help and was strongly exam focused. Although this study is focused on the enactment of formative assessment in science lessons, this student was doing well academically in science regardless of the formative assessment practices taking place in her lessons. This suggested perhaps formative assessment practices are not the only way to improve learning among all students.

Similarities and Differences Among Factors: Ireland

It is common in a study using Q methodology that consensus and distinguishing statements among factors are discussed as they help to highlight the similarities and differences among a cohort of participants (Provost, Boscardin, & Wells, 2010; Van Excel & de Graaf, 2005; Zabala & Pascual, 2016). Table 17 outlines the statements that all the students from Ireland had shared opinions about. The similarities and differences between Factor 1 and Factor two were largely focused on the division of labour and different subjects involved in learning science.

Statement Number	Statement	Factor Array	Viewpoint
36	I feel safe when answering questions in class	-3	Strongly Agree
48	If I don't understand something in science, I work on it until I get it right	-2	Agree
30	My teacher is the best person for describing concepts in science	-2	Agree
35	The class shares their ideas about a topic with the teacher	-1	Agree/Neutral
31	I often give my classmates feedback on their work	0	Neutral
23	I have enough time to think before answering a question	0	Neutral
37	I never reflect on how I am doing in science	2	Disagree

Table 17: Consensus statements between Factor 1 and Factor 2 in Ireland

All Irish students strongly agreed with the statement: I feel safe when answering questions in class. Comments about of sharing opinions and engaging with questions (even if they didn't know the answer) were common in the science classes in Ireland, this will now be referred to as comfortable discourse environments (Van Zee et al., 2001). This data suggested that the science community in which these students were learning was conducive to learning, this was discussed in detail in Factor 1. The second research question of this study was to identify factors shaping formative assessment enactment and these data would suggest that a comfortable discourse environment was one of these factors. This was backed up by literature that suggests that students engage more in teaching and learning when they are learning in comfortable discourse environments (Van Zee et al., 2001) .

Statement Number	Statement	Factor 1 Array	Factor 2 Array	Difference
2	I learn science best when I work on my own	1 (disagree/ neutral)	-4 (strongly agree)	5
10	My parents/guardians check my homework is done	-1 (agree/ neutral)	4 (strongly disagree)	5

Table 18: Distinguishing statements between Factor 1 and Factor 2 in Ireland

The distinguishing statements in Table 18 illustrated that the biggest difference among students was their reliance on others for learning both in school and out. It was clear that the Factor 2 student from Oakpark did not like working with others and commented in interview that her parents did not need to check her homework because she always had it completed.

Findings from Scotland

In the data from Scotland, two factors were significant. 22 out of the 24 students from Scotland loaded significantly on Factor 1 while the remaining two students made up Factor 2. The Factor 2 students attended Woodhill school but had different science teachers. In Milltown students 1-6 were from Alice's class and students 7-12 were in Nora's class. In Woodhill students 1-6 were in Sophie's class and students 7-12 were in Amy's class. Table 19 outlines the factor matrix for the students from Scotland, with an X indicates a defining sort.

Student	Factor 1 Loading	Factor 2 Loading
Milltown Student 1	0.8185X	-0.0536
Milltown Student 2	0.7867X	0.0720
Milltown Student 3	0.7393X	0.2831
Milltown Student 4	0.6708X	0.0447
Milltown Student 5	0.5712X	0.0059
Milltown Student 6	0.7316X	0.0055
Milltown Student 7	0.7955X	0.1033
Milltown Student 8	0.7892X	-0.0529
Milltown Student 9	0.7348X	0.1601
Milltown Student 10	0.5395X	0.1588
Milltown Student 11	0.8677X	0.1528

Milltown Student 12	0.7059X	-0.0065
Woodhill Student 1	0.7140X	0.1630
Woodhill Student 2	0.3978	0.5160X
Woodhill Student 3	0.8019X	0.2646
Woodhill Student 4	0.7759X	0.0780
Woodhill Student 5	0.7252X	-0.1654
Woodhill Student 6	0.5510X	0.1616
Woodhill Student 7	0.5484X	0.3046
Woodhill Student 8	0.5831X	0.2943
Woodhill Student 9	-0.2232	0.4406X
Woodhill Student 10	0.4608X	0.2378
Woodhill Student 11	0.7029X	0.2216
Woodhill Student 12	0.7240X	-0.0159

Table 19: Factor loadings for students from Scotland

There was minimum correlation between the two factors. Analysis followed the same approach as the Irish Q data. Statement rankings (+4 to -4) and Z-scores were used to analyse the level of agreement or disagreement the students had toward a statement. A negative rank/Z-score indicated agreement, while a positive rank/Z-score indicated disagreement. Table 20 outlines each Q statement with its factor ranking and Z-score. The two factors were then interpreted.

Statement Number	Statement	Scotland Factor 1 Rank	Scotland Factor 2 Rank	Scotland Factor 1 Z-Score	Scotland Factor 2 Z-Score
1	Doing well in science depends on having a good science teacher	1	-2	0.59	-0.73
2	I learn science best when I work on my own	0	2	-0.01	0.96
3	In science classes, there is no room for expressing your own ideas	3	1	1.60	0.35
4	I am aware of what I have learned in science	-3	-3	-1.22	-1.11
5	I like exams because the results show me how I am doing	-2	-3	-0.83	-0.88
6	I help other members of my group if they are stuck	0	1	-0.36	-0.08
7	I understand how to improve my learning using feedback	-1	2	-0.55	0.61
8	The purpose of science class is to prepare for exams	2	0	0.83	-0.27

9	The teacher always grades our work	0	1	-0.02	0.42
10	My parents/guardians check my homework is done	-1	0	-0.53	-0.23
11	I am good at studying science outside of school	0	4	-0.38	2.11
12	In science, we're always doing the same exercises repeatedly	3	-1	1.55	-0.38
13	My parents/guardians help me with my science work	0	-2	-0.34	-0.69
14	There is no point in doing science homework	3	1	1.68	0.00
15	A lot of the time I am unsure of what I am learning during a science lesson	3	-2	1.66	-0.54
16	When other students ask questions in class, I get the opportunity to answer them	0	0	-0.24	-0.15
17	I enjoy working as a team	-1	-1	-0.43	-0.35
18	I am not responsible for the learning of others during group	1	-1	0.57	-0.42
19	I am the only person responsible for my learning	2	4	0.64	2.46
20	I check over a piece of work once it is complete	-1	0	-0.60	-0.15
21	The teacher asks questions that we all can answer	0	-1	-0.33	-0.46
22	I feel I can ask questions in class	-4	-2	-1.61	-0.61
23	I have enough time to think before answering a question	-2	1	-1.09	0.00
24	At the end of most science lessons, it is clear to me what I have learned	-4	0	-1.43	-0.15
25	Science lessons are different from other lessons	-1	1	-0.46	0.15
26	The teacher lets us know what we will learn in a lesson	-4	0	-1.40	-0.23
27	I know exactly what is expected of me when I work in small groups	0	-2	-0.33	-0.54
28	I feel I can't ask the teacher if I am struggling with science	4	4	1.78	2.11
29	I am aware of what I need to revise in science	-2	-1	-0.72	-0.35
30	My teacher is the best person for describing concepts in science	-2	-4	-0.87	-2.19
31	I often give my classmates feedback on their work	1	3	0.42	1.92
32	I think that the feedback we receive from the teacher is fair	-3	0	-1.19	-0.27
33	It benefits my learning of science when we work in small groups	1	-4	0.45	-1.57
34	Exams are boring	2	-2	0.64	-0.81
35	The class shares their ideas about a topic with the teacher	1	1	0.00	0.42

36	I feel safe when answering questions in class	-3	-2	-1.33	-0.81
37	I never reflect on how I am doing in science	2	2	1.32	0.69
38	Working in groups means that everyone in the group learns something	-1	-3	-0.40	-0.96
39	I value feedback my classmates give me on my work	-2	1	-0.69	-0.08
40	I set goals for my learning	1	-3	0.13	-1.11
41	The teacher is the only person in the class that gives feedback	2	2	1.04	0.77
42	Mostly I feel happy in my science classes	-3	3	-1.25	1.15
43	The teacher's feedback to me is unhelpful	4	3	1.72	1.84
44	Certain students are asked more questions in class than others	2	-4	1.43	-1.42
45	Doing exams motivates me to work harder in science	-1	2	-0.66	0.88
46	The pace of most science lessons is too fast	4	0	1.68	-0.19
47	I often ask other students in the class questions	1	3	0.42	1.38
48	If I don't understand something in science, I work on it until I get it right	-2	-1	-0.90	-0.50

Table 20: Statement rankings and Z-scores from Scotland

Factor Interpretation

Factor 1: Positive Learning Relationships with Adults

This factor can be summarised as students who looked to the adults in their lives (teachers and parents) for help with learning, had a positive relationship with their teachers that they believed was a factor contributing to their learning, and were confident in their teachers' role in guiding the learning in class. Table 21 displays these 22 students' shared viewpoints on the statements. Positive values (in brackets on the table) indicate disagreement and negative values indicate agreement, statements students were unsure about (value of zero) are also included.

Strongly Agree	Neutral/Not Sure	Strongly Disagree
22. I feel I can ask questions in class (-4)	2. I learn science best when I work on my own (0)	28. I feel I can't ask the teacher if I am struggling with science (4)
24. At the end of most science lessons it is clear to me what I have learned (-4)	6. I help other members of my group if they are stuck (0)	43. The teacher's feedback to me is unhelpful (4)
26. The teacher lets us know what we will learn in a lesson (-4)	9. The teacher always grades our work (0)	46. The pace of most science lessons is too fast (4)

36. I feel safe when answering questions in class (-3)	11. I am good at studying science outside of school (0)	14. There is no point in doing science homework (3)
42. Mostly I feel happy in my science classes (-3)	13. My parents/guardians help me with my science work (0)	15. A lot of the time I am unsure of what I am learning during a science lesson (3)
4. I am aware of what I have learned in science (-3)	16. When other students ask questions in class, I get the opportunity to answer them (0)	3. In science classes, there is no room for expressing your own ideas (3)
32. I think that the feedback we receive from the teacher is fair (-3)	21. The teacher asks questions that we all can answer (0)	12. In science, we're always doing the same exercises repeatedly (3)
	27. I know exactly what is expected of me when I work in small groups (0)	

Table 21: Scotland Factor 1 student viewpoints

The quantitative data in Table 21 suggested that learning in science was taking place through comfortable discourse environments (statement 3: In science classes, there is no room for expressing your own ideas, statement 22: I feel I can ask questions in class, statement 28: I feel I can't ask the teacher if I am struggling with science, statement 36: I feel safe when answering questions in class), clear guidance on where learning is going (statement 24: At the end of most science lessons it is clear to me what I have learned, statement 26: The teacher lets us know what we will learn in a lesson, statement 4: I am aware of what I have learned in science, statement 15 (disagreement): A lot of the time I am unsure of what I am learning during a science lesson), and valued teacher feedback (statement 32: I think that the feedback we receive from the teacher is fair, statement 43: The teacher's feedback to me is unhelpful). Students had mixed feelings about learning with others (statement 2: I learn science best when I work on my own, statement 6: I help other members of my group if they are stuck, statement 27: I know exactly what is expected of me when I work in small groups), learning outside of school (statement 11: I am good at studying science outside of school, statement 13: My parents/guardians help me with my science work) and if the questions their science teachers ask were helping them to learn (statement 16: When other students ask questions in class I get the opportunity to answer them, statement 21: The teacher asks questions that we all can answer).

Division of Labour and Community

The neutral/not sure section of Table 21 presented some interesting findings on the division of labour in Scottish science lessons. The students signified they were unsure of whether they learned more on their own or in groups (statement 2: I learn science best when I work on my own, statement 6: I help other members of my group if they are stuck, statement 27: I know exactly what is expected of me when I work in small groups), whether they were able to study

at home on their own (statement 11: I am good at studying science outside of school), or if their parents were involved with their learning (statement 13: My parents/guardians help me with my science work).

Learning in School

Formative assessment practices advocate for peer learning in the classroom to help improve student learning skills. Looking at peer learning with the Scottish Factor 1 students, their comments on the division of labour in class were torn. On the one hand, a cohort of students saw the benefit of learning from peers, exemplified by Milltown Student 4:

> "I find it better and easier to work in a team. If you are shy and you don't really want to speak to the teacher, you could speak to the people in the class that are your friends. If you are shy and you are stuck, then you don't want to ask then they could explain it for you…sometimes it is better to get feedback off your friends than off the teacher because maybe they might explain it better."
>
> (Milltown Student 4)

While others did not see the advantage of working in groups:

> "Some people just don't work, and it just makes it harder. I don't really like working in teams because I don't feel like anyone pays attention."
>
> (Woodhill Student 4)

> "I think that I learn more if I am working by myself because I think if you are working in a group you always end up with one person being left out and then they don't learn as much so I'm not a big fan of working as a team…Well normally I am in a small group I admit that I don't really work as hard as I probably should in the group because I don't enjoy it as much as working by myself."
>
> (Milltown Student 6)

The student comments above clarified their quantitative data: the students were not ambivalent about group learning, they had strong contrasting opinions on their experience of learning in groups.

Learning at Home

Additionally, an interesting topic of conversation with students in interview was the influence that family played in learning. Literature linking formative assessment and the influence of home on students' learning is rare. Getting help from others outside the classroom is as an

integral part of social constructivism and links to the concepts of scaffolding (Bruner, 1976) and the zone of proximal development (Vygotsky, 1978). The discourse from interview among the Milltown students suggested that parents were willing to help their children with their science homework:

> "If didn't understand the way the teacher explained it, I could go home and maybe ask them and maybe they would have a…. not a better understanding but like better at explaining than maybe what I thought the teacher had."
>
> (Milltown Student 4)

However, data from other students in Milltown suggested that help was not always required from home as they were confident in completing homework individually:

> "They (parents) sometimes do (check homework) but they don't very often because I can normally do it myself."
>
> (Milltown Student 9)

Interviewer:	First thing you put down there "my parents or guardians help me with my science work". Why is that in neutral to disagree?
Milltown Student 10:	Because if I don't need help, I don't ask them.
Interviewer:	If you did need help would you ask them?
Milltown Student 10:	Yes.
Interviewer:	And would they help?
Milltown Student 10:	Probably.
Interviewer:	Do they check that your homework is done?
Milltown Student 10:	No.
Interviewer:	But they would give you a hand if you were stuck?
Milltown Student 10:	Yes.

