Exploring final year Initial Teacher Education students and probationary teachers' ways of knowing and meaning-making through professional reflective practice.

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Scottish Attainment Challenge Project

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Executive summary

The research outlined in this report was initiated in response to a call by the Scottish Government for educational researchers to focus their research on aspects related to attainment, and in particular to seeks to understand the challenges faced by the education system as it endeavours to close the 'attainment gap' between the most and least disadvantaged pupils in our schools. In response to this challenge, the Scottish Government has put forward a range of policy initiatives, such as the Attainment Challenge, the Pupil Equity fund, and the National Improvement Framework to support and drive changes in the education system. An important aspect of these policy initiatives is the call for teachers, at all levels of the system, to improve school (and pupil) performance by increasing the use of data-informed decision making, through the systematic gathering and monitoring of performance information in terms of assessing children's progress as part of the school improvement cycle.

Central to the effort to gain an understanding of how this policy context is operationalised in practice, is the need to gain insights into Scottish teachers' (and student teachers') attitude towards the use of data to inform classroom practice. In addition, there is a need to explore how Scottish teachers (and student teachers') conceptualise what educationally relevant 'data' is, what do they see as important data/evidence to be gathered, how do they gather that data, what do they do with that data in terms of analysis and interpretation, and how those analyses and interpretations are used to inform professional judgements and decisions at the classroom level in order to make appropriate adjustments to pedagogy.

The UWS project aligns to this need to gain greater insight into how teachers used educationally relevant data by exploring how early career teachers (final year initial teacher education students and probationary teachers) come to know and make meaning from educationally relevant evidence (data/information) as part of their reflective practice. Our research used an exploratory, sequential, mixed methodology approach to gather multiple sources of data from three groups of initial teacher educations students studying on the Professional Graduate Diploma in Education (Secondary), Professional Graduate Diploma in Education (Primary) and Bachelor of Arts (Hons) Primary Education programmes within the University of the West of Scotland.

Our preliminary findings indicate that final year initial teacher education students' attitude towards the use of data differs dependent on their programme of study. The attitude profiles indicate that final year initial teacher education students' attitude can shift and improve towards the use of data over time. As evidence by shifts in the attitudinal profiles of students from all three programmes.

Context dependency emerged as a critical factor in final year initial teacher education students' attitude towards the use of data. This factor summarises attitudes around items such as the availability of data handling tools, ready to use packages of materials to support data-informed decision making, and the support of colleagues in school to use data being important to their decision to engage in data-informed decision making. Enjoyment also emerged as important but in a negative way. In all student groups the level of enjoyment was low and this impacted upon the affective state domain of attitude towards the use of data. For example, the number of

students from all three groups identified as being low in enjoyment and highly anxious increased in the Post questionnaire analysis compared to the Pre.

While it is encouraging to note that final year initial teacher education students' attitude towards the use of data to inform practice can improve over time, other findings indicate that when these students are asked to analyse, interpret and make meaningful inferences from tracking and monitoring data, they struggle to fully appreciate what the data has to say and have difficulty making sense of the messages that emerge from such data in terms of pupil attainment, what that data indicates about teaching and what school level to national level data has to say about school performance.

In particular, undergraduate primary students performed significantly less well in comparison to secondary students. However, what was of more concern was that 58.1% of Professional Graduate Secondary students and all of the Bachelor of Arts students scored ≤ 50% in this activity. This suggests that more targeted support is required to help these students to develop data literacy skills, and to help them to make better use of such data to direct pedagogical decisions and professional judgements.

When considering what forms of data and evidence final year initial teacher education students draw on as part of their reflective practice, we found that from the students within our sample draw heavily on observing teacher and school-based mentor feedback, teacher directed activities such as formative assessment and pupils' work. However, they made limited use of summative assessment as evidence within their lessons reflections. In addition, the students did not make effective use of their wider professional reading to help them develop their teaching practice. We suggest that this provides evidence of a theory-practice gap. We believe that as ITE tutors we need to support our students to navigate this gap in order to develop further our students' efforts to translate educational theory into concrete examples for classroom practice.

The findings from this research provides a number of useful insights into what support Initial teacher education within the Division of Education at the University of the West of Scotland has to do to prepare our students and to equip them to function within contemporary school practice. In this regard, we intend to further develop teaching sessions and workshops designed to support student teachers development of data literacy skills by providing them with authentic, setting and stage specific, data analysis and interpretation learning experience. This will be further enhanced by school placement tasks designed to heighten student teachers awareness of the diversity and range of data available for teachers to use and the importance being placed on their ability to use data by stakeholders within the education system.

List of abbreviations

BA4	Bachelor of Arts 4th year
CfE	Curriculum for Excellence
DDDM	Data-driven Decision Making
DIDM	Data-informed Decision Making
DYW	Developing the Young Workforce
E&Os	Experiences and Outcomes
GTCS	General Teaching Council for Scotland
GIRFEC	Getting It Right for Every Child
HMIe	Her Majesty's Inspectors of Education
ITE	Initial Teacher Education
NIF	National Improvement Framework
PCK	Pedagogical Content Knowledge
PGDE (P)	Professional Graduate Diploma in Education (Primary)
PGDE (S)	Professional Graduate Diploma in Education (Secondary)
RIC	Regional Improvement Collaborative
SIMD	Scottish Index of Multiple Deprivation
SfR	Standard for Registration
SPR	Standard for Provisional Registration
SQA	Scottish Qualification Authority
TIS	Teacher Induction Scheme
UWS	University of the West of Scotland

First they said they needed data about the children to find out what they're learning. Then they said they needed data about the children to make sure they are learning. Then the children only learnt what could be turned into data. Then the children became data.

Michael Rosen read this poem to the Last NUT conference 2018 as a cautionary lesson for the profession

Introduction

Over the last two decades, many Western democracies have implemented laws and policy reforms focused on education and schooling. These reforms are designed to put the child at the heart of the education system and places demands on teachers to use multiple sources of evidence to guide their professional judgments and decisions to improve the educational outcomes for all children and young people[1]. Notable examples of these law and policy reforms range from the No Child Left Behind Act (2002) - now superseded by the Every Student Succeeds Act (2015) - in the United States, to the Education (Scotland) Act (2016) in Scotland. The Education (Scotland) Act 2016 put the National Improvement Framework (NIF) on a statutory footing and aims to reinforce a number of other educational policies initiatives in particular, Getting It Right for Every Child (GIRFEC).

In December 2019, the Scottish Government launched an update to the NIF entitled *Achieving Excellence and Equity 2020: National Improvement Framework and Improvement Plan* (Scottish Government (2019). This document reaffirms the claim that the NIF and Improvement plan "complements the ongoing implementation of Curriculum for Excellence (CfE), Getting It Right for Every Child (GIRFEC), and Developing the Young Workforce (DYW), which are the three supporting pillars of the Scottish education system."(Scottish Government, 2019 p .4) In addition, it sets the main priorities and key performance indicators for the education system for 2020.

In practical terms, the NIF is underpinned by four priorities. The first priority focuses efforts to improve attainment, particularly in literacy and numeracy. The second priority focuses on 'closing the attainment gap' between the most and least disadvantaged pupils. The third priority focuses on improving the health and wellbeing of pupils. Lastly, the fourth priority focuses on improving employability skills and sustained, positive school-leaver destinations for all young people. To deliver the desired improvement in educational outcomes for all Scottish pupils, the NIF has six 'drivers'.

1. *School Leadership:* how we develop and support our head teachers and how we develop leadership across all parts of our school community
2. *Teacher Professionalism:* how we support teachers in their professional development
3. *Parental Engagement:* how we ensure the maximum benefit of parental involvement and engagement in children's learning and in the life of the school
4. *Assessment of Children's Progress:* how we gather (data) information about children's progress and how we use this (data) information to support improving outcomes for all
5. *School Improvement:* every school has a responsibility to evaluate how well it is doing against the National Improvement priorities and other performance measures. These are

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[1] While many Scottish Government policies such as the NIF refers to children and young people, we will use the term pupil in reference to children and young people as this is a more common way to speak of school aged children.

evaluated by the schools themselves, by the local authority and by Her Majesty's Inspectors' of education (HMIe) inspections

6. ***Performance Information****:* how we gather and analyse (data) information to help us target areas for improvement, show where we have been successful and where we may need to do more.

It is important to highlight here that three of the six drivers focus on the gathering, analysing and interpreting of information / data /evidence about pupil (and by extension school) performance, to support improvements in outcomes for all pupils.

Clearly these drivers imply that teachers in general, and head teachers in particular, ought to be *cognisant of*, and *conversant with* the multiple lines of evidence available to them relating to pupils learning. Whilst placing the onus on them to be able to make effective professional judgements about pupils learning and be able to act on those judgements in a manner that facilitates improvements in pupil performance outcomes. In addition, the other professional drivers relevant to this context are the General Teaching Council for Scotland's (GTCS) Standards for Registration, Career-long Professional Learning and Leadership and Management which specify the need for teachers to reflect on and be professionally enquiring into all aspects of their teaching practice.

For a long time, teachers have been collecting and using many different forms of 'data' both formally and informally (Mandinach & Gummer, 2016). We suggest that this is nothing new. For example, teachers assess the level of pupils' engagement, attentiveness and alertness in class. They observe and react to pupils' behaviour and performance. They monitor pupils' learning strengths as well identify areas for further learning and development. Every day, teachers make professional judgements regarding what pedagogies to use in lessons, as well as assessing whether there is a need to provide pupils with social or emotional support. Furthermore, teachers have to judge when it is appropriate to make accommodations for pupil behaviour in order to support pupils, in an effort to help them make progress. While these examples cover a range of sources of information that teachers engage with every day, many of these examples are difficult to utilise in a concrete and systematic way. While many of the observations made by teachers provide contextual information with regards to pupils' learning, only a few of these provide measurable evidence of learning and progress over time.

Whilst we acknowledge that the range and nature of the data available for teachers to use to support their decision making as part of their reflective practice is growing, we note that parallel to this growth is an increasing awareness that teachers must understand how to use 'tangible' evidence to inform their decisions rather than overly relying on anecdotes, intuitions, or personal preferences. We suggest that there is a growing need for educational researchers to ask *How prepared are pre-service and in-service teachers to handle, use and make meaning from different forms of educational data in order to meet the broad aims of the NIF?*

Moving forward, we would like to make four observations that we feel are relevant to the NIF. First, there is an argument that the NIF, while espousing the notion of placing pupils *and* the teaching and learning process at its centre, that it more accurately places measurement (i.e. the gathering of data/information/evidence) at its' centre. This point reminds us of the poet and children's author Michael Rosen's speech to the last National Union of Teacher Conference in 2018 which cautions us to be vigilant against the slide towards children becoming data (see the poem at the beginning of

this report). While we acknowledge that schools are about many things, we also accept that they are first and foremost about teaching and learning.