Data showed that the Scottish Factor 1 students had a good community of support from home that when needed, helped their learning. This finding on division of labour in the activity system links to the bottom tier element of community and how it contributed to achieving the outcomes of an activity system. Looking at the community surrounding Milltown school, only 0.05% of students were SIMD[21] 1 through 3, with many students being SIMD 6 or above. According to the Head Teacher, parents in the community were mostly employed and took an active role in school life. The parents' council were strongly involved in the school by

[21] SIMD: Scottish Index of Multiple Deprivation. A scale from 1 to 10 where areas are ranked on their level of deprivation, one being most deprived and 10 being most affluent.

fundraising, helping to draft policies and being kept up to date about assessment and *Visible Learning* (Hattie, 2012). This finding was like Oakpark in Ireland where the socio-economic context of the school community was linked to the level of help students received at home with their schoolwork.

Qualitative comments from the students in Woodhill suggested that their parents were willing and able to help them with their home learning despite being from a very different socio-economic context. The students had the following comments to share:

> "I don't even have homework every night but like my mum and dad ask if I have got any homework and then if I say yes, they will have a look at it once I've finished."
>
> (Woodhill Student 8)
>
> "You don't just need your teacher to do well in science. Because your mum and dad and other people can help you."
>
> (Woodhill Student 11)

Interviewer:	'My parents check my homework is done.' So, they do that all the time?
Woodhill Student 3:	They will ask me if I have got homework and if I have done it.
Interviewer:	Do they help you with your homework?
Woodhill Student 3:	Sometimes if I'm struggling with something I will ask them, but they like to see that I am learning how to do it in class and understand it.

In the area surrounding Woodhill there was very significant social deprivation with 39% of students being SIMD 1 through 3, and nearly 50% being SIMD 1 through 4. This did not stop families being involved in the school community. According to the Head Teacher of Woodhill, the community strongly valued its school, and parents and families took an active role in their children's education. Families got involved in activities such as the parents' council, fundraising, family cook schools, exercises classes, and home learning information evenings, all facilitated by the school. So, the school itself strived to build a positive learning community among all its members and had negated the effect of socio-economic status on learning. This corroborated the data from Amy's evaluative episode (Chapter 8) where the school community were influencing how teaching, learning, and assessment played out at Woodhill.

Tools

Positive Teacher Student Relationships

It was evident from student data that they believed their teachers cared about them and their learning. In conversations, the students frequently spoke about how they liked their science teachers. Teacher personality traits such as being friendly, nice, caring, and funny were common replies when the students were asked about their science teachers. This is noteworthy as there is a paucity of Scottish research on this topic. During interview students they made the links between their relationship with their science teacher and their improved learning:

> "The teacher is really nice. She doesn't really get angry a lot…Like she will help you with your work if you are stuck. She won't get mad at you if you ask for help…most teachers are like that."
>
> (Milltown Student 1)

Interviewer:	What did you put into strongly agree 'I feel like I can ask questions in class'?
Milltown Student 7:	Because the teacher is really friendly, and you are not scared of them and you don't think you can just like…. I think you can ask questions because she is a nice teacher, and she is not just going to shout at you if you get it wrong. She will help you with it.
Interviewer:	Is that like most teachers in the school or is it just Nora?
Milltown Student 7:	That is most teachers in the school.

> "If I am struggling with something I can ask the teacher and I don't feel embarrassed to ask her because we don't annoy each other. If we are struggling with something it is not nice…She will explain it to me and she will show me. She will explain it bit by bit and step by step."
>
> (Woodhill Student 4)

> "The teacher also motivates you as well…She kind of makes you like science (laughing)…She does fun stuff…she doesn't really care what you ask she always tries to help you; she won't get you in trouble and stuff if you don't know the answer".
>
> (Woodhill Student 7)

Having a positive relationship with the science teacher was an important part of these students' learning. The interview comments suggested that their teachers often helped with them work, motivated them to work harder, and broke down the learning so that they could understand

science concepts. This tool was also evident in the Scottish evaluative episodes where Nora was helping individual students with their self-assessment task in Episode 1 (Chapter 7) and when Amy reassures a student who was absent that he would be able to catch up in that lesson (Chapter 8).

Sharing and Understanding Learning Intentions and Criteria for Success

The most common group of statements to be included in strongly agree/disagree with the students from Scotland were those concerning where the learning was going i.e., sharing, and understanding learning intentions and criteria for success. This type of guidance from a teacher or co-constructed with the students, was a tool in the activity system for improved learning. This tool differed to the tool from Ireland concerning learning intentions and success criteria where in Scotland the students were involved in this process and in Ireland they were not. According to Education Scotland (Scottish Government, 2011) "sharing success criteria along with learning intentions allows learners to see what success looks like" (p.18) and provides for self-assessment of learning and achievement. The Scottish Curriculum for Excellence encourages this type of guidance in lessons, and from conversations with the students in Milltown, they believed this tool was being implemented in science lessons:

Milltown Student 7: She will put a success criteria on the board and like learning intentions.

Interviewer: Can you give me an example of what they might look like? What will they say?

Milltown Student 7: It will be like "today we are doing an experiment on friction" and then the success criteria will be like "by the end of this lesson you will know what friction is" and things like that. "

A student from Alice's class detailed how this tool benefitted their learning:

Milltown Student 3: Yes, we get learning intentions and success criteria.

Interviewer: What do they look like?

Milltown Student 3: Usually the learning intention is "I'm going to learn about this and that" and success criteria is like what we are going to work on.

Interviewer: What do you think of the success criteria and learning intentions?

Milltown Student 3: I think they are helpful.

Interviewer: Why is that?

Milltown Student 3: Because it tells you what we are going to be working on, like what we need to strive for.

In addition, another of Alice's students discussed how they were involved in the co-construction of success criteria in lessons:

Interviewer: So how does the teacher let you know then what you will learn in a science lesson?

Milltown Student 1: She will tell us before what we are going to learn.

Interviewer: Okay, does she write it up anywhere or anything?

Milltown Student 1: Yes, we have got a board that she writes it up on.

Interviewer: What does she write on the board?

Milltown Student 1: She will write our success criteria and our learning intentions.

Interviewer: What is the difference between learning intentions and success criteria?

Milltown Student 1: One is what we are going to learn, and success criteria is what we would want to have learned.

Interviewer: Okay, does she come up with all of them on her own?

Milltown Student 1: No sometimes we do the success criteria.

Interviewer: And do you like doing that?

Milltown Student 1: Yes, it is fun.

Interviewer: Why do you think that is?

Milltown Student 1: You get a chance to go and write something that you think you should learn.

The qualitative interview data from Milltown suggested that teachers' guidance was not only being used as a tool to aid learning, but Alice was also co-constructing the success criteria with her students activating them as owners of their own learning. Although not commented on in interview, Nora also used her learning intentions to gauge where the learners were at. Her Evaluative Episode 2 (Table 11) illustrated that she was using SOLO taxonomy to let the students decide the level of learning for the lessons. This signified that guidance on where the learning was going was an explicit rule for learning in Milltown.

The data in Woodhill were similar where students made the link between learning intentions, success criteria, and becoming more autonomous learners. They said:

> "We use them to let us see what we are going to learn and to help us to know what we need to do."
>
> (Woodhill Student 6)
>
> "I would look at the success criteria and learning intentions and see what I have achieved so far and what I have not."
>
> (Woodhill Student 8)

Moreover, in Woodhill, students were provided with a learning intention checklists by their science teachers:

> "At the start of the topic we'll put the sheet thing…it's like different learning outcomes. We'll stick that in at the very start of that topic… and at the end when we're going for like a test or something we'll, we'll go through all of it and we will tick, there's red, amber and green and we'll just tick if we know it, if we don't know it, if we need to work on it and that means that for studying we can go through that and see what's amber and what's red and what we need to study".
>
> (Woodhill Student 1)

This was an example of a very simple tool used by teachers to show students where they were going in their learning and what they needed to learn. This section can be summarised by saying that learning guidance was a clear factor that was contributing to the learning of students in Scotland.

Factor 2: Peripheral Learners

There were two students from the Scottish cohort who did not share similar views on teaching, learning, and assessment as the Factor 1 students. These students were both from Woodhill but had different science teachers. They loaded significantly onto a second factor that was categorised as having a strong reliance on the teacher (statement 19: I am the only person responsible for my learning, statement 28: I feel I can't ask the teacher if I am struggling with science, statement 30: My teacher is the best person for describing concepts in science, statement 43: The teacher's feedback to me is unhelpful), disliking exams (statement 5: I like exams because the results show me how I am doing, statement 8: The purpose of science class is to prepare for exams), and not feeling actively involved in science lessons (statement 44: Certain students are asked more questions in class than others, statement 47: I often ask other students in the class questions, statement 42: Mostly I feel happy in my science classes). In short, they believed the division of labour in their lessons was not conducive to their learning

as they relied strongly on the teacher and felt they were not involved in the learning experiences happening in their science lessons. Table 22 summarises their beliefs on teaching, learning, and assessment:

Strongly Agree	Neutral/Not Sure	Strongly Disagree
30. My teacher is the best person for describing concepts in science (-4)	8. The purpose of science class is to prepare for exams (0)	19. I am the only person responsible for my learning (4)
33. It benefits my learning of science when we work in small groups (-4)	10. My parents/guardians check my homework is done (0)	11. I am good at studying science outside of school (4)
44. Certain students are asked more questions in class than others (-4)	16. When other students ask questions in class, I get the opportunity to answer them (0)	28. I feel I can't ask the teacher if I am struggling with science (4)
4. I am aware of what I have learned in science (-3)	20. I check over a piece of work once it is complete (0)	31. I often give my classmates feedback on their work (3)
40. I set goals for my learning (-3)	24. At the end of most science lessons it is clear to me what I have learned (0)	43. The teacher's feedback to me is unhelpful (3)
38. Working in groups means that everyone learns something (-3)	26. The teacher lets us know what we will learn in a lesson (0)	47. I often ask other students in the class questions (3)
5. I like exams because the results show me how I am doing (-3)	32. I think that the feedback we receive from the teacher is fair (0)	42. Mostly I feel happy in my science classes (3)
	46. The pace of most science lessons is too fast (0)	

Table 22: Scotland Factor 2 student viewpoints

Division of Labour

Reliance on the Teacher

These two students had low self-efficacy about their learning in science lessons. Interview data exemplified how they felt about the division of labour in their science lessons. They believed the teacher was largely responsible for their learning:

> "I think it is a bit of my responsibility but like if the teacher doesn't explain it well and that, I don't think that is my responsibility to work it out and everything."
>
> (Woodhill Student 2)

> "Some of your friends obviously don't know as much as the teacher. She would be the best person to ask…the teachers are also responsible for students' learning because they are the ones that teach us. That is what their job is."
>
> (Woodhill Student 9)

This suggested that these students were not self-directed learners, the person responsible for their learning in their eyes was the teacher. This correlated with Amy's evaluative episode (Table 12) where she was in control of the learning for much of the lesson starter task.

Peripheral Learning

These students gave the impression they were on the outside of what was happening in their science lessons. They exemplified this by strongly agreeing with statement 44 (Certain students are asked more questions in class than others), and strongly disagreeing with statements 42 (Mostly I feel happy in my science classes), and 47 (I often ask other students in the class questions). These students were unhappy in science, but it appeared to stem from lack of engagement with lessons. They believed that "good students" were more included in lessons and when it came to them getting involved, they felt very self-conscious. One student said:

> Interviewer: So if you didn't know the right answer to something and she called on you. How would you feel about that?
>
> Woodhill Student 2: Like shy and on the spot and like worried in case I get it wrong, and everybody laughs at you or something.

While the other student wanted to get involved more in lessons, they felt like they weren't given the opportunity:

> "People that are better in science they get asked questions much more…They don't put their hand up as well and just get asked…Sometimes I don't have enough time."
>
> (Woodhill Student 9)

This corroborated evidence from Amy's evaluative episode where she relied on specific students to answer questions, and other students were able to disengage. Although the Factor 2 students were in the minority (two out of 12 students in Q), their reliance on the teacher and peripheral learning in science were factors that were not contributing to their learning of science.

Similarities and Differences among Factors: Scotland

Table 23 outlines the statements that all the students from Scotland had shared opinions about.

Statement Number	Statement	Factor Array	Viewpoint
4	I am aware of what I have learned in science	-3	Strongly Agree
17	I enjoy working as a team	-1	Neutral/Agree
16	When other students ask questions in class, I get the opportunity to answer them	0	Neutral
35	The class shares their ideas about a topic with the teacher	1	Neutral/Disagree
37	I never reflect on how I am doing in science	2	Disagree
41	My teacher is the only person in the class that gives feedback	2	Disagree
28	I feel I can't ask the teacher if I am struggling with science	4	Strongly Disagree

Table 23: Consensus statements between Factor 1 and Factor 2 in Scotland

The Scottish students shared the strongest beliefs about statement 28: I feel I can't ask the teacher if I am struggling with science. This again showed the positive relationships between the students and their science teachers. However, these relationships played out in in different ways. The Factor 1 students believed their science class was a safe learning environment to express opinions, while the Factor 2 students relied on the teacher greatly for guidance in science. In addition, all students from Scotland emphasised their awareness of their science learning by strongly agreeing with statement 4 (I am aware of what I have learned in science) and spending time thinking about their learning (statement 37: I never reflect on how I am doing in science). This was illustrated during interviews:

> "You need to reflect on how you are doing to see whether you are like improving or not." (Milltown Student 4)
>
> "When I get results back for tests for any subject, I always take a picture of the results so like I can reflect back on the results of that and try and remember what I got wrong." (Woodhill Student 1)
>
> "I would look at the success criteria and learning intentions and see what I have achieved so far and what I have not." (Woodhill Student 8)

These students believed they were using classroom tools such as test results and success criteria/learning intentions lists to help them improve their learning. These tools were just some of the factors that were contributing to their learning of science.

Statement Number	Statement	Factor 1 Array	Factor 2 Array	Difference
42	Mostly I feel happy in my science classes	-3 (Strongly Agree)	3 (Strongly Disagree)	6
44	Certain students are asked more questions in class than others	2 (Disagree)	-4 (Strongly Agree)	6

Table 24: Distinguishing statements between Factor 1 and Factor 2 in Scotland

The biggest differences among the students from Scotland (Table 24) were about happiness in science class. Q data suggested that this was in part due to the lack of opportunity to answer questions in class. The Factor 2 students made it clear that they did not feel involved in learning as often more high achieving students took the focus of a lesson and this was observed in Amy's class. It is worth remembering at this point that the Factor 2 students attended Woodhill so the differences among factors cannot be generalised to both Scottish schools. Woodhill Student 2 commented: "someone always puts their hand up before you". This is very different to comments from Milltown students, where they conveyed that randomised questioning techniques were the norm of their science lessons:

Milltown Student 9: She sometimes picks from the lollipop jar.