Second, the NIF focuses attention on educational outcomes and the need to systematically measure these over time in order to establish baselines and to monitor progress. Implied in this observation is the need to be more *intentional* in identifying what is being taught by teachers and learned by pupils. Third, the NIF has brought renewed emphasis to the learning experiences of *all* pupils in *all* schools – not just a select few and as such we agree that it is aligned with other educational legislation and policies. Finally, the NIF underlines the need to increase the organisational learning capacities of schools, local authorities and Regional Improvement Collaborative (RIC). The primary focus of this organisational learning being on the effective and efficient alignment of classroom practice with specified learning outcomes where the lifeblood of this learning process is the data generated by teachers in schools as they go about pursuing this alignment with consistency. Framed in this manner, organisational effectiveness can be understood as a function of how strategically a school, local authority or RIC consistently uses data generated in and around its core task (i.e., teaching and learning) to inform ongoing decisions in the pursuit of quality learning outcomes for all pupils.

This educational context (and policy discourse) has created an environment in Scottish education that encourages teachers to engage in evidence-based or more specifically data-informed (-driven) decision making as part of their professional reflection on pupils' progress and by extension their teaching practices with the expressed aim of improving educational outcomes for all pupils. It is within this context that the UWS research project is situated.

The UWS research project aims to…

- Characterise final year Initial Teacher Education (ITE) students' attitude towards the use of data within their practice;
- Explore how final year ITE students handle, analyse and make meaning from educational data as part of their professional judgment and decision making processes.
- Explore what evidence final year ITE students draw on as part of their written reflection focused on lessons taught during their teaching practice placements.

Research questions
In order to achieve the project aims, the UWS research team set the following research questions.

1. Does final year ITE students' attitudes towards the use of data differ according to programme of study?
2. What factors impact final year ITE students' attitudes towards the use of data?
3. Is it possible to improve final year ITE students' attitudes towards the use of data, through focused teaching sessions?
4. To what extent can final year ITE students' analyses and interpret educationally relevant data as part of their reflective practice?
5. What type's information/evidence/data do final year ITE students draw on as part of reflections on lessons taught during episodes of teaching practice?

6. To what extent do final year ITE students use data to improve pupil's learning and their teaching?

Framing the questions

In this section, we describe how we have theoretically framed the research questions. First, we situate the study specifically within the Scottish educational policy context. Second, we describe the key areas of literature that relate to teacher knowledge and patterns of knowing. Third we ground this context and the theory of teachers' knowledge and patterns of knowing within the contemporary literature on reflective practice. Finally, we draw on literature relating to attitude in general and focus this specifically on how we theoretically framed the questionnaires used in the quantitative phase of the research to ground their use in the study within the realm of the individual student teacher.

Scottish Educational Policy context

As previously stated, internationally there has been a shift in educational policy towards evidence-based decision-making within schools (Mandinach, 2012; Schildkamp, Karbautzki, & Vanhoof, 2014; Scottish Government, 2017). This has resulted in increased political pressure on national education systems to account for perceived deficiencies in pupils' educational outcomes and further has led to calls for teachers to engage more deeply with educational data as part of their reflective practice to guide their professional judgement and decision-making processes.

The policy drivers specifically relevant to the UWS research project are the National Improvement Framework (NIF) for Scotland, and the GTCS Standards for Registration (SfR). In general terms, the NIF focus on how teachers, principal teachers/faculty head teachers and head teachers use data to inform their professional judgements and decision making processes as part of their professional practice. These judgements and decisions being predicated on the desire to improve the educational outcomes for all pupils through assessment of pupil progress, the use of performance information/data/evidence and efforts to improve school performance against the National Improvement priorities and other performance measures. In terms of the GTCS standards, there are a number of standards that frame and position final year ITE students within the context of this research.

More specifically the relevant SfR (GTCS, 2012) statements that relate to the UWS project are
- 2.1.2 - *Have knowledge and understanding of the relevant area(s) of pre-school, primary or secondary curriculum*;
- 2.1.5 - *Have knowledge and understanding of the principles of assessment, recording and reporting*;
- 2.3.2 - *Have knowledge and understanding of the importance of research and engagement in professional enquiry*;
- 3.1.3 - *Employ a range of teaching strategies and resources to meet the needs and abilities of learners*;
- 3.3.1 - *Use assessment, recording and reporting as an integral part of the teaching process to support and enhance learning*;
- 3.4.1 - *Read and critically engage with professional literature, educational research and policy; and*

- 3.4.2 - *Engage in reflective practice to develop and advance career-long professional learning and expertise*

Teachers knowledge and patterns of knowing

Research on teacher knowledge suggests that teachers draw upon a variety of knowledge types, learn and use that knowledge within their professional practice in a variety of different ways, and for a variety of purposes (Markauskaite & Goodyear, 2017). It is clear from a cognitive standpoint that teachers' professional knowledge comes in many forms and develops formally, informally and in non-formal ways (Eraut, 2000; 2004; 2007).

In an effort to describe the form that teachers' professional knowledge might take, Michael Eraut suggests that professional knowledge can be characterised in a number of ways,

- *Codified knowledge* (propositional knowledge- discipline based theories and concepts, generalisations of practical principles; accumulated memories of episodic events and specific propositions about particular cases, decisions and actions;
- *Personal understandings* of people and situations, practical wisdom, tacit knowledge and aspects of personal expertise including personal knowledge and interpretation of experience;
- *Self-knowledge,* attitudes, values and emotions – senses of meaningfulness of the purpose, sense of choice, extent to which one feels supported, encouraged or discourages;
- *Meta-processes* – process knowledge for directing one's own behaviour and controlling one's engagement in other processes. This includes agency and reflection; and
- *Know-how* or process knowledge – knowing how to conduct the various processes that contribute to professional action, skills and practices (Eraut, 1994; 2009; 2010).

This characterisation fits well with the Aristotelian conception of different modes of knowing as episteme (true and certain propositional knowledge scientifically derived), techne (know how), doxa (commonly held attitudes and beliefs or self-knowledge) and phronesis (practical wisdom or meta-processes) (Grint, 2007; Eisner, 2002). Teachers' propositional knowledge often characterised as their subject matter knowledge, does not fully encompass the range of knowledge held or applied by teachers in order to engage in effective teaching and learning. In order to express how teachers practically utilise their growing professional knowledge within the complex dynamics of the classroom we need to understand the other forms of knowledge teachers engage with beyond subject matter knowledge.

In the mid-1980s Lee Shulman (Shulman, 1986, 1987) introduced the concept of Pedagogical Content Knowledge (PCK) to describe the knowledge that teachers use to transform particular subject matter for student learning, taking into account possible (mis) conceptions and learning difficulties (Berry, Depaepe and van Driel, 2016). Shulman argued that this knowledge, associated with ''the most regularly taught topics in one's subject area'' (Shulman, 1986, p. 9), includes representations of knowledge (analogies, illustrations, examples, explanations, and demonstrations), and student learning difficulties and those strategies effective to deal with them.

According to this conceptualisation, PCK is a subcategory of content knowledge, topic-specific, and includes two further subcategories - knowledge of representations and of learning difficulties and strategies of overcoming them. While the topic-specificity of PCK was neglected by some

researchers, the conceptualisation of PCK as a subcategory of teacher content knowledge (as subject matter knowledge for teaching) has been accepted. Interestingly, Shulman (1987) identified PCK as a category of the knowledge base of teachers, as one of seven categories that also included content knowledge, general pedagogical knowledge, curriculum knowledge, knowledge of learners and their characteristics, knowledge of educational contexts, and knowledge of educational ends, purposes and values. While the notion of PCK has been influential in research on teaching and teacher education in a variety of disciplines (Science, mathematics physical education and technology), the concept has been criticised as lacking an empirical underpinning, for having fussy boundaries, for being rather static and narrowly conceptualised. Over time, there have been a number of studies that have empirically shown that PCK is an important determinant of the quality of instruction and consequently, students' progress (Baumert, et al., 2010). In terms of the second criticism, Gess-Newsome (1999) made a distinction between the integrative and transformative model of teacher knowledge where in the transformative model treats PCK as a unique form of knowledge on which teachers rely while teaching. It is important to note that PCK is more than a form of factual knowledge that can be acquired and applied since research suggests that what teachers know or think cannot be separated out from what teachers actually do in class or what students gain from that teaching. In other words, PCK is a more dynamic construct that describes the process that teacher employ when confronted with the challenge of teaching particular subjects to particular learners in specific settings (Shulman, 2015).

This perspective advocates a more complex view of PCK that is knowing-to-act and is inherently linked to, and situated in, the act of teaching within a particular context. We would argue that while PCK can be viewed as the knowledge of expert teachers, that, in a normative and prescriptive way, can be passed on to student and newly qualified teachers, it is also the professional knowledge that each teacher develops on the basis of their experiences during teacher education and in practice, and as such is inseparable from the context in which it is developed and used. The concept of PCK has been expanded by researchers to include knowledge of curriculum and knowledge of purpose for teaching as well as knowledge of students understanding and knowledge of instructional strategies (Shulmans original components).

Patterns of knowing
Barbara Carper (1978) speaking from the nursing perspective suggests that knowing within all experience can be framed within four fundamental patterns of knowing, the empirical; the ethical; the personal; and the aesthetic. The empirical refers to the science of professional practice i.e. education, being factual based, and descriptive. The ethical which specifically focuses upon 'matters of obligation' or what ought to be done and relates to action. The aesthetics refers to the art of professional practice i.e. teaching. This pattern being the most difficult to succinctly describe as it includes such things as an appreciation of the pupil experience; the design of teaching and learning activities; and the relationship of the particular to the universal. Personal knowledge is concerned with the knowing, encountering and actualising of the concrete, individual self - the knowledge needed to engage in authentic personal relationships.

Christopher Johns (1995) framed learning through reflection within Carper's fundamental patterns of knowing as a useful way to support individuals to make sense of their practice and to perceive the dimensions of their personal knowledge. In so doing, he integrated the four patterns of knowing more clearly within cue questions that practitioners might pose as part of their reflections. Others such as White (1995) added Socio-political knowing as a fifth pattern and Heath (1998) added the

pattern of Unknowing to Carper's original construct of knowing within professional practice. Socio-political knowing includes understanding factors that impact upon the teaching profession. Examples of such factors might include the behavioural culture within schools that surrounds teaching, the politics that govern it, and the complex physical, fiscal, and psychological environments of each school setting.

Unknowing as a pattern of knowing is a somewhat paradoxical concept that relates to the growing awareness that a student teacher does not know and cannot know or understand reality when they first encounter it. Taken in the context of teacher epistemology and ontology, unknowing represents the idea of openness, of qualitative receptivity to what may be learned, and of acceptance that not all the important questions have been asked and that many answers to both scientific and philosophical questions remain elusive (Heath, 1998; Averill and Clements, 2007). By recognising this 'unknowing', student teachers can remain alert to multiple perspectives while acknowledging their own lack of empirical knowledge, which enables them to avoid the belief that formal theory and research is applied or rejected without thought.

Unknowing promotes alertness to learning how, when and where theory and research may be applied to produce desirable outcomes. In the education literature, there are two pictures presented of the teacher - that of the expert practitioner and of teaching dominated by routine and coping. The former could represent awareness of unknowing that permits progress, the latter early closure with confidence in one's own state of knowing, albeit at times resulting from external pressures to get through the work. Jacobs-Kramer and Chinn (1988) argue that all knowledge patterns must be integrated to enable deliberate professional judgements and that failure to integrate these knowledge patterns impedes choice and produces negative professional outcomes. Unknowing assumes that knowledge is tentative and dynamic. It elevates the importance of questions over answers and releases preconceptions, stereotypes, assumptions and biases. Unknowing is essential for the advancement of educational practice but is also a rich arena for co-discovery between the student teacher and their pupils. When cultivating the pattern of unknowing, student teachers welcome challenge to authoritative knowledge, share responsibility and cultivate a sense of openness within their reflections.

When taken together as part of (student) teachers' reflective practice, these patterns of knowing (Empirical, Personal, Ethical, Aesthetic, Socio-political and Unknowing) provide a richly diverse set of perspectives from which to draw on as they seek to shape their efforts to make meaning from their classroom experiences and drive the professional judgements they make about pupils' learning and the effectiveness their teaching.

Student teachers reflective practice

Teaching is a practice-based profession that requires teachers (and student teachers) to develop the ability to reflect upon the experiences and critical incidents they encounter during teaching practice. The way student teachers make sense of these experiences is complex, often problematic and has resulted in reflective practice becoming an increasingly important area of focus for educational research since the ability to effectively reflect on practice forms an important aspect of initial teacher education across Europe (Gillies, 2016).

The discourse surrounding reflective practice within initial teacher education identifies its' utility in assisting student teachers to make sense of their practice by broadening their perspectives within

practicum and supports their efforts to address the many challenges they face during teaching placements (McGarr and McCormack, 2014). However, when professional reflection is poorly done, particularly when practiced without sufficient care and attention being taken to ensure that the judgements made as a consequence of reflection are soundly based in terms of attention to wider reference-points, then reflection risks becoming 'ritualistic' (Moore 2004, p. 105), solipsistic navel-gazing, or an exercise in narcissistic self-affirmation (Gillies, 2016).

The concept of knowing involves a unique type of personal knowledge composed of objective knowledge, which interacts with the individual's growing attention, perception and awareness of developing acts of practice, and the subjective perspective on personal experience gained during practice (Mathewson Mitchell, 2013; Bonis, 2009). This perspective on knowing and by extension reflection, acknowledges the dynamic nature of refection as both process and product. The main attributes of how students comes to 'know' and make sense during practice lies in personal experience, knowledge (epistemic, procedural, tacit, ethical and aesthetic), and is shaped through personal perspectives.

The ontological assumption underpinning this view of knowing through reflection is objective knowledge (logically constructed) and subjective knowledge (inductively constructed through reason). A practical question is how might initial teacher education facilitate students' development as a reflective practitioner? Answering this question is made all the more difficult by the complex nature of the concept. Where do ITE tutors begin to untangle this complex, multifaceted and dynamic process? Often this begins with the use of personal narrative, usually within the evaluation and reflection sections of formal lesson plans. However, ITE students' tend to compartmentalise their reflections around stimuli emergent from critical incidents or problems that occur within lessons rather than reflecting the positive aspects of the lesson i.e. learning gains by pupils or what they have learned about their own practice. For reflective practice to act as an approach to promoting ITE students self-awareness so that they gain a greater understanding of themselves as well as their own perceptions and actions relative to teaching practice, we need to understand how reflective practice is positioned within policy documents which guide initial teacher education.

Positioning reflective practice as a mechanism for improving practice.
For teachers and ITE student teachers, reflective practice has shifted from being a desirable disposition to a mandatory activity (Glasswell and Ryan, 2017) due in part to the emphasis placed on professional reflection within many countries teaching standards. For example, the General Teaching Council for Scotland's Standards for Registration (SfR) (GTCS, 2012) states that

> Student teachers should be able to *reflect and engage in self-evaluation* using the relevant professional standard; *adopt an enquiring approach* to their professional practice and *engage in professional enquiry* and professional dialogue; and *evaluate their classroom practice, taking account of feedback from others*, in order to enhance teaching and learning **Standard 3.4.2** (GTCS, 2012 p. 19).

On the one hand, it could be argued from this example that the Scottish SfR positions reflective practice as a vital component of teachers' work and professional identity. On the other hand, it can be argued that the SfR lacks clarity in terms of potential actions to be taken by student teachers since it makes no suggestions as to how they might go about (i) evaluating pupils' learning; (ii) reflecting upon their developing classroom practice; and (iii) what they ought to focus on, and

attend to, as part of the reflective process. Also, the validity of such reflections can be open to question, given the fact that student teachers' 'frames of reference' can greatly impact upon the manner in which they focus and attend to aspects of practice. This notion suggests that students require more support, perhaps from their school mentor or ITE tutor, to reflect on the important aspects of a lesson in order to help the development of pedagogical content knowledge sufficiently to attain the required standard.

Glasswell and Ryan (2017) carried out a detailed analysis of how reflective practice was positioned within the teaching standard of six English speaking education systems (Australia, England, New Zealand, Scotland, Singapore and the USA) and have suggest that reflective practice (within these countries standards) is positioned as *an evaluative process* - where teachers evaluate their teaching, professional knowledge and their curriculum and lesson plans against standards and proscribed content; as *an adaptive process* – where teachers reflect on instruction to make adjustments for different groups, on teaching to improve it and on data in order to adjust teaching practice; as *a collaborative process* – where teachers work together to reflect on achieving improvements in teaching and learning, lead other teachers in reflecting on practice and learn from others to improve practice; and as *a transformative process* – where teachers reflect upon the social, political, ethical and moral issues in teaching and *adjust* their thinking in response to that reflection and where they *examine* their attitudes and dispositions and make adjustments when required.

Glasswell and Ryan's analysis suggests that reflective practice is positioned as the key to improving teaching practice but that the process is only stated in general terms. They also draw attention to concerns that mandating a process for reflection does not encourage the systematic and critical analysis of what is important (in education terms) or what seems integral to the thoughtful application of good judgement. This begs the question *how do student teachers engage meaningfully with reflective practice as a way of knowing and learning from teaching experience?*

We suggest that *if* reflection is a key component of learning through experience as Glasswell and Ryan (2017) suggest, *then* it is important that student teachers are supported to use reflection as a means by which they can surface experiential knowledge. By this we refer to how the ITE student teacher assimilates or accommodates learning through reflection with existing personal knowledge. It can be argued that the main purpose for advocating student teachers' development of reflective practice is to enable them to access, appreciate, understand and learn, through lived experience, to take appropriate action towards developing increasingly effective pedagogical practice. As a consequence, student teachers' respond to new situations from multiple perspectives and by drawing upon difference funds of knowledge. In this regard it is possible to argue that learning through reflection is a process of enlightenment, empowerment, and emancipation (Fay 1987). For example, 'enlightenment' is emergent form student teachers' understanding of 'who they are' in the context of defining and understanding their practice; 'empowerment' is emergent from having the courage and commitment to take the necessary actions to change 'who they are'; and 'emancipation' comes through them liberating themselves from previous ways of being to become 'who they need to be', as necessary to achieve effective practice.

As alluded to above, it is important to acknowledge that student teachers' *'frames of reference'* impact upon the way that they reflect upon experiences and how they focus and attend to critical incidents encountered during teaching practice. By frames of reference we mean the structure of assumptions through which individuals come to understand experiences. It is because individual

student teachers bring different prior experiences; knowledge; associations; conceptual understandings; values and beliefs; feelings; and conditioned responses that their frames of reference colour the way they view classroom experiences emergent from teaching practice (Mezirow, 1997). Within the context of transformational learning, Jack Mezirow (1997) suggests that frames of reference tend to selectively shape and bound experiences, preconceptions, cognition and feelings. They shape individuals actions and they govern their decision-making in terms of how they accept or reject ideas that fail to fit their preconceptions by labelling those ideas as unworthy of consideration; aberrations, irrelevant or just mistakes. He further suggests that they encompass cognitive, conative and emotional components that are composed of 'habits of mind' and 'a point of view', where 'habits of mind' are broad, abstract, orienting, habitual ways of thinking, feeling and acting that are influenced by ones assumptions and constitute a set of codes (Mezirow, 1990; Mezirow, 1997). These codes might originate from political, social, cultural, educational, economic or psychological perspectives where they become articulated within a specific point of view – the constellation of beliefs, value judgements, attitudes and feelings that shape a particular interpretation of an experience. With these points in mind, we need to turn our attention to the ways that reflective practitioners might come to know within their professional practice.

Gillies Heuristic of professional Judgement.
Donald Gillies (2016) arguing from an Arendtian perspective suggests that in order to support student teachers to make good professional judgement they "need to be encouraged to articulate in specific detail the sources which were deemed relevant, the ideas being drawn on, and why, when reflecting on a particular professional issue or experience" (Gillies, 2016, p158). He suggests that to enable student teachers to make sound judgements about their practice, they need to bring together perspectives drawn from three broad themes: self; others; and literature.

The theme of *Self* relates specifically to how the student teacher draws upon personal experience, reading and principles and values. The theme of *Others* relates to evidence that the student teacher engaged with – peers; partners; and professionals. The theme of *Literature* relates to how the student demonstrates their use of publications by applying evidence from research studies of various forms and from various contexts; applying theory and research evidence; pedagogy; policy - drawing from policy and guidelines relevant data, and subjecting it to critique, where appropriate. However, we suggest that in order for student teachers to engage in this type of action orientated professional reflection their frame of reference and in particular their attitudes and beliefs towards such professional behaviour needs to be understood. In the next section, we discuss the elements of attitude that impact on the way final year ITE students view the use of data.