Interviewer: What do you think of that?

Milltown Student 9: I think it is good.

Interviewer: Why do you think that is?

Milltown Student 9: Because it is just at random, so some people don't get asked more than other people do.

The students in Milltown were aware of the equally likely chance of getting asked a question in class and many believed that it contributed to more fairness in the classroom. Randomisation of questioning can be considered a both as a tool for formative assessment exercised by teachers, and a tool used by students to contribute to learning by staying engaged in class.

Comparing Factor 1 from Ireland and Scotland

This analysis compared the data from the Factor 1 students in both countries. Factor 1 students were chosen as they represented 94% of the students who took part in the Q methodology. Furthermore, due to data analysis methods (by country identifying common themes) including the Factor 2 students in this comparison was not possible. Differences among Factor 1 and Factor 2 students were presented by country in earlier sections of this chapter. Table 25 outlines

how most students in this study ranked each statement from the Q sample. To reiterate how the rankings worked, a score of -4 indicated that the students strongly agreed with a statement, 0 signified that the students did not hold any strong beliefs about the statement or were unsure about a statement, and a score of 4 suggested that students strongly disagreed with a statement.

Statement Number	Statement	Ireland Factor 1 Rank	Scotland Factor 1 Rank	Difference	View-point
1	Doing well in science depends on having a good science teacher	1	1	0	Neutral/ disagree
2	I learn science best when I work on my own	1	0	1	
3	In science classes, there is no room for expressing your own ideas	4	3	1	
4	I am aware of what I have learned in science	-3	-3	0	Strongly agree
5	I like exams because the results show me how I am doing	-2	-2	0	Agree
6	I help other members of my group if they are stuck	-4	0	4	
7	I understand how to improve my learning using feedback	-1	-1	0	Neutral/ agree
8	The purpose of science class is to prepare for exams	2	2	0	Disagree
9	The teacher always grades our work	0	0	0	Neutral
10	My parents/guardians check my homework is done	-1	-1	0	Neutral/ agree
11	I am good at studying science outside of school	1	0	1	
12	In science, we're always doing the same exercises repeatedly	4	3	1	
13	My parents/guardians help me with my science work	0	0	0	Neutral
14	There is no point in doing science homework	3	3	0	Strongly disagree
15	A lot of the time I am unsure of what I am learning during a science lesson	3	3	0	Strongly disagree
16	When other students ask questions in class, I get the opportunity to answer them	1	0	1	
17	I enjoy working as a team	-1	-1	0	Neutral/ agree
18	I am not responsible for the learning of others during group	2	1	1	
19	I am the only person responsible for my learning	1	2	1	
20	I check over a piece of work once it is complete	0	-1	1	
21	The teacher asks questions that we all can answer	-1	0	1	

22	I feel I can ask questions in class	-4	-4	0	Strongly agree
23	I have enough time to think before answering a question	0	-2	2	
24	At the end of most science lessons, it is clear to me what I have learned	-2	-4	2	
25	Science lessons are different from other lessons	1	-1	2	
26	The teacher lets us know what we will learn in a lesson	-3	-4	1	
27	I know exactly what is expected of me when I work in small groups	-1	0	1	
28	I feel I can't ask the teacher if I am struggling with science	3	4	1	
29	I am aware of what I need to revise in science	-4	-2	2	
30	My teacher is the best person for describing concepts in science	-2	-2	0	Agree
31	I often give my classmates feedback on their work	0	1	1	
32	I think that the feedback we receive from the teacher is fair	-3	-3	0	Strongly agree
33	It benefits my learning of science when we work in small groups	0	1	1	
34	Exams are boring	2	2	0	Disagree
35	The class shares their ideas about a topic with the teacher	-1	1	2	
36	I feel safe when answering questions in class	-3	-3	0	Strongly agree
37	I never reflect on how I am doing in science	2	2	0	Disagree
38	Working in groups means that everyone in the group learns something	0	-1	1	
39	I value feedback my classmates give me on my work	0	-2	2	
40	I set goals for my learning	-1	1	2	
41	The teacher is the only person in the class that gives feedback	2	2	0	Disagree
42	Mostly I feel happy in my science classes	-2	-3	1	
43	The teacher’s feedback to me is unhelpful	4	4	0	Strongly disagree
44	Certain students are asked more questions in class than others	2	2	0	Disagree
45	Doing exams motivates me to work harder in science	-2	-1	1	
46	The pace of most science lessons is too fast	3	4	1	
47	I often ask other students in the class questions	1	1	0	Neutral/ disagree
48	If I don't understand something in science, I work on it until I get it right	-2	-2	0	Agree

Table 25: Statement rankings and Z-scores from Factor 1 students in Ireland and Scotland

Table 25 illustrated that 22 out of the 48 statements (46%) were given the same rankings by both the students from Scotland and Ireland. This cohort of students all strongly agreed with the following statements:

- I am aware of what I have learned in science,
- I feel I can ask questions in class,
- I think the feedback we receive from the teacher is fair,
- I feel safe when answering questions in class,

while strongly disagreeing with the statements:

- There is no point in doing science homework,
- A lot of the time I am unsure of what I am learning during a science lesson, and
- The teacher's feedback to me is unhelpful.

The participants in both Factor 1 groups showed the common discourse of their science lessons was that of inclusive engagement. Students both asked and answered questions and were not afraid to make mistakes; they were actively involved in learning. This is discussed in more detail in the individual Factor 1 analyses earlier in the chapter.

Teacher Feedback

Conversations with students about teacher feedback consolidated the quantitative Q data where students from both countries discussed the feedback practices taking place in their science lessons. To reiterate, statements about the teacher's feedback being helpful and fair were among the strongest opinions held by students in the quantitative Q data. This linked to the formative assessment strategy of providing feedback that moves the learners forward and has been observed to be one of the most powerful influences on student learning and achievement (Hattie & Timperley, 2007).

Interviewer:	Why did you put that in the disagree section "the teacher's feedback to me is unhelpful"?
Milltown Student 9:	Because it is always really useful feedback that she gives us.
Interviewer:	What do you mean by useful feedback?
Milltown Student 9:	We can apply it to what we are doing in science.
Interviewer:	What is helpful about the teacher's feedback?
Oakpark Student 2:	That is how you learn. If they just keep saying you are doing great, you are doing amazing…everyone makes mistakes so you

> have to be able to learn from your mistakes and they are there to spot the mistakes and tell you about them so you can fix those mistakes and become a better student.

The comments suggested that science teachers were engaged with feedback practices that helped students to move forward with their learning. This was a very interesting finding from the Q methodology as classroom observation denoted a clear paucity in teachers engaging with effective feedback. Effective feedback is considered as feedback that helps students to improve their learning and/or self-regulation skills. By returning to fieldnotes it was concluded that when teachers provided *feedback* it was based on a behaviourist view of evaluation where praise on work was common. For example, providing students with comments such as "well done", "excellent" and "good work" regularly to acknowledge student effort. However, this does not fit with the definition of feedback in formative assessment as it was not specified by the teacher how students can move forward in their learning. Of all the techniques that are formative, observing effective feedback in classrooms was the most difficult to capture in observation. This was perhaps due the fact that classes were observed over a short period of time and therefore there were no tasks observed that warranted constructive feedback. However, some of the Q data suggested that students had experience of engaging with effective feedback, but this was not evident in observation data.

Peer Learning

The Factor 1 students had contradicting opinions about helping their peers in class. The students in Ireland strongly agreed with statement 6 (I help other members of my group if they are stuck), while the Scottish students were ambivalent or not sure about this statement. The students from Ireland said:

> "If my partner beside me needs help I would be happy to help if I know the answer… Some people might know more than you do, or you could be in a position to help someone else. It is good that we can all learn together."
>
> (Oakpark Student 6)

> "I feel like when you're doing group work the other people in your group can help you and you can also help the people in your group so you can learn new things and they can help you or you can help them."
>
> (Greenview Student 1)

Yet, the students from Scotland were uncertain about helping their peers. This came from a lack of cohesiveness among students and a lack of rules or instruction concerning peer learning. They illustrated their doubts about peer learning:

> "we will be told how much work we should have achieved but we might not have been told how we should help the other members of the group."
>
> (Milltown Student 12)
>
> "some people just don't work (in groups), and it just makes it harder."
>
> (Woodhill Student 4)
>
> "I think that I learn more if I am working by myself because I think if you are working in a group, you always end up with one person being left out and then they don't learn as much so I'm not a big fan of working as a team."
>
> (Milltown Student 6)

From the interview data, peer learning skills were not as developed in the Scottish classes. Although some students discussed the benefits of working in groups and asking their peers for help, they were largely unable to articulate specific examples of effective peer learning activities and often started their comments with "if you are doing group work…" suggesting hypothetical group work situations. Students were able to convey their experiences of learning in groups rather than articulating how the actual learning took place during group work.

To summarise this section, the data from the Factor 1 students suggested that the factors were contributing to improved learning were comfortable discourse environments and teacher feedback. There was a lack of evidence for group tasks being conducive to student learning with implementation being varied in both countries.

Conclusion

The purpose of this chapter was to address the forth objective of this research to examine students' beliefs about teaching, learning, and assessment practices enacted in their school and science classes. This was accomplished by examining the data through the lens of activity theory and the different elements that comprise the activity system (subject, tools, object|outcome, rules, community, and division of labour). Data were analysed via the Q methodology resulting in rich quantitative and qualitative data. Students form part of the subject of the activity system of a country and are intertwined with different elements within the system resulting in either inhibiting or reaching the object of activity. The Q data exhibited

how the division of labour, tools, and subjects had a significant impact on whether students achieved the outcome of their formative assessment activity systems.

There were five main findings emergent from the student data. These findings are summarised below with connections made to the evaluative episodes of Chapters 5-8 to triangulate the findings.

1. *Students strongly valued teacher feedback in science lessons. Students considered feedback as a tool used by teachers to improve their learning*.

This finding was problematic when compared with what was observed in the evaluative episodes (Chapters 5-8). Teacher feedback was not contributing to formative assessment enactment in observed lessons. Dylan tried to use quiz data to feedback to students where they were having problems but fell short of moving learning forward for students. Matthew cited in his second episode that "on *Schoology* you will be given feedback" on cell models but no actual feedback to students was observed in his lessons. Nora was the one receiving the feedback from students in her evaluative episodes and feedback was non-existent in Amy's lessons. These findings suggested that the duration period of classroom observations was too short to observe effective feedback in practice, this was a limitation to this study. It appeared that feedback was occurring (according to the students), but it wasn't being regularly enacted otherwise it would have been observed in one or more of the classroom observations.

2. *In both countries, students believed that a positive classroom culture was contributing to learning. This culture was built on positive teacher student relationships and comfortable discourse environments.*

Unlike feedback, the data on positive teacher student relationship and comfortable discourse environments were compounded by the evaluative episodes. In Dylan's episode it was evident that his students were not afraid to share their thoughts with him as they regularly shouted out answers in class. This demonstrated his approachability in the classroom. Similarly, one of Amy's students did not hesitate to ask her for help with work that he had missed in the previous lesson. The comfortable discourse environments where students shared opinions and engaged with questions was illustrated in various episodes, most notably with Nora's group being encouraged to feedback to her the level of learning (through SOLO taxonomy).

3. *In Ireland two additional tools for improving learning emerged from the analyses, these included the teacher clarifying learning intentions and sharing criteria for success, and homework.*

Clarifying learning intentions and sharing criteria for success was one of the most evident formative assessment strategies in the Q data from Ireland. However, in Ireland it was the teacher alone who enacted this strategy. It was evident in episodes that both Matthew and Dylan were the ones who explained what would be happening in lessons and guiding the learning. For example, in Matthew's second episode he asked a student "what was my aim, what did I want you to learn?". So, he had shared the intention of the lesson with the students but made it clear that it was him who was in control of the learning. Homework as a tool for improved learning was an interesting finding from the student data as there is a gap in the research field of homework and its connection to formative assessment (Strandberg, 2013). Looking at homework in the evaluative episodes, Matthew used homework as a formative assessment activity where students were to bring their learning together via a homework task. Additionally, it was of interest who was helping students with homework, with Irish data suggesting that the students from the more affluent area (Oakpark) were getting more help with work at home.

4. *In Scotland clarifying learning intentions and sharing criteria for success, was also a tool used in science lessons. However, unlike Ireland the division of labour with this tool was shared among the teacher and the students.*

The main difference between the countries regarding the learning intentions and success criteria was who was involved in this formative assessment strategy. In Ireland the teacher took control of this tool whereas in Scotland the students were involved in setting the learning intentions. This was exemplified in Nora's second episode where she created the learning intentions, but the students were the ones who chose what intention they would start the lesson at. This was known as SOLO taxonomy (Collis & Biggs, 1982)

5. *A minority of students had negative experiences of science lessons.*

Among students in Ireland this was attributed to a dislike of group work, while in Scotland unhappiness in science classes came from learning being focused on exams and feeling like they were not a part of the learning activities taking place in lessons. Although it was only three out of 48 students who described these negative experiences, it was clear in some of the evaluative episodes why this would be the case. For example, Matthew's first evaluative episode begun after students had been working in groups of two. Observation data illustrated that engagement in the task was mixed with some pairs working well and others disengaging due to the long-time frame set for the task (30 minutes). Learning being focused on exams was not evidenced in the evaluative episodes however the Factor 2 students from Scotland believed that exams were having a negative influence on their learning. Feeling isolated from the learning activities in lessons was evidenced in Amy's evaluative episode where Amy often

directed her questions at students who she knew would respond to her with the answer she was looking for. Moreover, this was considered as part of the reason why there was consistent low-level chat and disruption throughout Amy's episode.

10. Discussion and Conclusion

Introduction

This thesis was based on the research problem that the purpose of formative assessment is not fully understood by teachers and aimed to unearth why this was the case. This problem stemmed from two main issues, the first issue being a lack of empirical research on formative assessment, particularly in Ireland. As the literature review of Chapter 3 demonstrated there is little empirical data on how formative assessment is enacted in second level classrooms. This thesis aimed to address this gap in the knowledge. The second issue was concerned with how formative assessment has been interpreted differently by different stakeholders in education including policy makers, school leaders, teachers, students, and theorists.

From conducting a theoretical, empirical, and methodological literature review, gaps in the existing scholarship on formative assessment were identified in four main areas. The first gap was concerned with the limited variation of research participants in empirical studies on formative assessment. Black and Wiliam's 2009 definition for formative assessment included teachers, school leaders, and students in the enactment of effective formative assessment. Therefore, a study gathering data from all these groups was needed. The second gap in the literature showed that teacher professional identity was under researched in terms of its influence on formative assessment enactment. Research on teacher identity has shown how it is an important factor in improving student learning and merited further consideration (MacDonald Grieve, 2010, Priestley, Biesta, & Robinson, 2015). The third gap in the literature is on another under researched factor that can influence formative assessment: student behaviour. This was an emergent finding from this thesis that student behaviour was influencing a teacher's ability to enact formative assessment. The final gap in the literature was concerned with data on student voice. To find out how students learn best, student voice needs to be considered more in empirical research (Ní Chróinín & Cosgrave, 2013). However, there is a lack of research in this area, particularly in Ireland. Moreover, utilising the Q methodology to gather data from students is a relatively new research methodology in educational research and benefits from adding statistical significance to qualitative findings (Akhtar-Danesh et al., 2008; Killam et al., 2013; Parker & Alford, 2010).

Addressing the research problems and gaps in the literature cited above required expanding the knowledge and understanding on formative assessment in Ireland and Scotland. This process was facilitated using the lens of activity theory. This study sought to answer the following questions:

1. How is formative assessment understood and enacted in lower second level classes in Ireland and Scotland?
2. What are the factors that shape formative assessment enactment in science classes in these countries?

These questions had yet to be answered in the literature with a specific paucity on the factors that promote or inhibit formative assessment practice. To recap, factors in this research were any influence effecting a teacher's practice. The objectives of the research set out to:

1. Observe assessment practices in science lessons to determine if formative assessment is embedded in practice.
2. Determine teachers' understanding of formative assessment and identify what they believe to be the significant influences on their teaching practices.
3. Ascertain the influence of cultural context on teaching, learning, and assessment practices within schools.
4. Examine students' beliefs about the teaching, learning, and assessment practices enacted in their school and science classes.
5. Investigate the influence of curriculum policy on a school's approach to formative assessment.

A wider interpretation of formative assessment was sought, moving beyond just looking at the five core strategies for formative assessment (see Table 2, Chapter 2) to considering how cultural context affects the enactment of formative assessment. Cultural contexts have a significant influence on how teaching, learning and assessment plays out in schools (Darmody et al., 2020; Devine et al., 2013; McSweeney, 2012) and there exists a lack of research into how cultural contexts influence formative assessment (Black & Wiliam, 2012). In this thesis cultural and contextual influences were presented as factors influencing formative assessment enactment and included (but were not limited to) curriculum, community involvement, and whole school assessment initiatives. These factors made up the elements of the activity system, and by examining the bottom of an activity triangle in particular, factors were emergent that influenced the relationship between the subject, their tools, and the object of their activity system. In addition, the student voice was heard through the Q methodology where student

viewpoints on teaching, learning, and assessment were explored. This built an informed picture of formative assessment through all the actors involved in creating learning. Moreover, both Ireland and Scotland have experienced relatively recent curricular reforms at second level with formative assessment integration being a focal point in both sets of policy (Department of Education and Skills, 2015a; Scottish Executive, 2004). These curriculum reforms were considered as a factor influencing formative assessment enactment thus, data regarding policy enactment were gathered to gauge how formative assessment was understood in the context of both countries.

Overview of Main Findings

This thesis advances the scholarship on formative assessment by adding two main findings to the field. These findings are considered as a pair of factors that help to enact formative assessment effectively in schools.

1. ***Cultural context*** *plays a significant role in deciding what teaching, learning, and assessment practices are given value within an education system.*

This thesis explored formative assessment through sociocultural theory which allowed for the importance of cultural contexts in formative assessment to be unearthed. Social and community factor such as parental involvement in school life, whole school initiatives, and countrywide values, were considered significant in the implementation of teaching, learning, and assessment practices. This thesis showed how in Ireland it was difficult for teachers to enact formative assessment due to the constraints put on them by the culture of educational assessment. Summative assessments and high-stakes terminal examinations are highly valued in Ireland and therefore it was difficult for schools and teachers to go against the grain and implement more formative assessment practices in their classrooms. In addition, this thesis uncovered that the policy borrowing between Scotland and Ireland in relation to formative assessment was not successful. Again, the cultural context of education in Ireland did not lend itself easily to adapting more formative methods that were commonplace in the Scottish Curriculum for Excellence. These findings were in line with existing literature that demonstrate the importance of considering cultural context when examining formative assessment (Black & Wiliam, 2009; Dann, 2018; Pryor & Crossouard, 2008) however a case study approach to examining cultural context in detail in Ireland and Scotland had yet to be given due consideration.

2. *Teachers' **assessment literacy** is underdeveloped therefore it is difficult for them to enact formative assessment effectively.*

This research found that teachers' assessment literacy is underdeveloped and therefore do not know how to take formative assessment from a tools-based approach to a meaningful process for students where they can improve their learning. Assessment literacy has been explored in existing literature (DeLuca et al., 2016; Smith et al., 2013; Stiggins, 1991) however this thesis adds particularly to the scholarship on assessment literacy in Ireland and the effects of teachers' underdeveloped assessment literacy on student learning. There was little evidence to show how teachers' enacted formative assessment practices were influencing students' learning. A lack of alignment between teachers' intended and enacted practices was the main reasons for this. However, teachers were not entirely to blame for their underdeveloped assessment literacy, there were a myriad of factors impeding their formative assessment enactment including curriculum policy, school norms, relationships within the school, the school community, and the provision of professional development.

By considering cultural context and assessment literacy, formative assessment can be enacted effectively by teachers in schools. This chapter will now proceed by exploring these findings in greater detail and explicitly linking the findings back to the data collected.

Empirical Findings

The empirical findings were presented in Chapter 5 through to Chapter 9. Findings for Chapters 5 to 8 were presented through *evaluative episode* vignettes (Hardman, 2007) that analysed classroom practice in relation to the activity system. Data gathered from interviews with a focus on cultural context were also included in these chapters to complete each case's activity system. Chapter 9 presented student data concerning their beliefs on teaching, learning, and assessment. The Q methodology (Stephenson, 1953) was utilised where qualitative data through interview, and quantitative data via a card sort were gathered from students.

Answering the Research Questions

Using the data gathered from the empirical chapters and policy review, the research questions can now be addressed.

1. How is formative assessment understood and enacted in lower second level classes in Ireland and Scotland?

Ireland

Data from Ireland revealed that a contradiction existed among teachers' intended and enacted practices. That is, their understanding of formative assessment explained in interview did not align with their practice in lessons. Dylan's intended practice focused on a tools-based approach to improving student learning. He commented in interview that technology was his tool of choice to check student understanding and monitor progress. His vision for formative assessment aligned with the formative assessment strategy of engineering effective classroom discussions and tasks that elicit evidence of learning (Wiliam & Thompson, 2007). However, data from his evaluative episode illustrated that he used technology as a tool to check for understanding but failed to monitor student progress using the information he had gathered. Dylan was operating at the level of the *letter* of formative assessment and data suggested that his lack of follow-through on formative assessment activities i.e., responsive teaching, meant that students did not have the opportunity to improve their learning using this tool. Responsive teaching is a defining principle of formative assessment where "evidence about student learning is used to adjust instruction to better meet student needs" (Wiliam & Thompson, 2007, p. 64). It requires a level of teacher noticing that "invites action that is inclusive, dynamic and purposeful response to evidence of student ideas" (Cowie et al., 2018, p. 464). This means that teachers like Dylan need to develop the skills to act on the fly and use the information gathered from students to improve the learning. The data showed that Dylan did not use the evidence he gathered to meet the learning needs of his students. He was focused on the surface techniques for formative assessment (e.g., *Quizziz*) and lacked an understanding of the underpinning principles of formative assessment. His assessment literacy was poor, and this was due to a lack of agency over his practice and the unproductive professional development he had engaged with both in and out of his school. Dylan was at the point in his professional learning journey where he was practicing the *letter* of formative assessment and was in need of professional development opportunities that would help him to pass over the threshold from practicing the *letter* of formative assessment to adopting the *spirit* of formative assessment (DeLuca et al., 2019).

For Matthew in Oakpark, his understanding of formative assessment was based on three techniques: technology, questioning, and developing students' learning skills. The first two techniques were enacted through the tools in his activity system (Figure 10, Chapter 6) and the final technique was linked to the formative assessment strategy of activating students as owners of their own learning. There was limited evidence from fieldnotes and video that showed

Matthew was “coaching” (his terminology) the students to develop their learning skills, and this was the closest Matthew got to reaching the intended outcomes of formative assessment: improved student learning and responsive teaching. Likewise, the other two techniques: technology and questioning were limited in their effect on student learning. The data on his use of technology presented a profound contradiction in his activity system. In interview he conveyed a strong passion for using technology in his practice, however this was not evident during the observation periods. Moreover, Matthew conveyed how it was difficult to go against the grain with his unique practices in Oakpark as the surrounding community did not value alternate assessment methods outside of traditional examinations. This showed how the cultural context of Oakpark was having a profound influence on the uptake of teaching, learning, and assessment practices and their value among the Oakpark community.

The division of labour in Matthew’s activity was skewed in favour of teacher led activities. He demonstrated a tendency to dominate learning, i.e., he was in control of learning activities. This failed to actively engage students with their learning, a fundamental principle of formative assessment that would help students improve their learning. This demonstrated that Matthew was still a novice when it came to his professional learning in formative assessment. He was struggling with reframing his practices so that they were more student led rather than teacher dominated. The data from the Q methodology supported the evaluative episode finding that the teacher was largely in control of the learning in the classroom. The student data showed that the division of labour or power was primarily in the hands of the teacher, and they lacked the opportunity to actively engage with their learning. Power dynamics are not something that is commonly researched in the formative assessment literature. Therefore, this finding adds to the scholarship on formative assessment by suggesting that division of labour must be shared among all subjects in the classroom for formative assessment to be enacted effectively.

To summarise the findings from the activity systems in Ireland, the data revealed that teachers used two formative assessment strategies: engineering effective classroom discussions and tasks that elicit evidence of learning, and activating students as the owners of their own learning. However, they fall short in enacting these practices in their lessons as they did not understand the underlying principles of formative assessment: improving learning and responsive teaching. Formative assessment depends on what teachers notice, select as a focus, interpret the information and act on it (Cowie et al., 2018, p. 464) and this type of teacher noticing influences understanding (Erickson, 2011). These kinds of responses or moments of

contingency shape the trajectories of student learning (Santagata, 2011) yet they were not given due consideration by the Irish teachers in this research. Their focus was on the techniques for formative assessment illustrating a surface level or tokenistic enactment. Black and Wiliam warned of a superficial interpretation of formative assessment in their early work (1998a, 1998b) and later research reports similar findings (James et al., 2006; James & McCormick, 2009). The fact that it is still evident in Ireland over ten years later is a concern.

The data from Ireland explored how formative assessment was understood and enacted, it also signified a dearth of specific formative assessment strategies in the classroom, most significantly "providing feedback that moves learners forward" (Wiliam & Thompson, 2007, p. 64). In Chapter 2 and Chapter 3 feedback was situated as a fundamental formative assessment strategy and its importance in improving learning and providing for responsive teaching was well documented (Bloom et al., 1971; Hattie & Timperley, 2007; Miller & Lavin, 2007; Nicol & Macfarlane-Dick, 2006; Sadler, 1989; Shepard, 2000). Equally the literature suggested that feedback processes are often enacted superficially (Atjonen, 2014; Harris, Brown, & Harnett, 2014; Molloy & Boud, 2012; Nicol & Macfarlane-Dick, 2006) and this appeared to be the case in this thesis. Findings from the Q methodology in Chapter 9 discussed how students strongly valued teacher feedback in science lessons. The statement: *the teacher's feedback to me is unhelpful* held the highest Z-score of 2.013 indicating strong disagreement. The students believed that feedback was a strong tool used by teachers to improve their learning. This presented as a paradox, as formative feedback was not evident in the evaluative episodes presented in Chapters 5 and 6. This raised the question of whether students understood what effective formative feedback was? Upon analysis of the student interview data, it became apparent that students didn't receive feedback from teachers that moved their learning forward. The student comments on feedback were vague and generic which can raise concerns about the validity of students' self-reporting on their own learning Their teachers "looked over" copybooks and told them they "need to study a bit". From looking at the data, it was deduced that these students were receiving comments about their work from the teacher however these comments were not formative i.e., they did not provide students with adequate information to move their learning forward. So, to answer the question, students did not understand what effective feedback looks like in terms of improving their learning.

Scotland

Scotland was used as a comparative case for examining formative assessment enactment in this research. Scotland had formative assessment engrained in its curriculum for a number of years through Assessment is for Learning (Scottish Government, 2005) and the Curriculum for Excellence (Scottish Executive, 2004). These initiatives predated Ireland's Junior Cycle Framework and it was envisaged that there would be a deeper level of understanding in Scotland, and this would provide insight into how Ireland could engage more with formative assessment. This preconception was confirmed in Milltown where Nora had formative assessment and student learning at the heart of her practice, however in Woodhill similarities were drawn with Dylan and Matthew, whereby the intentions for enactment were there but the follow through was lacking due to constraining factors.

Nora from Milltown was the only participant teacher who embedded formative assessment into her practice effectively to reach the outcomes of improved student learning and responsive teaching. Unlike other teachers in this study, she was leading the *spirit* of formative assessment in her school (DeLuca et al., 2019; Marshall & Drummond, 2006). She enacted this by actively involving students in their learning through reflection tasks, setting of learning outcomes, and using student responses to plan subsequent learning. Nora was able to build on her professional learning to notice and act on feedback she got about her students learning. Her intended and enacted practices were aligned and in interview she provided a deep insight into how she facilitated learning in her lessons. Her interview data corroborated what was observed in lessons where strong use of SOLO taxonomy (Collis & Biggs, 1982) and the strategy of actively involving students as owners of their own learning were evident. Including Nora's activity system as a case study in this thesis meant that effective formative assessment practice was documented, and conclusions could be drawn as to what causing formative assessment to be embedded in her practice. These conclusions (referred to as factors throughout the thesis) included the agency she had in curriculum implementation, her professional identity, and her involvement with *Visible Learning* (Hattie, 2012) in Milltown. These factors demonstrated how her rich assessment literacy and advanced professional learning in formative assessment was leading to students enhancing their learning. This was corroborated with the Q data from Nora's students (Chapter 9).