Final year ITE student teachers attitudes towards the use of data
Research suggests that some teachers feel threatened by the concept of data-informed practice and under prepared to engage in data-driven decision-making (DDDM) (Dunn, Airola, Lo, and Garrison, 2013a). Emerging research evidence also suggests that many teachers do not systematically use data-informed judgements or if they do, they only trust the data that confirms their intuition rather than using data to shape their professional judgements (Dunn, Airold & Garrison, 2013b). It is at this point that the (students) teachers 'frame of reference' colour the way they privilege and legitimise certain forms of evidence / data / information. What these findings indicate is that many in-service teachers lack the skills, motivation or positive attitude towards the use of data to support their professional judgements. What is less well understood is how pre-service teachers are prepared to

use the wide range of the data available to them and what factors affect their use of data within their decision making and professional judgement processes.

As a construct, teachers' attitudes and beliefs towards the use of educational data is complex. Arguably it is teachers' attitudes and beliefs that influence their action in the classroom. Therefore, information about teachers' reasoning is required. While research suggests that 'belief' describes the ideas that influence teachers' decision-making regarding pedagogy, classroom behaviour and the way they organise lessons (Beck and Lumpe, 1996). When clusters of beliefs are organised around an object or situation and predisposition to action, this holistic organisation becomes an attitude" (Pajares 1992). Attitude is a psychological tendency to evaluate an object (in this case the use of educational data by teachers) in terms of favourable or unfavourable, and attributes dimensions such as good/bad or positive/negative (Ajzen, 2001).

It is the evaluative element of this definition that plays a central role in distinguishing attitude from the concept of belief, which is more related to faith in or confidence that a principle can be accepted as true, often without proof; or opinions, which are personal beliefs or judgement which may or may not be formed through recourse to evidence. Attitudes, once formed, become stable, can be difficult to change, and are highly context dependent. Ajzen (2001) suggests that attitude is a complex construct composed of multiple dimensions and/or sub-components which require to be evaluated separately, since these contribute to varying degrees towards the overall object of attitude. If we are to understand final year ITE student teachers' attitude towards the use of educationally relevant data better, then we need to understand the dimensions and sub-components that reflect that attitude.

Our study, drawing on Bandura's social learning theory (Bandura, 2001) and characterises the dimensions of student teachers' attitude towards the use of data within their professional reflections, by exploring the dimensions relating to the domains of cognitive belief (Perceived Relevance and Perceived Difficulty), the affective state (Anxiety, Enjoyment) and perceived control (Self-Efficacy, Context Dependency). In addition, it aims to explore how ITE students analyse and interpret educational data since we argue that the ability to analyse and interpret data is related to attitude through the concepts of Self-efficacy, Anxiety, Context Dependency, Relevance and Difficulty. We wish to clarify whether final year ITE students perceived self-efficacy when using educationally relevant data differs from their actual ability.

Methodological approach
In this section of the report, we address the methodological and the ethical approach taken to frame the research. In so doing, we outline the intended sampling strategy and the methods of data collection. Also, we describe the impact that the COVID-19 pandemic and subsequent lockdown had on the data collection between March 2020 and June 2020 where appropriate.

Methodology
The UWS sub-project research adopts an exploratory, sequential, mixed methods approach to investigate how final year ITE students use multiple forms of evidence as part of their developing reflective practice.

UWS sub-project has three strands.

1. *Improving* final year ITE students' knowledge and understanding of issues related to disadvantage and low attainment, expanding the range of academic sources and data on which they can draw when considering related classroom challenges, and so aiming to improve the quality of educational decision-making by beginning teachers in relation to supporting pupils struggling with their learning.
2. *Exploring* how final year ITE students use evidence to make evidence-informed judgments regarding pedagogical choices and classroom management and organisational strategies designed to improve attainment within their classroom setting.
3. *Following* ITE students into practice and will focus upon how newly qualified probationary teachers build upon and utilise their knowledge and understanding of evidence-based decision-making during their professional reflection on pupils' learning and what this means in terms of their developing pedagogical practice.

Research Design

In order to explore the three strands, we designed the research around sequential mixed method approach. The design incorporated three phases (1) An Instructional phase; (2) A quantitative phase; and (3) A qualitative phase (See Figure 1 for an overview of the research design).

Figure 1: *Research design overview*
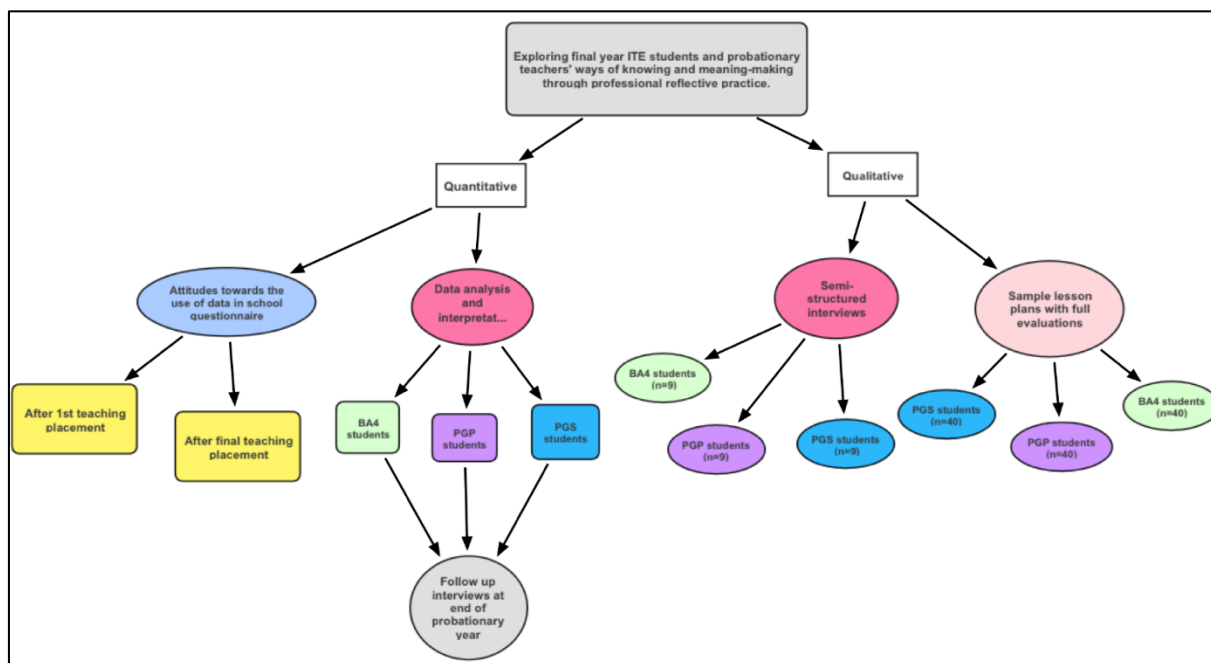
The Instructional Phase

The instructional phase involved eight dedicated teaching sessions of 2 hours focused on the theory and practice relating to data literacy (three sessions), one session relating to the theory and practice relating to principles of assessment, one session each relating to a critical overview of the National Improvement framework and the theory and practice of practitioner enquiry and three sessions relating to the theory and practice of reflection in, on and for practice. These teaching sessions were facilitated by members of the UWS research team.

The Quantitative Phase

The quantitative phase of the project was broken down into two parts. The first part asked all of the final year ITE students across the three ITE programmes within UWS to complete a questionnaire designed to probe the final year ITE student teachers' attitude towards the use of data within teaching practice (pre and post teaching placements). The questionnaire contained two sections, one asking demographic questions relating to gender, age, previous undergraduate degree (only from PGDE (S) and (P) students), and the local authority where their last teaching placement school was situated. The other contained 51 randomly distributed items from 10 subscales. Students' placed their responses along a five-point Likert scale - Strongly Disagree (1) to Strongly Agree (5) dependent on their opinion where extremes of the scale were the only named categories. Each of the 10 subscales related to the dimensions of attitude towards the use of data within teaching practice. Six subscales relating to four domains of attitude towards the use of data within teaching practice were – (1) The Cognitive Belief domain (Perceived Relevance, Perceived Difficulty); (2) The Affective State (Anxiety, Enjoyment) and (3) The Perceived Control domain (Self-Efficacy, Context Dependency). Two subscales related to Effectiveness for Pedagogy and Intentions towards Using Data and two subscales related to Reflective Scepticism and a Critical Openness originating from the Critical Thinking Disposition Scale (Sosu, 2013).

In the second part, all final year ITE students were asked to complete a paper-and-pencil data analysis and interpretation activity designed to explore how they analyse and make meaning from tracking and monitoring data. Each question in this activity was designed to take the students through the reasoning sequence outlined in their Data Literacy teaching sessions. This followed the conceptual framework for data literacy for teachers outlined by Mandinach & Gummer (2016). Through this conceptual framework, Mandinach & Gummer (2016) suggest that teachers should follow an inquiry cycle which moves from *identification* of a problematic issue, to refining that issue into a question or set of questions that can be examined empirically.

As the issue or problem becomes more clearly defined, teachers must *identify and use data* that might illuminate and refine what the problems are. The process describes the need to interpret and draw inferences from the data to *transform the data into a useable form*. Teachers then must take that transformed data and turn it *into decisions about classroom action* to identify and implement a potential solution to the problem or issue. The final component of the cycle is to *evaluate the outcome* of the inquiry cycles work when the solution is implemented. Following this logic, the data analysis and interpretation activity was designed to assess student teachers ability to analysis and make meaning from classroom level data (section 1), from school level data (sections 2.), and from school to national level comparator data (Section 3).

To achieve this multi-layered assessment of student teachers ability to analyse educationally relevant data, the sequence of questions posed was designed to assess the extent to which student teachers can recognise the properties of a raw set of class summative assessment data (questions 1a i – iii). This theme was continued in questions 1b (i-iii) which presents the student with a class set of assessment data in a transformed form and asked the students to analyse the data set to identify and make inferences in terms of general class attainment (Q1b (i), which topic was best understood - Q1b (ii) and least well understood - Q 1b(iii) and to explain how they came to this answer. The purpose of these questions was to assess the general ability of the student teachers to pick out the headline messages from the data.

In section 2 of the data analysis and interpretation activity, question 1(c) and 1 (d) asked students to identify the highest and lowest attaining pupils and to explain how they came to this answer and to reflect on the data set as a whole as if this was their class what would this data set indicate about the pupils attainment and their teaching.