Amy from Woodhill in Scotland presented a different case when examining her formative assessment enactment. Amy was somewhere between learning and practicing the *letter* of

formative assessment in her practice (DeLuca et al., 2019; Marshall & Drummond, 2006). She had taken the initiative to engage with professional learning on formative assessment however this was not observed effectively in her lessons. In Amy's case, it was tensions arising within her classroom community that was impeding her practice. An interesting finding arose from examining Amy's activity system: the effect of classroom behaviour on formative assessment practice. This finding was significant as there exists a gap in the literature on the relationship between negative behaviours and formative assessment. Amy encountered a variety of classroom management issues with her students and although she dealt with these problems calmly and professionally, the opportunity for formative assessment was often lost due to these interruptions. Amy was part of a school community where school-wide tools for formative assessment were common. One of these tools was the lesson starter that was designed to build on student prior knowledge and help the teacher to decide on the next steps in learning. The intended practice of the lesson starter was well intentioned, but the problems with the classroom community meant that the outcomes of the formative assessment task (improved learning and responsive teaching) were not met. This had repercussions for how Amy organised the division of labour in her lessons, her lack of control of student behaviour meant she often dominated the learning and as a result students lacked the opportunity to be owners of their own learning. These observations deviated from Amy's comments in interview where she believed students had the opportunity to "lead their own learning" in science lessons.

Summarising the findings from Scotland about understanding and enacting formative assessment, broad generalisations cannot be made between Ireland and Scotland. Looking at understanding first, it was clear that the Scottish teachers were more familiar with formative assessment discourse, but this did not have a direct impact on their enactment in the classroom. When enactment was observed, the strategies of clarifying learning intentions and sharing criteria for success, activating students as owners of their own learning, and activating students as instructional resources for one another were the most prevalent, while providing feedback that moves learning forward was lacking. Interestingly although in Nora's evaluative episodes we see students acting as instructional resources for one another, students themselves were unsure if this strategy was beneficial to their learning. Q methodology data from the Scottish students signified that they were impartial about peer learning and often preferred relying on the teacher to help them improve.

Like the data from Ireland, the Scottish students strongly valued the feedback they received from their teacher, however teacher feedback that moves learning forward was not evident in

Amy or Nora's lessons. However, it was of interest that Nora used the feedback she received from students (through thumbs up etc.) to check for understanding. Feedback for Nora was a reciprocal activity, but this interpretation is not considered in Wiliam and Thompson's framework for formative assessment (2007). For them, feedback is provided by the teacher alone (see Table 2, Chapter 2) and getting feedback from students to improve learning is not included in their table.

Considering the findings from both Ireland and Scotland in relation to feedback, a reimagined framework is proposed (see
Table 26). In the original table presented by Wiliam and Thompson (2007, Table 2, Chapter 2), feedback was a process that's division of labour lay with the teacher and negated that feedback can be a reciprocal process aimed to improve learning and adapt teaching as demonstrated by Nora in Chapter 7. To reiterate the research problem that formative assessment is not fully understood, by adapting the table (highlighted in green) to include the peer and learner as part of the feedback process the 'big idea' of formative assessment: moments of contingency to meet learners needs, is given due consideration. This helps teachers to notice that they can use feedback from students to respond to their learning needs.

<table>
<tr><th></th><th>Where the Learner is Going</th><th>Where the Learner is Right Now</th><th>How to Get There</th></tr>
<tr><td>Teacher</td><td>Clarifying learning intentions and sharing criteria for success</td><td>Engineering effective classroom discussions and tasks that elicit evidence of learning</td><td rowspan="3">Providing feedback that moves learners forward</td></tr>
<tr><td>Peer</td><td rowspan="2">Understanding and sharing learning intentions and criteria for success</td><td>Activating students as instructional resources for one another</td></tr>
<tr><td>Learner</td><td>Activating students as the owners of their own learning</td></tr>
</table>

Table 26: Reimagination of Wiliam and Thompson's Framework Relating Strategies of Formative Assessment to Instructional Processes

2. What are the factors that shape formative assessment enactment in science classes in these countries?

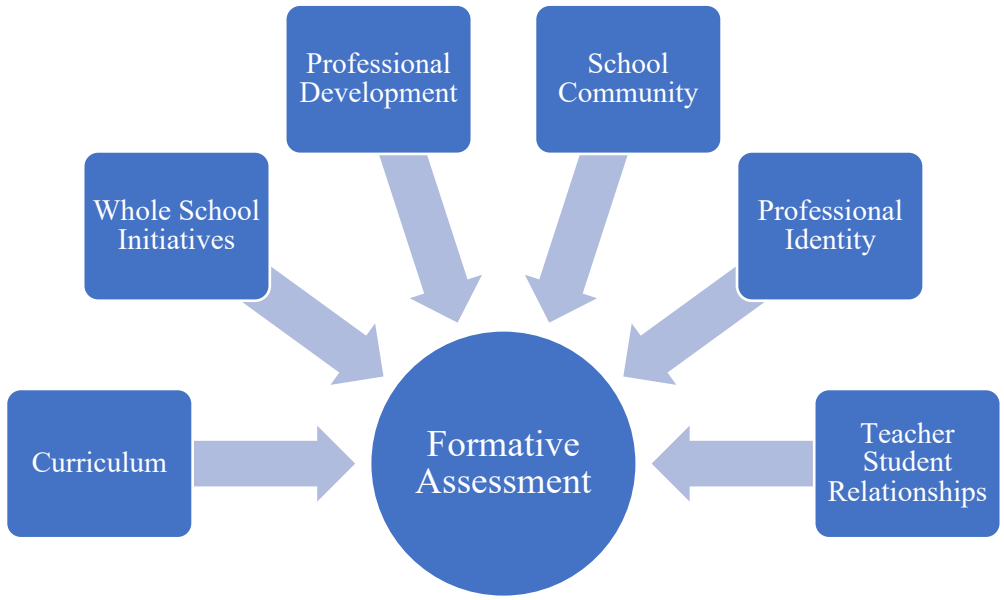

Figure 17: Factors effecting formative assessment enactment

The first research question considered how formative assessment was understood and enacted in Ireland and Scotland. The second question looked at the different factors that shaped enactment and in particular what factors were promoting or inhibiting formative assessment. Drawing from the data chapters, Figure 17 depicts the various factors that were considered to influence formative assessment enactment in both Ireland and Scotland. For example, the curriculum forms part of the cultural context of a school and education system, while a teacher's professional identity links to their assessment literacy. A breakdown of these factors is now forwarded.

Curriculum

To reiterate, Ireland and Scotland were chosen due to curriculum reform in favour of increased formative assessment at lower second level. Based on written curriculum (e.g., the Junior Cycle Framework) teachers can make pedagogical decisions that support the use of formative assessment. By properly engaging with the written curriculum teachers can express agency over the content and meet the curricular needs in a way that derives meaning for both them and their students. After considering the different cases, curriculum was a factor that could both promote (in the case of Nora and Matthew) and inhibit (in Dylan's case) formative assessment

enactment. Looking to Scotland first, the Curriculum for Excellence provided teachers and schools with the flexibility to enact the curriculum as they saw fit for their particular cultural context (Scottish Executive, 2004). With Nora she demonstrated agency over the curriculum by designing modules to be implemented in science lessons that were relevant and engaging for her students while still meeting the expectations and outcomes of the curriculum.

It was not evident in Ireland that teachers exerted agency over the curriculum in a meaningful way. For example, Dylan expressed how he felt ill prepared to enact the curriculum due to a lack of professional development prior to the implementation of the science specification. Dylan was not confident enough to interpret the written curriculum himself and believed he needed training from others to sufficiently engage with the science specification. For Matthew, although he fell short of enacting formative assessment effectively, he was beginning to show signs of agency over the curriculum by completing project work with students. Having a new specification to work with provided Matthew the freedom to expand the learning outcomes of the revised science specification (Department of Education and Skills, 2015b). Matthew had previously taught in different jurisdictions around the world and was therefore familiar with interpreting and enacting different curricula. He was not afraid to individualise the curriculum to suit the needs of his students by incorporating project work into his lessons.

Whole School Initiatives

All the schools participating in this research were implementing some form of whole school initiative related to formative assessment, that was why they were chosen to participate in this research. These whole school projects involved either developing student learning skills or upskilling teachers in formative assessment techniques. However, not all initiatives were successful in embedding formative assessment. Previous research has shown that a school's cultural context needs to align with the national context in order for whole school initiatives to be successful (Darmody et al., 2020). Data from this thesis showed how summative assessment and high stakes testing was strongly valued in schools in Ireland such as Oakpark and therefore they found it difficult to implement more formative methods. Specifically, Oakpark aimed to advance the learning skills of their students through the *Learning Curve* module, however analysis of the student data from the Q methodology illustrated that a lot of the focus of the module was on exam preparation and linked to summative assessment. Examining the principal's comments about the module, it had the potential to develop students' self-regulatory

skills, however there was not enough observation or teacher interview data to demonstrate how it promoted formative assessment enactment in Oakpark.

Greenview chose to implement whole school initiatives through teacher professional development. At the time of research teachers were engaged with two main strands of professional development: technology and formative assessment. Data from Dylan's evaluative episode showed how having two big initiatives implemented in Greenview at the same time was leading to a piecemeal enactment of different pedagogies. Teachers were picking and choosing different aspects of the practices they were being taught and as a result neither they nor their students were able to derive meaning from these practices. This was evident with Dylan where he believed he was using technology for formative assessment whereas his use of technology did not improve student learning. In addition to the piecemeal enactment of different pedagogies, the training specifically provided on formative assessment was poor. It was a tools-based approach to implementing formative assessment techniques such as randomised questioning and the use of mini whiteboards. The training provided a surface level introduction to formative assessment by focusing on superficial techniques and neglected the outcomes formative assessment: improved learning and responsive teaching.

In Scotland the whole school approaches to formative assessment were more substantial. In Milltown the school was engaged with *Visible Learning* (Hattie, 2012) and at the time of research they were focused on learning intentions and success criteria. Data analysis showed that this whole school initiative was a factor promoting formative assessment enactment, but it raised the question of why was this whole school approach effective in Milltown and not in the schools in Ireland? Extrapolating from the data there were various reasons why *Visible Learning* was more effective at improving learning than Oakpark's *Learning Curve* or Greenview's formative assessment professional development. Firstly, Milltown engaged with experts on *Visible Learning* when implementing the initiative. This required a significant financial investment by the school.

Secondly the head teacher had created a guiding coalition, a group of staff dedicated to the roll out of *Visible Learning*. Of note was that Nora was a core member of this group. The group were responsible for helping other staff implement *Visible Learning* through professional development, learning lunches and one-to-one help. This suggested a level of distributed leadership in Milltown that was not evident in other schools. By distributing the leadership

among expert staff members, the head teacher had empowered members of staff to share their expertise in this area. Providing for distributed leadership in schools has been seen in research to contribute positively to school transformation and improvement (Harris & Deflaminis, 2016). Thirdly, *Visible Learning* was the only whole school teaching and learning initiative being implemented in the school at the time of research. Unlike Greenview where teachers were trying to implement both technology based and formative assessment practices, Milltown's sole focus for school improvement was on *Visible Learning*. Lastly, Milltown made a point of communicating the practices of *Visible Learning* with the families in the school. This meant that all members of the school community were focused on one initiative and understood why these practices were taking place.

Professional Development

The empirical literature from Chapter 3 cited the importance of formative assessment specific professional development for improved student learning (Black & Wiliam, 2005; Leahy & Wiliam, 2009; Lysaght & O'Leary, 2017). Data from this thesis illustrated how Scottish teachers were provided with more opportunity to engage with professional development they believed was most beneficial to their learning. This was a positive aspect of Woodhill in Scotland where teachers were engaged with *Practitioner Enquiry* (Menter et al., 2011) a type of individualised professional development comprised of an "investigation with a rationale and approach that can be explained or defended. The findings can then be shared so it becomes more than reflection or personal enquiry" (General Teaching Council for Scotland, 2020). In Woodhill, teachers had the option to use their 35 hours of mandatory continual professional development to undertake a research-based project, Amy chose to focus on questioning, a key technique for formative assessment. She was provided the time to engage with professional development that she believed was most beneficial to her as a teacher. This contrasted with the experience of professional development experienced by the teachers in Ireland. Data from the Irish teachers suggested that professional development was *top down* (Roseler & Dentzau, 2013; Vangrieken et al., 2017) for the most part meaning that it was something that was done to teachers rather than them having agency to choose their own area of interest and/or engage in a research activity.

The literature in Chapter 3 suggested that context specific professional development was key in getting teaching, learning, and assessment practices embedded within a school (James &

McCormick, 2009; Lysaght & O'Leary, 2017). These findings were consistent in Milltown where the *Visible Learning* initiative was introduced by experts but rolled out by teachers within the school. Data from Nora's evaluative episodes demonstrated her expertise in using learning intentions and success criteria, the *Visible Learning* technique being promoted in Milltown at the time of research. Context specific professional development was also experienced by Dylan in Greenview where he participated in school-based training in two main areas: formative assessment and technology. However, analysis of his evaluative episode demonstrated that the two big initiatives (formative assessment and technology) were not working together effectively to improve student learning. It was deduced that because the school was trying to promote two different areas of teaching, learning, and assessment at once, neither formative assessment or technology were given adequate time for meaningful engagement or enactment.

School Community

Community is part of the bottom tier of an activity system and is a sociocultural factor that influences activity through the subjects interactions with their environment (Hashim & Jones, 2007). Community is a factor that is part of cultural context. In this research the school community was considered as those situated in the school itself (students, teachers, school leaders (as well as the wider community in which the school is situated (family members, those living in the surrounding area of the school). In Scotland the school community was positively linked to formative assessment enactment, whereas in Ireland it was negatively linked to it. By making use of activity theory a contextual analysis of each case teacher and their community was created and illustrated how the cultural and historical norms of each country were influencing teaching, learning, and assessment. In Scotland the school community had a positive influence on schools. The community were very involved in their schools and were kept informed of the whole school approaches to teaching, learning, and assessment. This was most evident in Woodhill where parents were invited into the school to learn about how their children were being taught. Woodhill's community valued their school and in turn respected the practices being implemented.