Section 3 contained two questions that use graphs to illustrate the need for teachers to analyse and make sense of school to national level data. In question 2, the bar chart shows data from school X relating to the percentage of Leavers attaining literacy and numeracy at SCQF level 4 and 5. In question 3, the graph shows data for school X relating to the extent to which school X improves the attainment of pupils from lower attainer to high attainer against national data in relation to the pupils Scottish Index of Multiple Deprivation (SIMD) decile placing.

The Qualitative Phase
The qualitative phase was also broken down into two parts. In the first part, of those final year ITE students that responded to the pre questionnaire, a sample of students from across the PGDE (S), PGDE (P) and BA4 Primary Education programmes were asked to take part in a semi-structured interview designed to probe the students perspectives on what they view as educationally relevant data, their feelings, attitudes and beliefs about using data as part of their reflective practice and what their experiences while on their first main teaching placement was with regards to how teacher used data day-to-day with them while on placement.

In the second part of the qualitative phase final year ITE students were asked to submit a sample of fully evaluated lesson plans to the research team so that they might explore what they reflected upon while on each teaching placement, and what evidence they used to drive their professional judgments as part of their reflective practice.

Ethics
The UWS research project was designed to comply with the British Educational Research Association (BERA) ethical guidance for conducting educational research (BERA, 2018). In this regard, ethical approval for this study was sought from the School of Education and Social Sciences ethics committee in August 2018 and permission to carry out the study was given in September 2018.

Sample and the impact of the COVID-19 pandemic and lockdown
The study began in August 2018 and was initially planned to span two academic sessions (Session 2018/19 and 2019/20). The plan was to sample across the three final year ITE programmes – the BA (Hon) Primary Education, PGDE Primary (PGDE (P) and PGDE Secondary [PGDE (S) within UWS. The initial phases of the study went well in terms of recruitment for the Quantitative and Qualitative elements of the programme. For example, the pre and post questionnaire for the first year of the study recruited 109 Pre and 102 Post PGDE (P) students; 71 Pre and 66 Post PGDE (S) students and 65 Pre and 49 Post BA4 (Hon) students. However, while we managed to recruit 86 Pre PGDE (P), 65 Pre PGDE (S) and 50 Pre BA4 (Hon) students in session 2019/20, due to the COVID-19 pandemic we could not complete the Post questionnaire since the date that these were due to be completed was the first day of lockdown and none of the students felt able to complete the questionnaire.

At this point it is important to note that the power calculation for a moderate size effect of 0.4 indicates that we required a minimum of 140 participants in each group for the study to have sufficient statistical power. Given that none of the groups have yet to reach this number of

participants (Pre and Post) to meet this statistical milestone, we would suggest that a further round of data gathering is required to have sufficient confidence in the inferences made from this research. If we had been able to complete this session's data gathering we would have been able to reach this statistical point.

In terms of the data analysis and interpretation activity. We managed to recruit 51 BA4 students and 57 PGDE (S) but no PGDE (P) students in session 2018/19. In session 2019/20 due to the normal timing of the activity, no students could be recruited due to the COVID-19 lockdown. It is important to emphasise here that the COVID-19 pandemic has significantly impacted on the quantitative component of the study. It is our intention to extend the study into session 2020/21 to complete this aspect of the study.

In terms of the qualitative phase of the study, we managed to recruit 3 BA4 students, 2 PGDE (S) students and 1 PGDE (P) student for interview in session 2018/19 with no students coming forward to be interviewed in session 2019/20. The low response rates in session 2018/19 is a measure of how busy these students are at the time of sampling. The lack of engagement with the interviews by the students in session 2019/20 is due to the lockdown and the pressures that these final year ITE students were under at the time. Due to a lack of participation so far, and the impact of COVID-19 on the sampling for session 2019/20, we do not intent to present the data from the semi-structured interview as we feel that the findings would be too narrow and would not present a balanced view of the final year ITE students' views and perceptions. It is our intention to carry forward this work into session 2020/21. To increase participation, we will change the timing of the interviews to the period between the end of November and the beginning of December.

In terms of gathering the reflections on lessons taught element of the qualitative phase, we managed to recruit 39 PGDE (S) students, one PGDE (P) student and no BA4 students over session 2018/19. In session 2019/20, we recruited 29 PGDE (S) and no PGDE (P) and no BA4 students. The higher participation of the secondary cohort with this element of the study is partly due to the fact that two of the three researchers have a high involvement with the PGDE (S) programme as subject tutor so this group of students may be more trusting of them in comparison to PGDE (P) and BA4 students. The reflection on lessons taught data presented will come from the PGDE (S) cohorts however, due to the lockdown, we do not have data for the third teaching placement for PGDE (S) for session 2019/20 as placement did not take place. We plan to extend this phase of the research into session 2020/21 to increase participation form BA4 and PGDE (P) students.

The Analytical approach

Quantitative Data Analysis

Questionnaire analysis
Upon submission of the questionnaire, each group's questionnaires were checked for completion, verified by checking for pattern or spoiled papers and processed by hand using a double entry system on an Excel spreadsheet. The data was then sorted into programme groups and then from the random order that each item was presented, into groups of items relating to each subscale. The data was then transferred to SPSS for downstream descriptive and inferential statistical analysis between the PDGE (S), PGDE (P) and BA4 groups.

For the tracking and monitoring data analysis and interpretation activity, the scripts were sorted into programme groups. They were then marked by two researchers and cross checked for concordance. All data was entered into an Excel spreadsheet and then transferred to SPSS for downstream descriptive and inferential statistical analysis.

The statistical analysis applied to the data set included multiple regression analysis to compare attitudinal subscale within and between participant groups as well as Mann-Whitney U-Tests, Chi-Square with Kendal's Tauβ and Friedman ANOVA to compare differences between participants groups. In terms of the analysis between Pre and Post samples, an increase in the mean for the subscale indicates an increase in agreement with the statements within the subscale and a decrease indicate more disagreement with the statements within the subscale.

Qualitative Data Analysis.

Fully evaluated lesson plans

The final year students that volunteered their fully evaluated lesson plans where sorted into programme groups, scanned and stored centrally for analysis. The fully evaluated lesson plans were analysed in a staged manner using a modified version of Gillies (2016) heuristic of professional judgement (see Table 1 below). In stage one, each lesson plan, evaluation & reflection was read once to ascertain the context of the lesson; to identify the learning outcome; and how the student planned to implement the lesson. This allowed the researcher to gauge the context and subject content for each lesson being evaluated. Then all lesson plans, evaluations and reflections were read for a second time and coded. The lesson plan, evaluations and reflections were then read for a third time to identify examples of students' writing which typically reflected the main theme emergent from the heuristic of professional judgment. The number of times a specific code was mentioned by each student was collated and tabulated for further downstream analysis.

The tabulated data from the third stage of the qualitative analysis was then analysed statistically to assess whether the differences in the number of times a code was identified per student over each teaching placement were significantly different using a Kruskal-Wallis Test (one-way ANOVA) to explore potential differences between teaching placement data.

In addition, the fully evaluated lesson plans were analysed to characterise the range and type of information/data/evidence that the final year ITE teacher use to inform their reflections.

Table 1: Modified version of Gillies (2016) analytical framework.

Aspect	Code	Descriptor
Self	**SPe** (**NEv** - no evidence to support Claim; **EvC** - Evidence to support Claim)	***Personal experience*** – drawing on situations and circumstances already encountered which provide insight to the matter in question; drawing on relationships, advice, and memory with recourse to evidence to support claims.
	SPr	***Personal reading*** – applying insights from one's own reading – personal, pleasure, academic, journalistic, professional, and practical – to instances from practice.
	SPV	***Principles and values*** – considering how these personal views position the situation in question; reflecting if these are helpful or require refinement.

Others	OPe	*Peers* - eliciting the opinion of others in a similar situation, either generally or as observers of own practice.
	OPa	*Partners* – seeking views from others involved in one's context – support staff, parents, external and internal stakeholders.
	OPu	*Pupils* – eliciting the views of those taught, of those for whose ultimate benefit teachers are employed.
	OPP	*Professionals* – eliciting and drawing from tutors, from the views of the wider profession, from written and spoken data, and from wider relevant professional standpoints.
Literature	LPu	*Publications* – applying evidence from research studies of various forms and from various con- texts such as philosophy, psychology, sociology, politics, and history; applying theory and research evidence from such.
	LPe	*Pedagogy* – considering and applying to context, learning theory and debate on teaching methods.
	LPo	*Policy* – drawing from policy and guidelines relevant data, and subjecting it to critique, where appropriate.
Practicum	BeMa	**Behaviour Management** – Descriptions of issue regarding pupil behaviour during lesson; issues with classroom management
	ReNI	**Recognition of Need for Improvement** – Description of the need to improve an aspect of teaching or description of an area of development that the student is working on

Analysis of findings

The analysis of findings presented here is structured to follow the phases of the research described in the methodological approach section in terms of quantitative and qualitative phases. It is also important to note that due to the disruption of data collection in session 2019/20 caused by the COVID-19 pandemic and the subsequent lockdown, this analysis is preliminary.

In each sub-section, the findings and analysis are summarised. In the first subsection we outline the quantitative phase beginning with the Pre and Post questionnaire data which looks specifically at students' attitude towards the use of data as part of their reflective practice. We then go on to describe the findings of the data analysis and interpretation of educationally relevant data activity, which focuses on student teachers ability to analyse and interpret data. We then follow up by comparing the attitudinal findings to the ability findings in order to assess whether there is a gap between final year ITE student teachers attitude towards using data and their ability to use different types of data. In the second sub-section the qualitative analysis of the student teachers reflections and evaluations of lessons taught is outlined.

Quantitative analysis

Pre and Post Final Year ITE Students Questionnaire
Preliminary analysis of the reliability for each statement within the 8 subscales relating to the use of data within the questionnaire is good. The Cronbach's Alpha for each participant group was > 0.75 with the PGDE (S) [0.904], PGDE (P) [0.84] and BA4 [0.85].

The mean scores (Pre and Post) for each subscale (see Table 2) suggests that there is a statistically significant difference between Pre and Post mean scores for PGDE (P) Students Anxiety and Perceived Context Dependency, both of which increased. There was a significant increase in Pre and

Post mean scores for PGDE (S) students Perceived Context Dependency but no significant difference between Pre and Post for the Data effective for pedagogy and Intention to use data subscales. However, there was a significant decrease in PGDE (S) students' agreement with the difficulty subscale.

It is interesting to note from Table 2 that BA4 students' means scores significantly increased Pre v Post for the perceived difficulty subscale as well as for the Data effective for pedagogy and Intention to use data subscales, whereas there was no significant difference on these subscales for PGDE (P) students. Furthermore, the mean scores for the Perceived Context Dependency subscale showed no statistically significant difference between Pre and Post for BA4 students, however, given that the p-value was just insignificant (p=0.06) we suggests that with an increase in student participant numbers, this might become significant given that it is trending towards significance. As previously stated in the analytical approach section of this report, the current sample is not statistically powerful enough to reach the threshold for a moderate size effect and therefore this analysis is preliminary.

Table 2: Comparison between the subscale mean scores for PGDE (S), PGDE (P) and BA4

Sub-scale	PGDE (S)		PGDE (P)		BA4	
	Pre	Post	Pre	Post	Pre	Post
Self-Efficacy	3.49 (0.62)	3.56 (0.51)	3.20 (0.52)	3.55 (058)*	3.56 (0.51)	3.69 (0.47)
Anxiety	2.68 (0.85)	2.60 (0.79)	2.93 (0.85)	3.01 (0.75)	2.60 (0.79)	3.19 (0.86)*
Enjoyment	2.98 (0.87)	2.95 (0.84)	2.64 (0.71)	2.73 (0.75)	2.95 (0.84)	2.87 (0.67)
Context Dependency	3.05 (0.49)	3.27 (0.59)*	3.10 (0.44)	3.36 (0.57)*	3.27 (0.59)	3.46 (0.54)#
Relevance	3.87 (0.66)	3.76 (0.60)	3.88 (0.54	3.80 (0.65)	3.76 (0.60)	3.97 (0.56)
Difficulty	3.42 (0.79)	3.14 (0.80)*	3.45 (0.72)	3.42 (0.56)	3.13 (0.80)	3.55 (0.73)*
Data Effectiveness for Pedagogy	3.64 (0.78)	3.54 (0.67)	3.77 (0.55)	3.75 (0.52)	3.54 (0.67)	3.97 (0.46)*
Intention to use data	4.04 (0.72)	3.95 (0.67)	4.06 (0.50)	4.01 (0.53)	3.95 (0.67)	4.18 (0.44)*

*Note: *Sig diff p<0.05 pre v post for a Mann-Whitney U-Test; # ns p=0.06 Pre v Post for a Mann-Whitney U-Test*

Correlational analysis of the attitudinal subscales.
In terms of how each subscale relate to one another, it is important to correlate those subscale that are theoretically related in terms of the Cognitive Belief domain (Perceived Relevance, Perceived Difficulty); the Affective State domain (Anxiety, Enjoyment) the Perceived Control domain (Self-Efficacy, Context Dependency) and the Affective Control domain (Anxiety v Self-Efficacy). Figures 2, 3, 4 and 5 show the scatterplots for the correlation subscales for each of the four attitudinal domains shown in Table 3 and 4. Table 3 and 4 summarises the proportion of Final year ITE Students per programme that fall within quartile 1, 2, 3 and 4 (Q1= High potentials; Q2= Promising; Q3= reluctant; Q4= indifferent respectively).

Statistical analysis indicates that there is a highly significant correlations for Context Dependency v Self Efficacy (the perceived control domain) within the three groups of ITE students [See Figure 2] (PGDE (P), F= 25.262, p<0.0001; PGDE (S), F= 65.647, p<0.0001 and BA4, F= 12.971 p= 0.001). However, findings indicate that there was no significant correlation between Anxiety v Enjoyment (the affective state domain) with PGDE (S) (F= 1.304, p=0.257) and BA4 (F= 1.009, p=0.320) participants but that there was a significant correlation between Anxiety v Enjoyment with PGDE (P) participants (F= 16.634, p<0.0001) [see Figure 4].

When we look more closely at the proportion of students within each quadrant of the correlational graphs, we can see a shift in the proportion of students categorised as High Potential, Promising, Reluctant and Indifferent [see Table 3 and 4]. In terms of the Affective Control domain (Anxiety v Self-Efficacy) of student teachers attitude towards the use of data within their reflective practice, we see an increase in the proportion of students that are categorised as High Potential with PGDE (S) increasing by 7.6% (from 52.8% to 60.4% Pre v Post) and PGDE (P) students by 15% (from 34.2% to 49.3% Pre v Post). However, there is a decrease in the proportion of BA4 students categorised as High Potential by 8.4% (from 54.4% to 46.0% Pre v Post).

By way of contrast, the proportion of PGDE (P) and BA4 students categorised as Promising increased by 2.6% (31.6% to 34.2% Pre v Post) and 16.6% (from 34.7% to 51.3% Pre v Post) respectively, while the proportion of PGDE (S) students categorised as Promising decreased by 4.2% (from 34.0% to 30.2% Pre v Post). What is pleasing to see in this data is the fact that when we look at the Pre v Post data, the majority of final year ITE students are in the High potential or Promising category. From Table 3 we see that 86.8% Pre v 90.6% Post of PGDE (S) students, with 65.8% Pre v 83% Post of PGDE (P) students, and 88.6% Pre v 97.3% Post of BA4 students being associated with the High Potential or Promising Categories for the Affective Control domain.

In terms of the final year ITE students responses in the Affective State domain (Anxiety v Enjoyment) we see a 19% increase in the proportion of PGDE (S) students within the High Potential category (from 23.5% to 42.5% Pre v Post). However, there is a 20.6% decrease (from 43.1% to 22.5%) in the proportion of BA4 students' categorised as High Potential with a very small (1.2%) decrease in High potential PGDE (P) students (from 28.2% to 27.0% Pre v Post). By way of contrast, there is an 8.8% decrease (from 21.6% to 12.8% Pre v Post) in the proportion of PGDE (S) students identified as Promising with a 4.7% increase (from 12.8% to 17.5% Pre v Post) in PGDE (P) students and a 13.6% increase (from 15.7% to 29.3% Pre v Post) in BA4 students being identified as Promising. However, there was also an increase in the number of PGDE (S) by 10.2% (from 19.6% to 29.8% Pre v Post), PGDE (P) by 4.7% (from 34.6% to 39.6% Pre v Post) and BA4 students' by 10.5% (from 25.5% to 36.0% Pre v Post) identified as reluctant.

When we look at the proportion of final year ITE students in the High Potential or Promising categories of the Affective State domain, we see that there is a shift in the proportion of students Pre v Post where only 45.1% of PGDE (S) students are in either category compared with 55.3% Post. This trend is followed by PGDE (P) students where only 41% Pre and 44.5% Post where in these categories. What is interesting is that for BA4 students' 58.8% of students where in both categories in the Pre sample compared to only 51.8% in the Post sample. These findings may suggest that final year students do not overly enjoy the thought of working with data and indicates that ITE tutors might need to devise teaching sessions that contain a variety of activities designed to scaffold

student teachers learning with regards to the analysis and interpretation of educationally relevant data.

In terms of the final year ITE students Perceived Control domain (Context Dependency v Self-Efficacy) we see a marginal increase by 1.9% in PGDE (S) students identified as High Potential (from 25.9% to 27.8% Pre v Post) with no increase in PGDE (P) students (from 25.0% Pre and 25.0% Post) and a decrease by 6.2% (from 24/4% to 18.2% Pre v Post) in BA4 students identified as High potential. This is contrasted by a large increase (+26.7%) in the proportion of PGDE (P) students (from 33.3% to 60.0% Pre v Post), a reasonable increase (+12.9%) in BA4 students (from 65.9% to 78.8% Pre v Post) and a marginal increase (+5.9%) in PGDE (S) students (from 56.9% to 62.8% Pre v Post) identified as Promising. What is particularly interesting about this data is that when we compare the proportion of students Pre v Post for the Perceived Control domain, there are 82.8% Pre v 90.6% Post PGDE (S), with 58.3% Pre v 85% Post PGDE (P) and 90.3% Pre v 97% Post of BA4 students identified as either Promising of High Potential .

There are three messages that emerge from this data. First, it is encouraging from an educational perspective to see that the majority of students sit within the High Potential and Promising categories in terms of the Affective Control and Perceived Control domains. Second, there is good evidence that student teachers' perceptions of Affective Control and Perceived Control can be improved in terms of their state of anxiety, self-efficacy and context dependency. Third, the students' level of perceived enjoyment (relating to their use of data within their reflective practice) is low and could potentially explains the proportionate decrease in the percentage of students identified in the High Potential and Promising categories within the Affective State domain in comparison the data for Affective Control and Perceived Control domains.

In terms of the Cognitive Belief domain of final Year ITE student teachers' attitude towards using data within their reflective practice, as stated previously, there is a significant decrease in PGDE (S) students responses in the Post questionnaire in relation to the Difficulty subscale (Mann-Whitney U-Test Pre v Post, p=0.04), while there was a significant increase in BA4 students response to the Post questionnaire on the Difficulty subscale (Mann-Whitney U-Test Pre v Post, p=0.005). When we look at the correlational analysis of the Difficulty and Relevance subscales for the final year ITE students we see a 13.8% increase (from 16.7% to 30.5% Pre v Post) in the proportion of PGDE (S) identified as High Potential whereas there was a 6.7% decrease (from 20.7% to 14.0% Pre v Post) in PGDE (P) and a 14.0% decrease (from 29.8 to 15.8% Pre v Post) in BA4 students identified as High Potential. In terms of the Promising category there was a 19.7% decrease in PGDE (S) students (from 76.2% to 56.5% Pre v Post), a 1.3% increase in PGDE (P) students (from 75.9% to 77.2% Pre v Post) and a 26.8% increase in BA4 students (from 57.4% to 84.2% Pre v Post) identified as Promising. This data indicated that there is a shift in the proportion of PGDE (P) and BA4 students to Promising from High Potential and a shift in the opposite direction for PGDE (S) students from Promising to High Potential.

Table 3: Percentage distribution of final year ITE student's that identify as having a High Potential, Promising, Reluctant and indifferent attitude towards the use of data within their reflections in the Affective Control and Affective State domains.

Descriptor	Affective Control Anxiety v Self Efficacy						Affective State Anxiety v Enjoyment					
	%PGDE (S)		%PGDE (P)		%BA4		%PGDE (S)		%PGDE (P)		%BA4	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
High Potential	52.8	60.4	34.2	49.3	54.4	46.0	23.5	42.5	28.2	27.0	43.1	22.5
Promising	34.0	30.2	31.6	34.2	34.7	51.3	21.6	12.8	12.8	17.5	15.7	29.3
Reluctant	5.7	0.0	21.0	9.0	2.2	2.7	19.6	29.8	34.6	39.6	25.5	36.0
Indifferent	7.5	9.3	13.2	7.5	8.7	0.0	35.3	14.9	24.4	15.9	15.7	12.2

Table 4: Percentage distribution of final year ITE student's that identify as having a High Potential, Promising, Reluctant and indifferent attitude towards the use of data within their reflections in the Perceived Control and Cognitive Belief.