In contrast in Ireland, the community had a negative effect on teaching, learning, and assessment. A tradition of high stakes testing, and exam focused learning meant that the surrounding community did not place a high value on formative assessment. This was very

clear in Oakpark where the parents in the surrounding community did not value the formative assessment methods being enacted and often complained to the principal about this. The data again showed that a school's cultural context needs to align with national norms for initiatives to be implemented successfully. Oakpark was a very clear example of where the misinterpretation surrounding formative assessment led to it not being valued in the community. For the parents (and teachers), formative assessment was something extra to be done in the classroom that distracted students from preparing for examinations. If formative assessment was undertaken effectively by engaging students actively in their learning, students would derive more meaning from subject matter and in turn perform better in examinations. This is the double edge sword of formative assessment. It is intended to complement summative assessment (Black & Wiliam, 1998a, 1998b) however a lack of understanding is devaluing its effectiveness.

A possible solution to improving the community's perceptions of formative assessment would be to keep them informed as to how it can improve student learning. However, principals from Ireland participating in this research made it clear that they did not engage their surrounding communities enough about the teaching, learning, and assessment practices taking place in their schools. Therefore, it was difficult for parents to buy into the benefits of formative assessment without being informed by the schools in which their children were attending.

Professional Identity

As Chapter 2 explored, professional identity is a difficult concept to pin to a precise definition (Beijaard et al., 2004) however, for this research it was considered as how teachers construct their own ideas of 'how to be', 'how to act' and 'how to understand' (Sachs, 2005, p. 15). Having a professional identity that is beneficial to student learning depends on influences including community, environment, past educational experiences, and promoting quality in the workplace (Antonek et al., 1997; Coldron & Smith, 1999; Moore & Hofman, 1988) For Nora professional identity was a factor that influenced her formative assessment enactment positively. She had constructed her professional identity through education, becoming a Chartered Teacher (Scottish Executive, 2001) and expressing agency over her practice. Nora was considered as someone who had advanced pedagogical content knowledge (Shulman, 1986)stemming from the various facets of her professional identity. She demonstrated agency by designing science modules and creating progress booklets for the science students in her

school. This type of iterational agency was not evident with the teachers from Ireland. In addition, Nora held a Master's in Education and became a Chartered Teacher so she could remain in the classroom and progress in her career without having to become a member of management. This type of agency is considered as iterational (Priestley & Biesta, 2013) as it was formed in Nora's past experiences. Her professional identity was shaped by her extensive professional development and focused on improving student learning, a key outcome of formative assessment. In this case she exhibited practical-evaluative agency (Priestley & Biesta, 2013) where her skills, knowledge, personal and professional values were helping her to enact formative assessment. This was evident in her evaluative episode where she utilised SOLO taxonomy so students could decide on the level of the lesson, and when she used feedback from students to plan subsequent activities based on their current level of learning. She solidified her dedication to student learning in interview by commenting that her job was to "understand where they're at and to understand how to move them forward". Nora can be considered as an outlier in the data, her case study provided insight into how formative assessment can be embedded in practice so that students can improve their learning. However, she was not the norm when it came to formative assessment enactment, the other seven teachers participating in this research fell short of effective enactment of formative assessment, making Nora a unique case.

Teacher-Student Relationships

Drawing from interview data, the teacher-student relationship was a common topic of conversation with both teacher and students. Data from students obtained through the Q methodology illustrated that a positive relationship with the teacher was a key factor in improving their learning. Students explained these positive relationships by commenting that their science teachers were friendly, nice, and caring. Interestingly, all teachers who were participants in this research received positive comments from their students about their effective relationships. By making an explicit link between the tools that help students to learn and the community in which they were learning, inferences were drawn as to how relationships mediate learning. This finding would not have been uncovered if formative assessment was not explored through activity theory that considered both the tools and community of an activity system that improve learning. These findings are line with literature that suggests positive relationships are important for student success (Bainbridge Frymier & Houser, 2000; Davis & Dupper, 2004; Fredriksen & Rhodes, 2004; Hughes, 2011).

However, this finding was not without its limitations. Students did not go into detail or explain how positive relationships with teachers were helping improve their self-regulatory skills: a fundamental aspect of formative assessment. This was more evident with the Scottish students who were able to discuss self-regulation in interview, however awareness of self-regulation was lacking among the Irish students. Further research is needed to explore the nuances of the teacher student relationship that make it an effective tool for formative assessment. In addition to the relationships being positive, the data suggest that reliance on the teacher was also significant. Students preferred to turn to their teacher when needing guidance rather than asking their peers. While the data suggested that student-teacher relationships were positive, overreliance on the teacher can lead to students not developing their self-regulatory skills. This was evident with the Factor 2 students from Woodhill in Scotland who believed it was the teacher who was responsible for their learning as "that is what their job is" (Woodhill Student 9). This issue merits further insight through research.

Theoretical and Policy Implications

Chapter 2 discussed the theorisation of formative assessment from its establishment as a behaviourist approach to learning in the 1960s, through the constructivist and social constructivist movements of the late 20th century, to finally being situated among sociocultural theories such as activity theory. Activity theory was the most suitable theory to frame this study as it provided a framework for an in-depth exploration of teaching practices by examining the elements of activity systems: the tools, rules, community, and division of labour, that all contribute to how a teacher teaches his/her students. Moreover, as activity theory allocates a space in analysis for examining the sociocultural influences on teachers' practices (e.g., provision for professional development in the school or curriculum enactment) it was a suitable theoretical lens to address the questions and objectives of this thesis. These sociocultural influences were included when exploring formative assessment enactment through the subject of the activity system: the science teacher and their students. Using the lens of activity theory, tools (for example teacher questioning, technology, lesson starters) were examined in-depth to ascertain which ones were promoting or inhibiting formative assessment. If inhibitors were found, contradictions were explored. The second question focused beyond what was happening in the classroom hence a theoretical framework that moved beyond examining classroom

practices alone was needed so that teaching, learning, and practices could be explained in relation to cultural and contextual influences.

This thesis argued for a sociocultural framing of formative assessment to understand how it can be enacted effectively in different jurisdictions. A sociocultural theorisation requires various elements of teaching, learning, and assessment practices to be explored to rationalise why or why not formative assessment is enacted. These elements include agency, identity, and the division of labour, elements of sociocultural theory that are that often overlooked in educational research (Pryor & Crossouard, 2008). One way this thesis added to the scholarship on formative assessment as a sociocultural theory was by looking at teachers' agentic capacity to enact formative assessment. A key finding was that teachers felt constrained by their cultural contexts and therefore their capacity to enact formative assessment effectively was reduced. This was evident with Dylan who showed little agentic capacity in adapting the new science specification. He did not feel it was his intrinsic responsibility to familiarise himself with the specification and accredited his ill preparedness to a lack of professional development. The cultural norm in Ireland was for external bodies to provide training in reformed practices to prepare for new curricula. This can be of great benefit to teachers as they are provided with guidance on how to proceed with reform however by externalising this change, teachers reduce their agentic capacity and take less responsibility for the types of practices they include in their lessons. DeLuca, Chapman-Chin, and Klinger's research on the implementation of effective formative assessment professional learning (2019) needs to be considered in the Irish context so teachers can fundamentally shift their thinking about formative assessment and enact the *spirit* of formative assessment

Building on the rationale for presenting formative assessment as a sociocultural theory, activity theory was most suited theoretical framework for this research. By applying activity theory, a key finding of this research was uncovered: the contradiction between teachers' intended and enacted practices. This would not have been possible without an activity theory theorisation where elements of the activity system can exist twice. Chapter 2 explained how an element can be understood as both a physical and mental process (Marx & Engels, 1978) where a teacher may have an idea of what formative assessment is in their mind (*genestand*) but how it actually enacted in their classroom (*objekt*) may be different. This was the case with Dylan, Matthew, and Amy. For Dylan, he set up his formative assessment activity well (a quiz to assess prior knowledge) but did not follow through in using the information gathered to help students move

forward in their learning. With Matthew, set up tasks to accomplish (for example the understanding of homework tasks) this but like Dylan in Greenview his follow up was poor and often focus was lost. Finally with Amy her intended formative assessment practice was to use questioning to elicit evidence of student learning, however, as became evident in her evaluative episode this was not enacted due to different constraints. Examining the contradictions between intended and enacted practices led to the constraints on formative assessment practices being uncovered. This would not have been possible without a sociocultural theorisation of formative assessment through activity theory. Finally, Chapter 2 called for more scholarship on formative assessment and sociocultural theory to help situate it in one specific theory to lessen the misunderstanding surrounding formative assessment, this is what this thesis accomplished.

Moving next to the policy implications of this research, policy in Ireland needs to be brought forward to situate formative assessment in sociocultural theory. Current education policy documentation in Ireland fails to rationalise how formative assessment can be embedded effectively in schools (see the Framework for Junior Cycle 2015), therefore its argument in favour of formative assessment is weak. Highlighted in Chapter 3 was international research on formative assessment policy. Research stemming from New Zealand, Queensland, and Norway shows how investing in education heavily, increasing professional development, increasing school autonomy, and slowing the pace of education reform can help policy on formative assessment to be embedded more effectively. Considering this, taking a more in-depth examination of how sociocultural factors effect formative assessment enactment (through conducting research or reviewing current literature), policy makers could maximise the benefits of formative assessment on student learning by making their argument more transparent. Additionally, through teacher professional development contextualised to individual schools with a focus on formative assessment, enactment could be improved. This merits further research on how context and culture can underpin the practices happening in a classroom.

This thesis used its empirical findings to show how formative assessment was enacted and the factors promoting/inhibiting its implementation. Formative assessment is at the forefront of policy documents at lower second level in both Ireland and Scotland, see for example the Junior Cycle Framework (2015) and Curriculum for Excellence: building the curriculum 5: a framework for assessment (Scottish Government, 2011), it can significantly improve student

learning and student self-regulation, and therefore needs to be given serious consideration in the common teaching, learning, and assessment practices of a school. For formative assessment it to be enacted successfully in schools, a research design like the one in this study is beneficial in finding out what is promoting or inhibiting current teaching, learning, and assessment practices. This means that steps could then be taken to improve the level of enactment.

Recommendations for Future Research

Some recommendations for future research have already been cited in this chapter, however the findings also merit further investigation in the following areas:

- The two emergent factors (cultural context and assessment literacy) have the potential to help stakeholders in education promote effective formative assessment practices among schools, teachers, parents, and students. By adapting the two main findings of this research (cultural context, assessment literacy) steps can be taken to consider this pair of factors and how they influence practice through such means as professional development or inclusion in curriculum documentation.
- Examining the activity system of an individual teacher can be used as a starting point to enhancing teaching, learning, and assessment practices in schools. By unearthing the strengths and tensions in a teacher's activity system, a school could enter the expansive learning cycle (Engeström, 2001) and significant advancement in resolving tensions and building on strengths could be made.
- The responsive aspect of formative assessment is overlooked in much empirical research on formative assessment. A possible avenue for investigation would be to build stronger links between formative assessment and teacher noticing. The work of Cowie, Harrison, and Willis (2018), Erickson (2011), and Mason (2002) need to be given more consideration when examining how teachers respond to student learning.
- The understanding of the influence of community in Ireland and Scotland merits further research as it is undertheorized in relation to formative assessment.
- This research highlighted the importance of teacher agency in professional identity. A more detailed examination of the nuances of how teacher professional development can promote effective practices merits further exploration. DeLuca, Chapman-Chin, and Klinger (2019) have developed a teacher professional learning continuum that may prove useful in exploring professional development and formative assessment.

- Examining the interplay between summative and formative assessment did not form an integral part of this study. Summative assessment plays a significant role in second level education in both Ireland and Scotland and how it can be carried out effectively alongside formative assessment should be explored.

Limitations of the Study

This study, as with any research study was constrained by limitations out of the researcher's control. There were three main limitations to this research, the first being generalisability. As the research took a case study approach to examining each teacher's activity system in detail the generalisability of the findings was limited. Each individual teacher brought their own idiosyncrasies to their practice and therefore what worked for one teacher may not work for others. Furthermore, this study was largely focused on the cultural context of schools and like the teachers, each school had its own strengths and weaknesses. Hence, generalising the results to all schools in Ireland or Scotland was not practically feasible.

Another limitation of the study concerned the time constraints of working with schools. There were many variables at play in the day to day running of a school and this meant that data collection was limited to a specific time frame. As the researcher was working full time in Ireland, getting to Scotland to collect data was limited to a window of one month. This provided for one week of observation for each teacher in Scotland and an extended observation period may have unearthed further interesting findings, especially in relation to teacher feedback that moves learning forward, a strategy for formative assessment that was not apparent in the observed lessons.

The final limitation of this research was concerned with the *hawthorn effect* (Landsberger, 1958) which may have influenced the data collected due to the fact that the school leaders, teachers, and students knowing that they were part of a research project. This may have influenced the data as participants may have altered their everyday practice considering a researcher being present.

Conclusion

This research was built on the premise that formative assessment is misunderstood and that more empirical evidence was needed to ascertain why this is the case. The main findings of the

research uncovered that teachers' assessment literacy needs to be developed to successfully enact formative assessment, and the cultural context of a country is significantly impacting the types of teaching, learning, and assessment practices that are commonplace in second level schools. Formative assessment is often treated as a homogenous entity, devoid of the variety of social, cultural, and contextual factors that can promote or inhibit enactment. This thesis adds to the scholarship on formative assessment by presenting it as a multidimensional process where a myriad of factors including curriculum, whole school initiatives, professional development, school community, professional identity, and teacher-student relationships can have a significant effect on how it plays out in schools. Data arising from this research can be used by stakeholders in education to understand how to enact formative assessment to improve student learning, inform policy change and implementation and inform teacher professional development on formative assessment.

The study adopted the theoretical lens of activity theory to explore the nuances of several second level science teachers' practices and the contextual influences acting on them. The Q methodology provided for the student voice to be heard and gather meaningful data on their views on teaching, learning, and assessment. Observing teachers in practice and interviewing school leaders helped to complete the picture on how formative assessment was enacted in schools and what factors were promoting or inhibiting its implementation. Although the study had its limitations concerning generalisability and observer effect, the findings are significant in adding to the body of knowledge on teaching, learning, and assessment in Ireland and Scotland. In this era of curriculum reform and cultural context becoming dominant in educational discourses, this research has shed light on how research can be conducted to reveal the individual nuances of a school that can promote better teaching, learning, and assessment practices.

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Appendix A: Interview Questions

Principal/Head Teacher

Opening of Interview

1. How many years' experience do you have working as a principal?
   Probing Questions: How did you come to work in this school?

2. How many teachers are there working in this school?

3. What is the current school enrolment?

4. Can you describe to me your typical day in school?
   (experience question to relax the participant into the interview)

School Community:

5. Can you tell me about the ethos of the school?
   (Appearance the school wishes to portray, pupils' relations with staff, school attitudes to students and one another, the school as a community)
   Probing Questions: Do you think all staff follow this ethos?
   What about the students?
   How do you think the ethos influences the teaching and learning in this school?

6. How would you describe the community in which this school is located?
   (Socio-economic intake, parental involvement, active community)

7. Can you describe for me how science is perceived in this school?

Probing Questions: What are the provisions for science?

How many hours of science a week do students have?

Is science promoted outside the classroom?

What is the culture of science in this school?

8. Do teachers follow a prescribed textbook in science, or do they develop their own resources?

   (Are teachers creating content that fits to their formative assessment practices or are they following what is prescribed to them)

   Probing Questions: who decides on the resources used in science classes?

   Why do you think teachers follow/do not follow the textbook?

Tools and Division of Labour

9. Can you describe how students are assessed in this school?

   (How prominent is FA practice to the principal, is it used in conjunction with other methods)

   Probing Questions: What methods are used to monitor/promote learning?

   Are students aware of these methods?

10. What do you hope to achieve by implementing formative assessment practices in your school?

    (Are they focused on improving learning, following the prescribed curriculum…)

    Probing Questions: How did formative assessment come to be integrated into your school?

    How do the teachers engage with these methodologies?

    Has professional development played a role the pedagogy of your school?

    How is professional development communicated to teachers in this school?

11. Have you encountered any difficulties while trying to implement formative assessment strategies into your school?

(E.g., time, planning hours, lack of information, hesitation from teachers, parents etc.)

Probing Questions: How has the school overcome these difficulties?

12. What professional development opportunities are available to the teachers in your school?

(is professional development having an influence on FA practice in science)

Probing Questions: Are these opportunities optional?

Who decides what professional development the teachers engage with?

Do teachers get the opportunity to observe other teachers practice in this school?

What do they think of peer observation?

Is there anything about PD that teachers do not find beneficial?

13. Is there specific PD related to formative assessment?

Probing Questions: how do teachers get involved in this?

Do you/they think it is beneficial to their teaching?

14. Is there PD that's science specific?

Probing Questions: how do teachers get involved in this?

Do you/they think it is beneficial to their teaching?

Wider educational influences

15. How do you promote different learning and assessment strategies with the parents/guardians of your school?

(How are the parents brought into the assessment loop)

Probing Questions: Do you think that parents value formative assessment practices?

Are they aware of the formative assessment practices of your school?

16. Does what is happening in the wider education system in Ireland/Scotland have an influence on the day-to-day practice in your school?

(E.g., curriculum change, policy, teacher strikes, pay-cuts, CPD)

Probing Questions: What is your opinion of the curriculum?

Are industrial relations influencing the practices of your teachers?

Do you think these influences have a positive/negative effect on the teaching practices of your school?

How have you overcome the factors that are influencing teaching in a negative way?

Closing

17. Is there anything that I didn't ask you that you think I should know?

Teacher

Opening of Interview

(Background and demographic questions to ease participants in)

1. What subjects do you teach?

2. How long have you been teaching?

3. How long have you been teaching at this school?
   Probing Questions: How did you come to work in this school?

4. What is your experience of teaching science in this school and others you have worked in?
   Probing Questions: How long have you been teaching science at this school?
   Did you teach science in another school before this?

5. What is your experience of working with formative assessment practices in science? Probing Questions: Is it just this school that you employ formative assessment in your practice?

6. Can you describe to me your typical day as a teacher?
   (experience question to relax the participant into the interview)

Tools and Division of Labour

Teaching Science:

7. Can you tell me how you plan for your science lessons?
   (do they collaborate with other teachers, assess prior knowledge, use differentiation, use textbook/curriculum)

Probing Questions: Where do you get these ideas from?

How long does planning take you?

Do you follow a textbook?

If not, what do you use?

8. Can you outline for me a typical science lesson?

   (What are the different teaching methodologies used, do they stick strictly to the curriculum, are the students active, do they mention formative assessment)

   Probing Questions: What are you doing? What are the students doing? How is the time divided up?

9. Can you tell me about how the science group that I observed engage with science lessons?

   Probing Questions: How do they work in groups/individually?

   How involved do you think they get in science lessons?

   Why do you think this is so?

Using Formative Assessment:

10. What methods do you use to monitor student learning?

    (What are the different ways that they assess their students)

    Probing Questions: What role does feedback play in your teaching?

    Who provides feedback in your lessons?

    Do the students make use of feedback?

    What evidence do you have of this?

11. What does the term 'formative assessment/assessment for learning' mean in your classroom?

    (How have they interpreted the term, possibilities for new practices to be uncovered with this question)

    Probing Questions: Can you describe for me the approach you take with formative assessment?

Do you think FA is the same for every teacher?

Can you describe for me an instance that demonstrated your use of FA in science?

12. What motivates you to use formative assessment practices in your teaching?

(What are the factors influencing their pedagogy)

Probing Questions: Where did you learn/develop these practices?

Do you think FA is beneficial to your students?

Can you give me an example of how FA benefits your students?

13. Has professional development played a role in your teaching practice?

Probing Questions: Why did/do you attend professional development?

Do you take part in peer observation in this school?

If so, do you find it beneficial to your practice?

Can you describe for me some PD that you found particularly useful for your teaching?

Do you attend subject specific CPD?

Have you taken part in CPD related to assessment?

14. Have you encountered any difficulties while trying to implement formative assessment strategies into your lessons?

(E.g., time, planning, lack of information, hesitation from principal/parents etc.)

Probing Questions: How have you overcome these difficulties?

DO you think FA is easy to implement in the classroom?

How could other teachers make FA beneficial to them and their students?

What are the factors external to the classroom that you think influence how you teach?

Community

(Link to research question: What are the factors that promote or inhibit formative assessment practice in science classes and how can these be explained?)

15. Do you think your practice is like that in other classes in your school?

(Is formative assessment a whole school practice)

Probing Questions: Do you think there is an advantage to having a whole school approach to assessment?

Do you think the organisation of your school influences your pedagogy in class?

16. Do you think that parents/ guardians value formative assessment/assessment for learning as part of learning?

(do parents think it's time wasting, are they exam focused only, what do other teachers think)

Probing Questions: Are they aware of the formative assessment practices of your school?

What about the other teachers in the school, do you think they value formative assessment?

17. Do you think you would use the same teaching, learning and assessment practices if you were to change school?

(Is practice dependant on the school, would they go with the cultural norms of another school)

Probing Questions: Do you think other schools would be open to different assessment practices?

If not, why not?

Do you think your practice is influenced by the school you teach in?

18. Does what is happening in the wider education system in Ireland/Scotland have an influence on your teaching practice?

(E.g., curriculum change, policy, teacher strikes, pay-cuts, CPD)

Probing Questions: What is your opinion of the curriculum?

Do industrial relations influence your teaching?

Closing

(To make sure the interviewee can share their opinions on a topic that may not have been covered in the questions, but they feel is relevant to the research)

19. Is there anything that I didn't ask you that you think I should know?

Appendix B: Observation Schedule

School: *Date:*

Teacher: *Topic:*

Description of Classroom Environment:

(e.g., room layout, displays, seating plan, resources available to students)

Lesson Outline/ Distribution of Learning

(e.g., time taken for homework correction, introduction, group work, individual work, class recap etc.)

TIME ALLOCATED	EVENT

Key Features of the Lesson:

Questioning and Discussions

(whole class, peer-to-peer, teacher-student)

Teacher Instruction

(outlining tasks, adjusting instruction, learning intentions, setting success criteria for an activity)

Group Work

(organisation, participation, student engagement)

Individual Student Work

(teacher organisation, student engagement)

Feedback Practices

(acknowledging success, guiding future thinking, teacher and/or students)

Other Notable Lesson Features

Appendix C: Q Concourse

1. Doing well in science depends on having a good science teacher
2. I learn science best when I work on my own
3. In science classes, there is no room for expressing you own ideas
4. I am aware of what I have learned in science
5. I like exams because the results show me how I am doing
6. I help other members of my group if they are stuck
7. I understand how to improve my learning using feedback
8. The purpose of science class is to prepare for exams
9. The teacher always grades our work
10. My parents/guardians check my homework is done
11. I am good at studying science outside of school
12. In science, we're always doing the same exercises repeatedly
13. My parents/guardians help me with my science work
14. There is no point in doing science homework
15. A lot of the time I am unsure of what I am learning during a science lesson
16. When other students ask questions in class, I get the opportunity to answer them
17. I enjoy working as a team
18. I am not responsible for the learning of others during group work
19. I am the only person responsible for my learning
20. I check over a piece of work once it is complete
21. The teacher asks questions that we all can answer
22. I feel I can ask questions in class
23. I have enough time to think before answering a question
24. At the end most science lessons it is clear to me what I learned in that lesson
25. Science lessons are different from other lessons
26. The teacher lets us know what we will learn in a lesson
27. I know exactly what is expected of me when I work in small groups
28. I feel I can't ask the teacher if I am struggling with science
29. I am aware of what I need to revise in science
30. My teacher is the best person for describing concepts in science
31. I often give my classmates feedback on their work
32. I think that the feedback we receive from the teacher is fair

33. It benefits my learning of science when we work in small groups
34. Exams are boring
35. The class shares their ideas about a topic with the teacher
36. I feel safe when answering questions in class
37. I never reflect on how I am doing in science
38. Working in groups means that everyone in the group learns something
39. I value feedback my classmates give me on my work
40. I set goals for my learning
41. The teacher is the only person in the class that gives feedback
42. Mostly I feel happy in my science classes
43. The teacher's feedback to me is unhelpful
44. Certain students are asked more questions in class than others
45. Doing exams motivates me to work harder in science
46. The pace of most science lessons is too fast
47. I often ask other students in the class questions
48. If I don't understand something in science, I work on it until I get it right

Appendix D: Q Analysis

Factor analysis: Once the Q activities ceased with the students, the emergent quantitative data were analysed using factor analysis facilitated by PQMethod software (Schmolck & Atkinson, 2002). The Q data from each country were analysed individually. Principal components analysis (PCA) was followed by varimax rotations with eigenvalues greater than 1.00 determining the emergent factors. The varimax rotations were assisted by hand rotating factors so they could have a higher factor loading. Each factor loading represents a point of view and "indicate the extent to which each Q sort is similar or dissimilar to the composite factor array for that type" (McKeown & Thomas, 2013, p.53). The significance of a factor loading is determined by the standard error (margin of error) of a zero-order loading where N is the number of Q sample items (48), given by the expression:

$$SE_r = \frac{1}{\sqrt{N}}$$

In this study for loadings to be significant at the $p<0.01$ level they needed to exceed a factor loading of 0.37. After hand rotations of the factors, four factors were statistically significant at $p<0.01$, two from Ireland and two from Scotland. Z-scores were computed, negative Z-scores indicated agreement with a statement, positive scores denoted disagreement with a statement.

Appendix E: Early Q concourse of statements reviewed for inclusion in the Q sort

FaSMEd Ireland Q statements (FaSMEd, 2015)**:**

View of science

1. I hate science
2. Science comes naturally to some people
3. Science is fun
4. Science is frustrating
5. I am good at Science

Perceptions of examinations

6. Exams are boring
7. I like exams because the results show me how I am doing
8. Doing exams motivates me to work harder in science

Ideas about science teaching and learning

9. The best way to learn science is by doing loads of exercises from the book
10. If I don't understand something in science, I work on it until I get it right
11. In science classes, there is no room for expressing you own ideas
12. I learn science best when I work on my own
13. Doing well in science depends on having a good science teacher
14. In science, we're always doing the same exercises repeatedly

Addressing RQ1, OB1 (Review of Literature):

Peer learning

1. Working in groups means that everyone in the group learns something
2. I am not responsible for the learning of others during group work
3. It benefits my learning of science when we work in small groups
4. I enjoy working as a team
5. I know exactly what is expected of me when I work in small groups
6. I help other members of my group if they are stuck

Learning intentions and success criteria

7. The teacher lets us know what we will learn in a lesson
8. A lot of the time I am unsure of the purpose of a science lesson
9. At the end of most lessons, I am aware of what I learned

Questioning

10. I feel safe when answering questions in class

11. The teacher asks questions that we all can answer
12. Certain students are asked more questions in class than others
13. I have enough time to think before answering a question
14. I feel I can ask questions in class
15. I get the opportunity to answer questions asked by other students in the class

Self-assessment

16. I never think about how I am doing in science
17. I set goals for my learning
18. I am aware of what I have learned in science
19. I am aware of what I need to revise in science
20. I am good at studying science outside of school
21. I check over a piece of work once it is complete
22. I am the only person responsible for my learning
23. There is no point in doing science homework

Feedback and peer-assessment

24. The class shares their ideas about a topic with the teacher
25. The teacher's feedback to me is unhelpful
26. The teacher is the only person in the class that gives feedback
27. The teacher always grades our work
28. I think that the feedback we receive from the teacher is fair
29. I understand how to improve my learning using feedback
30. I often give my classmates feedback on their work
31. My teacher is the best person for describing concepts in science
32. I value feedback my classmates give me on my work

Addressing RQ2 and OB3(Review of Literature):

33. My parents/guardians help me with my science work
34. My parents/guardians check my homework is done
35. I feel I can't ask the teacher if I am struggling with science
36. Science lessons are different from other lessons
37. We use the textbook a lot in class
38. The pace of most science lessons is too fast
39. The purpose of science class is to prepare for exams
40. Mostly I feel happy in my science classes

Appendix F: Information Sheets and Consent Forms

Context, Culture and Curriculum: A cross-national comparative study exploring formative assessment implementation in Ireland and Scotland

INFORMATION FOR PARENTS/GUARDIANS

What is the research about?

Your child is invited to take part in a research study about teaching, learning and assessment in second level schools.

Who is doing the study?

My name is Niamh Burke, and I am a PhD student from Maynooth University Education Department. I am also a second level science and maths teacher working in Dublin at present. I have previous experience of working on research projects like this one.

What is the purpose of this study?

By doing this study I hope to get an insight into how formative methods of assessment help optimise your child's learning during science lessons.

What is Formative Assessment?

- Formative Assessment is the process used by teachers and students to respond to student learning immediately to improve that learning, during class time.
- It requires the teacher to adjust their teaching methods to allow for effective learning.
- It requires students to think about how they learn and take responsibility for their learning.

Where is the study going to take place and how long will it last?

The research will be conducted at two second level schools in Ireland and two second level schools in Scotland, including your child's school. The study will take place during March and April.

What will my child be asked to do?