Descriptor	Perceived Control Context Dependency v Self Efficacy						Cognitive Belief Difficulty v Relevance					
	%PGDE (S)		%PGDE (P)		%BA4		%PGDE (S)		%PGDE (P)		%BA4	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
High Potential	25.9	27.8	25.0	25.0	24.4	18.2	16.7	30.5	20.7	14.0	29.8	15.8
Promising	56.9	62.8	33.3	60.0	65.9	78.8	76.2	56.5	75.9	77.2	57.4	84.2
Reluctant	0.0	4.7	20.0	6.7	4.9	0.0	7.1	6.5	1.7	5.3	6.4	0.0
Indifferent	17.2	4.7	21.7	8.3	4.8	3.0	0.0	6.5	1.7	3.5	6.4	0.0

Figure 2: Scatterplot showing the distribution of mean scores for final year ITE students' Context Dependency and Self Efficacy per programme of study.
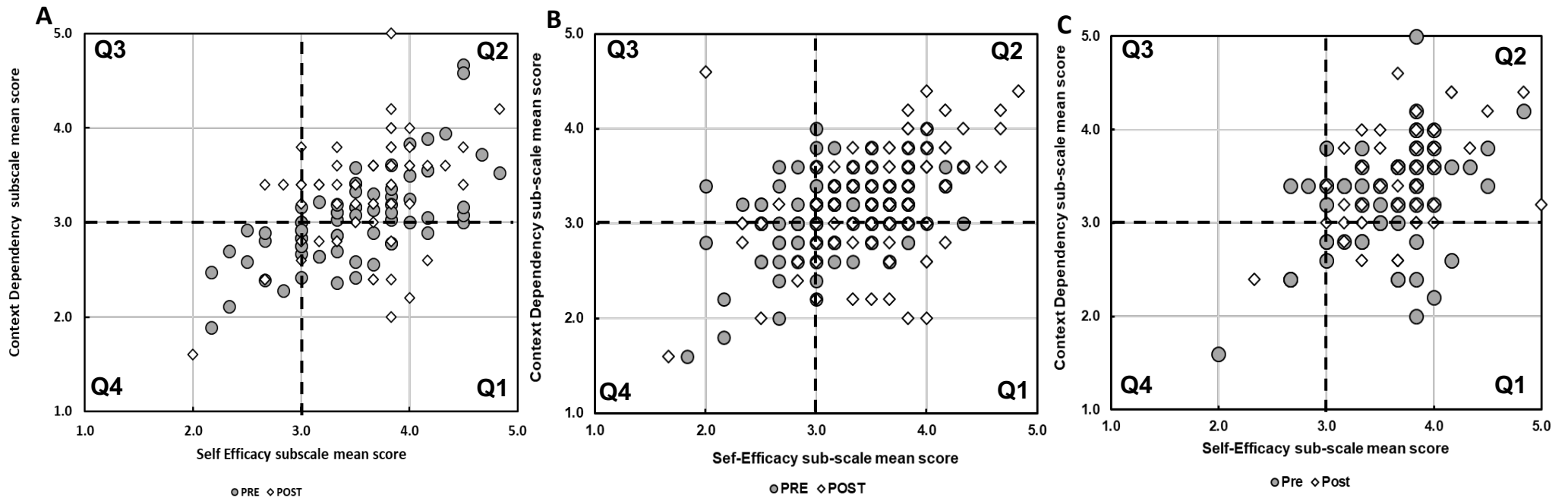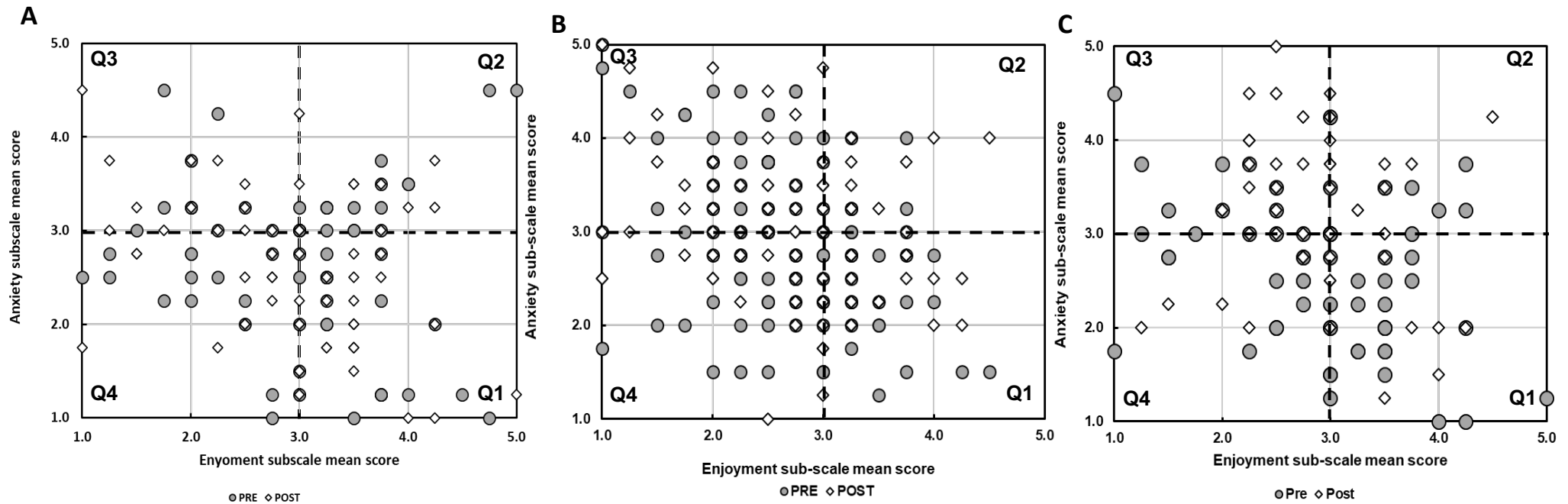

Note: Panel A shows a scatterplot for PGDE (S) participants (Pre n=71 Post n=66). **Panel B** shows a scatterplot of PGDE (P) participants (Pre n=109 Post n=102). **Panel C** shows a scatterplot for the BA4 participants (Pre n= 65 Post n=49). Dashed lines reflect the cut-off point for the quartiles, Self-Efficacy >3 is quartile 1 and 2; Self-Efficacy ≤ 3 is quartile 3 and 4; PD ≥ 3 is quartile 2 and 3; PD < 3 is quartile 1 and 4. Q1= High potentials; Q2= Promising; Q3= reluctant; Q4= indifferent.

Figure 3: Scatterplot showing the distribution of scores of final year ITE Students Anxiety and Self-Efficacy per programme of study.
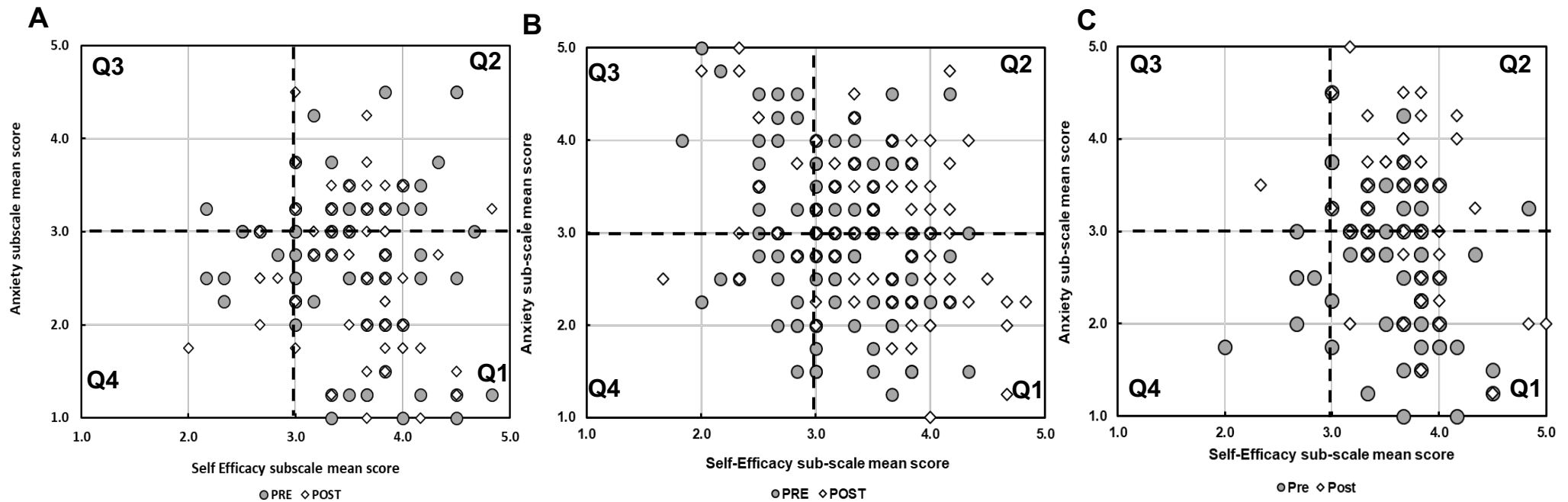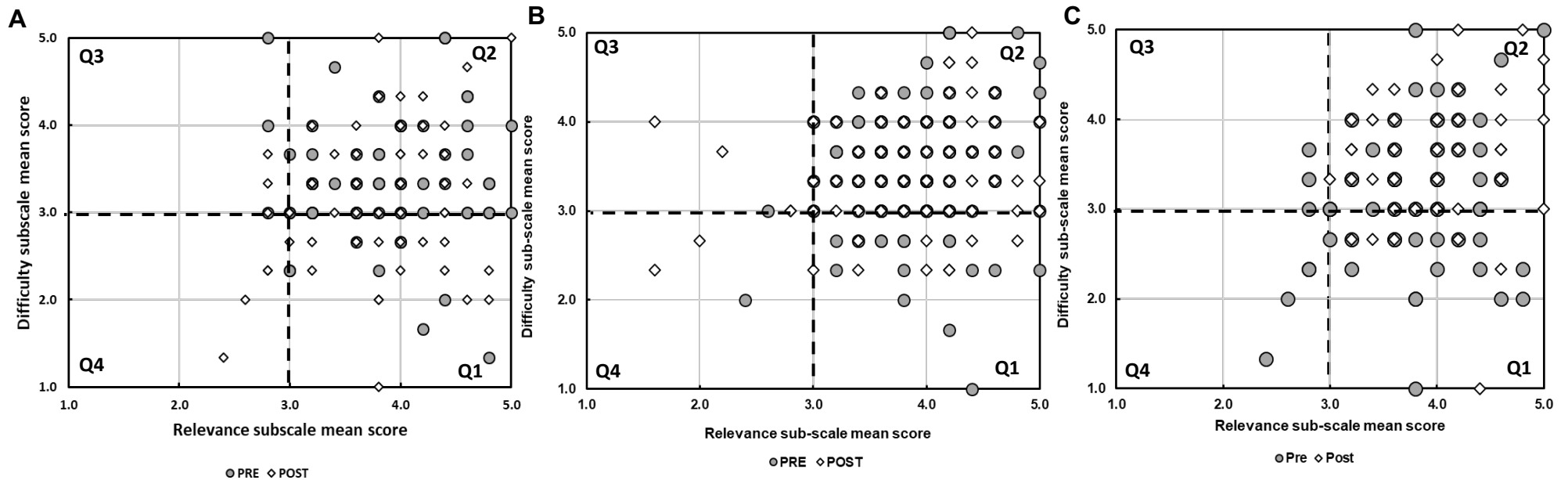
Note: Panel A shows a scatterplot for PGDE (S) participants (Pre n=71 Post n=66). **Panel B** shows a scatterplot of PGDE (P) participants (Pre n=109 Post n=102). **Panel C** shows a scatterplot for the BA4 participants (Pre n= 65 Post n=49). Dashed lines reflect the cut-off point for the quartiles, Self-Efficacy (SE) >3 is quartile 1 and 2; SE ≤ 3 is quartile 3 and 4; Anxiety ≥ 3 is quartile 2 and 3; Anxiety < 3 is quartile 1 and 4. Q1= High potentials; Q2= Promising; Q3= reluctant; Q4= indifferent.