All 1st year students will participate in their science classes as usual; the focus will be on enhancing the learning experience within the curriculum. I will video record a maximum of

four hours of science lessons. The video data will only be used for this project and will not be made publicly available or viewed by anyone other than my supervisors and me.

Should your child be asked to take part in a Q-Sort activity it will last approximately 30 minutes once classroom observation has ceased. The activity may be conducted outside of classroom time i.e., during lunchtime or after school. If your child is to participate the exact time of the Q-Sort will be negotiated with you beforehand. The Q-Sort is an exercise where the student will sort different statement cards onto a placemat depending on whether they agree or disagree with a statement. Your child will not be obliged to take part in these activities and can opt out at any stage. The activities will be audio recorded. The tapes and transcripts will only be listened to and viewed by me in Maynooth University. Your child will not be identified in any way.

What are the possible risks and discomforts?

To the best of my knowledge, the things your child will be doing have no more risk of harm than he or she would experience in everyday life. If they are uncomfortable with participating in the Q-Sort activity, they can make this clear on the consent form.

Does my child have to take part in this study?

Teaching of the curriculum will proceed as usual in your child's class. There will be no penalty if your child chooses not to volunteer, he or she will not lose any normal benefits or rights.

Who will see the information my child gives?

Your child's information will be combined with information from others taking part in the study. When the study is written up to share it with other researchers, I will write about the combined information. Your child will not be identified in these written materials in any way. If your child is not happy with any aspect of the transcript of their Q-Sort activity they may request that certain statements not be included in the final thesis. All information about the research will be stored on a secure server at the Department of Education at Maynooth University. The server is password protected and I will be the only person able to access the data.

What happens to the information about the research once it is complete?

Following the period of data retention recommended by Maynooth University (10 years), I will destroy all data.

- Hard/paper data such as the signed consent forms will be confidentially shredded.
- Electronic data will be overwritten.

What are the limits of confidentiality?

It must be recognized that, in some circumstances, confidentiality of research data and records may be overridden by courts in the event of litigation or in the course of investigation by lawful

authority. In such circumstances the University will take all reasonable steps within law to ensure that confidentiality is maintained to the greatest possible extent.

If my child is stressed or anxious following the study, who can I contact?

The school's councillor or chaplain would be more than happy to have a chat with you or your child if you have any concerns.

Context, Culture and Curriculum: A cross-national comparative study exploring formative assessment implementation in Ireland and Scotland

Parent/Guardian Consent Form

I confirm that I have read the information sheet and I give my consent for my child to take part in the research activities.

Name of Child: _____

I agree that:

- My child will be videoed as part of his/her science class. The researcher only may use this video. It will not be made publicly available.

☐ Agree ☐ Disagree

I agree that (please tick the box):

- My child may be chosen to take part in the Q-Sort activity, which will be audio-recorded and transcribed. Anonymised quotations (where individuals will not be named or identifiable) can be used in reports, publications and at events. The students chosen for the Q-Sort will be picked at random and not all students will participate.

☐ Agree ☐ Disagree

I am aware that I can withdraw consent for my child's participation at any time up until the work is published and my child has the right to access their data at their discretion.

Signed: _____

Please print your name: _____

Relationship to child: _____

Thank You

For more information contact the researcher, Niamh Burke at niamh.burke@mu.ie

PhD Supervisors: Dr. Delma Byrne, Maynooth University – 01 7083723

Dr. Majella Dempsey, Maynooth University - 01 7083529

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 the Secretary of the Maynooth University Ethics Committee at research.ethics@nuim.ie or +353 (0)1 708 6019. Please be assured that your concerns will be dealt with in a sensitive manner.

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INFORMATION FOR PRINCIPAL/HEAD TEACHER

What your school will be asked to do:

Within your school I will be collecting the following data:

Classroom observation – I will be observing a total of 4 hours of science lessons (equating to just over one week) with two science teachers in your school. Lessons will be video recorded for analysis however the contents of the video will only be available to my supervisory team (Dr. Delma Byrne and Dr. Majella Dempsey, both in Maynooth University) and I. The video data will not be used for dissemination. Classroom observation will occur in March/April or at your earliest convenience.

Teacher and Principal Interview – The two participating science teachers and you will be asked to participate in interviews during the research period. The interviews should last no longer than 45 minutes and will be audio recorded. Once again, the tapes and transcripts will only be listened to and viewed by the research team in Maynooth University. Teachers and principals will not be identified in any way. Interviews will be conducted on a one-to-one basis at your earliest convenience during the research period.

Student Q-Sort Activity - Six students (three male, three female) from each science class will be chosen at random to participate in this activity and will be selected by the researcher. The Q-Sort activity will last approximately 30 minutes and can be conducted on a one-to-one basis during or outside of class time i.e., during lunch or after school. If students need to stay after school this will be negotiated with parents and students prior to conducting the Q-Sort. This activity will be conducted during the research period. During the Q-Sorting exercise students will sort statement cards onto a placemat. While the students are sorting their cards, I will engage the students with questions about their choices. Students <u>will not</u> be obliged to take part in these interviews, and this is made clear on the assent form. Furthermore, students can opt out at any stage of the Q-Sort if they wish to do so.

What you will be asked to do:

I am asking for you to consent to your school being involved in the project (see consent forms below). Furthermore, I am asking for your participation in interview with me during the research period. The interview will be no longer than 45 minutes.

Anonymity and Confidentiality:

All school information will be combined with information from other schools taking part in the study. When the study is written up as a thesis, only combined information will be written. Teachers, principals, and students will not be identified in these written materials.

Once the audio interview files are transcribed teachers, you can have the opportunity to read over your transcript before it is used in the final thesis. If you are unhappy with any aspect of the transcript you may request that it not be included in the final write up.

All information about the research will be stored on a secure shared server at the Department of Education at Maynooth University.

Once the period of data retention has expired (a minimum period of ten years from the date of publication is recommended by Maynooth University), the data will be destroyed by me in the following ways:

- Hard/paper data such as the signed consent forms will be confidentially shredded.
- Electronic data (i.e., de-identified interview recordings) will be overwritten.

It must be recognised that, in some circumstances, confidentiality of research data and records may be overridden by courts in the event of litigation or in the course of investigation by lawful authority. In such circumstances, the University will take all reasonable steps within law to ensure that confidentiality is maintained to the greatest possible extent.

If you require more information about the research project, please do not hesitate to contact me at niamh.burke@mu.ie or at 086 8624332.

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School Consent Form

I confirm that I have read the information sheet and I give consent for
_____ (name of school)
to take part in the research activities.

I agree that:

- Science lessons will be videoed as part of the research. The researcher only will use this video. It will not be made publicly available.

☐ Agree ☐ Disagree

I am aware that any participant in the school can withdraw consent at any time up until the work is published and have the right to access their data at their discretion.

Signed: _____

Please print your name: _____

Position: _____

Thank You

For more information contact the researcher, Niamh Burke at niamh.burke@mu.ie

PhD Supervisors: Dr. Delma Byrne, Maynooth University – 01 7083723
Dr. Majella Dempsey, Maynooth University - 01 7083529

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 the Secretary of the Maynooth University Ethics Committee at research.ethics@nuim.ie or +353 (0)1 708 6019. Please be assured that your concerns will be dealt with in a sensitive manner.

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Principal Consent Form

I confirm that I have read the information sheet and I give my consent to take part in the research activities.

I agree that:

- Interviews will be audio-recorded and transcribed. Anonymised quotations (where individuals will not be named or identifiable) can be used in reports, publications and at events.

☐ Agree ☐ Disagree

I agree that:

- Science lessons in my school will be videoed as part of the research. The researcher only will use this video. It will not be made publicly available.

☐ Agree ☐ Disagree

I am aware that I can withdraw my consent at any time up until the work is published and I have the right to access my data at my discretion.

Signed: _____

Please print your name: _____

Thank You

For more information contact the researcher, Niamh Burke at niamh.burke@mu.ie

PhD Supervisors: Dr. Delma Byrne, Maynooth University – 01 7083723
Dr. Majella Dempsey, Maynooth University - 01 7083529

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INFORMATION FOR STUDENTS

What is the research about?
This research is about how different student learn and how assessment helps to improve your learning.

Who is doing the study?
Niamh Burke, a PhD student from Maynooth University will be carrying out the study. You may see Niamh Burke from time to time sitting in the back of your class; this is only so she can see how students learn best in class. Niamh is a science teacher too.

Where is the study going to take place and how long will it last?
The study will happen in your school and one other second level school in Ireland. Students in two schools in Scotland are also taking part. The study will take place in March and April of this year.

What will you be asked to do?
Your science classes will go ahead as normal with your teacher teaching like he/she normally does. Niamh might ask you to take part in what is called a Q-Sort Activity that will last for about half an hour. The Q-Sort is an activity where you will sort different statement cards about science teaching and learning onto a placemat depending on if you agree or disagree with a statement. During the activity, you will be asked some questions about your science lessons and how you think you learn best. Niamh Burke, who you will be familiar with from your classes, will do the activity with you. You do not have to take part in the activity if you don't want to and can leave the activity whenever you wish. The activity will be audio recorded. Niamh only will listen to this audio clip; no one else will have access to it.

Do you have to take part in this study?
You do not have to participate in this research if you do not want to. You should be aware that science class will go ahead as normal during the research so there should be no disruption to your learning, you can participate in the classroom observation only or you can decide to be selected for the Q-Sort too. The classes that are observed will be video recorded. The video will not be viewed by anyone except Niamh and her supervisors, and the footage will not be seen by anyone else.

Who will see the information about your class?

Your information will be combined with information from others taking part in the study in Ireland and Scotland. When the study is written up, combined information will be written. No one will be able to identify you in these materials in any way. When the interview data from the Q-Sort is typed up you can read this to see if you are happy with what you said. If you are not happy with anything you said you can ask for it not to be included in the final write up. All the information about the research will be stored safely on a server at the University in Maynooth. Only Niamh Burke will be able to access your information and she will password protect all information.

What happens to the information about the research once it is complete?
Once research is complete Niamh will destroy all data after the minimum period of data retention recommended by Maynooth University (ten years).

If you are stressed or anxious following the study, who can you contact?
The school's councillor or chaplain would be more than happy to have a chat with you if you have any concerns.

What are the limits of confidentiality?
It must be recognized that, in some circumstances, confidentiality of research data and records may be overridden by courts in the event of litigation or in the course of investigation by lawful authority. In such circumstances the University will take all reasonable steps within law to ensure that confidentiality is maintained to the greatest possible extent.

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Student Assent Form

I confirm that I have read the information sheet and I give my assent to take part in the research activities.

Name: _____

I agree that:

- I will be videoed as part of my science class. The researcher only may use this video. It will not be made publicly available.

☐ Agree ☐ Disagree

I agree that (please tick the box):

- I may be chosen to take part in the Q-Sort activity, which will be audio-recorded and transcribed. Anonymised quotations (where individuals will not be named or identifiable) can be used in reports, publications and at events. The students picked for the Q-Sort will be picked at random and not all students will take part.

☐ Agree ☐ Disagree

I am aware that I can withdraw my assent at any time up until the work is published and I have the right to access information collected about me during the research.

Signed Student: _____

Please print your name: _____

Thank You

For more information contact the researcher, Niamh Burke at niamh.burke@mu.ie

PhD Supervisors: Dr. Delma Byrne, Maynooth University – 01 7083723
Dr. Majella Dempsey, Maynooth University - 01 7083529

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INFORMATION FOR SCIENCE TEACHERS

Overview:

My name is Niamh Burke, and I am a PhD researcher with the Department of Education at Maynooth University. I am also a teacher at Kishoge Community College, Lucan, Dublin. As part of my doctoral research, I am exploring formative assessment practices in science lessons with a specific focus on factors that have an influence on effective formative assessment pedagogy. For example, factors could include classroom culture, school context and curriculum reform.

What you will be asked to do:

I am asking for your consent to participate in classroom observation and one-on-one interview with me. Details outlined below.

Classroom Observation – I will be observing a total of 4 hours of science lessons (equating to just over one week) with you and one other science teacher in your school. Lessons will be video recorded for analysis however the contents of the video will only be available to my supervisory team (Dr. Delma Byrne and Dr. Majella Dempsey, both in Maynooth University) and I. The use of video recording is for my personal use only. The video will not be made publicly available. Classroom observation will take place in March/April 2018, and I will negotiate with you the specific dates for observation prior to commencement.

Teacher Interview **–** Teacher interviews will take place in March/April 2018. The interview protocol will consist broadly of questions about your teaching, learning and assessment style. Interviews will be on a one-to-one basis and should last no longer than 45 minutes. Interviews will be audio recorded and transcribed so that all identifiers will be removed from the transcripts. You will not be identifiable in any way in the transcripts.

Anonymity and Confidentiality:

All school information will be combined with information from other schools taking part in the study. When the study is written up as a thesis, only combined information will be written. You will not be identified in these written materials.

Once the audio interview files are transcribed you will have the opportunity to read over the transcripts before they are used in the final thesis. If you are unhappy with any aspect of the transcript you may request that it not be included in the final write up.

All information about the research will be stored on a secure shared server at the Department of Education at Maynooth University.

Once the period of data retention has expired (a minimum period of ten years from the date of publication is recommended by Maynooth University), the data will be destroyed by me in the following ways:

- Hard/paper data such as the signed consent forms will be confidentially shredded.
- Electronic data (i.e., de-identified interview recordings) will be overwritten.

It must be recognised that, in some circumstances, confidentiality of research data and records may be overridden by courts in the event of litigation or in the course of investigation by lawful authority. In such circumstances the University will take all reasonable steps within law to ensure that confidentiality is maintained to the greatest possible extent.

If you require more information about the research project, please do not hesitate to contact me at niamh.burke@mu.ie or at 086 8624332.

Context, Culture and Curriculum: A cross-national comparative study exploring formative assessment implementation in Ireland and Scotland

Teacher Consent Form

I confirm that I have read the information sheet and I give my consent to take part in the research activities.

I agree that:

- Interviews will be audio-recorded and transcribed. Anonymised quotations (where individuals will not be named or identifiable) can be used in reports, publications and at events.

☐ Agree ☐ Disagree

- I will be video recorded during a number of science lessons. The video will not be made publicly available.

☐ Agree ☐ Disagree

I am aware that I can withdraw my consent at any time up until the work is published and I have the right to access my data at my discretion.

Signed: _____

Please print your name: _____

Role within school: _____

Thank You

For more information contact the researcher, Niamh Burke at niamh.burke@mu.ie

PhD Supervisors: Dr. Delma Byrne, Maynooth University – 01 7083723
Dr. Majella Dempsey, Maynooth University - 01 7083529

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