Figure 4: Scatterplot showing the distribution of scores of final year ITE Students Anxiety and Enjoyment per programme of study.

Note: **Panel A** shows a scatterplot for PGDE (S) participants (Pre n=71 Post n=66). **Panel B** shows a scatterplot of PGDE (P) participants (Pre n=109 Post n=102). **Panel C** shows a scatterplot for the BA4 participants (Pre n= 65 Post n=49). Dashed lines reflect the cut-off point for the quartiles, Enjoyment >3 is quartile 1 and 2; Enjoyment ≤ 3 is quartile 3 and 4; Anxiety ≥ 3 is quartile 2 and 3; Anxiety < 3 is quartile 1 and 4. Q1= High potentials; Q2= Promising; Q3= reluctant; Q4= indifferent.

Figure 5. Scatterplot showing the distribution of scores of final year ITE Students Difficulty and Relevance per programme of study.

Note: **Panel A** shows a scatterplot for PGDE (S) participants (Pre n=71 Post n=66). **Panel B** shows a scatterplot of PGDE (P) participants (Pre n=109 Post n=102). **Panel C** shows a scatterplot for the BA4 participants (Pre n= 65 Post n=49). Dashed lines reflect the cut-off point for the quartiles, Relevance >3 is quartile 1 and 2; Relevance ≤ 3 is quartile 3 and 4; Difficulty ≥ 3 is quartile 2 and 3; Difficulty < 3 is quartile 1 and 4. Q1= High potentials; Q2= Promising; Q3= reluctant; Q4= indifferent.

Data analysis and interpretation activity findings

As previously stated in the methodological approach section, the data presented for the Data analysis and interpretation activity will outline findings from PGDE (S) and BA4 students as no PGDE (P) students engaged with this activity. The analysis will first present the overall distribution of scores from the activity to assess the construct and face validity of the instrument used. Second, the findings in terms of mean scores for PGDE (S) and BA4 will be described. Third, we look specifically at the classroom level data in terms of how the students answered each groups of questions in order to highlight some of the emergent issues.

Distribution data for the research instrument.

The data analysis and interpretation activity involved the PGDE (S) and BA4 students answering 12 individual questions grouped around three themes (1) classroom level tracking and monitoring assessment data [(Q1a to 1d(iii) worth a total of 32 points], (2) School to virtual comparator data [Q2 worth a total of 6 points]. And (3) School to National trend data using SIMD deciles [Q3 worth a total of 5 points]. The maximum number of points available for this activity was 43. Figure 6 shows the frequency distribution of scores for the activity.

Figure 6: Frequency distribution for the data analysis and interpretation activity scores
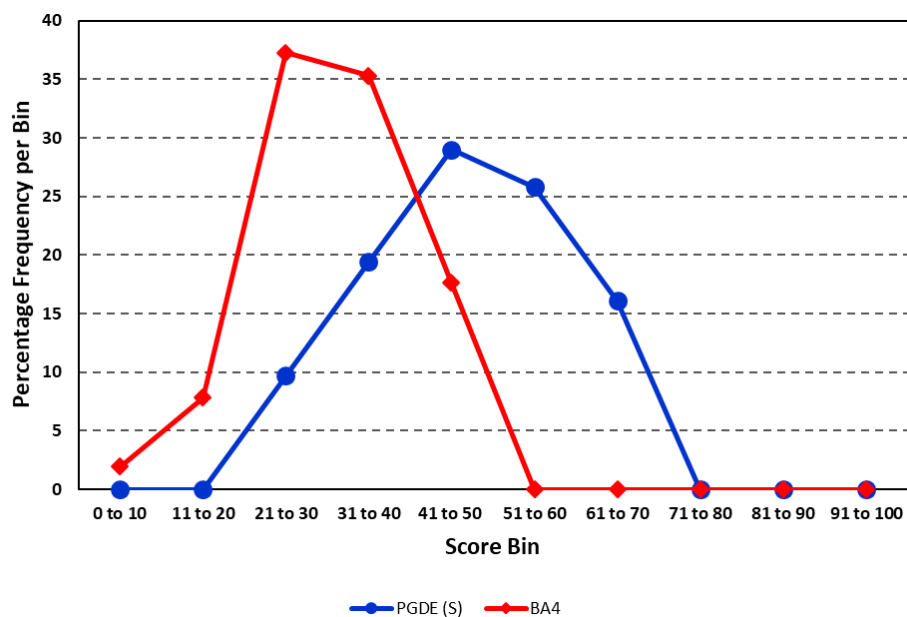
The data presented in Figure 6 indicates that frequency of scores for the PGDE(S) is normally distributed. However, the frequency of scores for the BA4 is skewed towards the lower score end of the graph. This suggests that there may have been some issues with the way the BA4 students viewed the activity and implies an issue with the construct validity of the activity items. This line of thought will be picked up later in the section that outline the student responses to each question in the activity.

Looking specifically at the mean scores focused only on the classroom level data within the activity we see that the BA4 students' distribution curve becomes less skewed.

Figure 7: Classroom level data scores for the data analysis and interpretation activity.
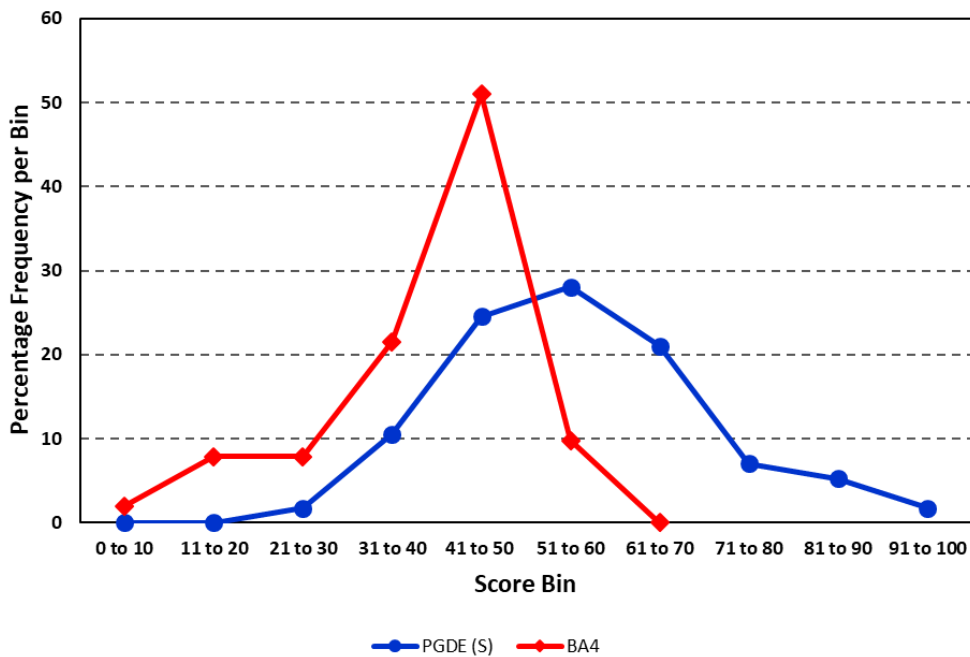
Mean scores for the activity between PGDE (S) and BA4 Students
The total mean score and class level mean scores for each group of students is presented in Table 5.

Table 5: Summary statistics for the Data analysis and interpretation activity for PGDE(S) and
BA4 students

	PGDE (S)		BA4	
	Total	**Class Level Data**	**Total**	**Class Level Data**
Mean	47.9	55.8	31.5	39.0
SD	10.9	10.3	9.7	10.7
SEM	2.0	1.9	1.4	1.5
Median	48.8	46.9	32.6	40.6

What Table 5 shows is that PGDE (S) total mean score (± Standard deviation; Standard Error of Mean) for the activity was 47.8% ± 10.9%; 1.9. The BA4 total mean score for the activity was 31.0% ± 9.7%; 1.4. There is a strong statistical difference (Mann-Whitney U-Test $p<0.000018$) between the PGDE (S) and BA4 total mean scores. When we look at the classroom level tracking and monitoring data element of the activity the PGDE(S) mean score ± 55.8% ± 10.3%; 1.9 and the BA4 mean score is 39.0% ± 10.7; 1.5. Again there is a strong statistical difference in the scores between both groups. (Mann-Whitney U-Test $p<0.0001$).

This data indicates that the PGDE(S) and BA4 students could not fully analyse the data presented and in particular, the BA4 students struggled to make valid inferences from the data. The purpose of this activity was to explore how final year ITE students reason with and make meaning from educationally relevant data. Before we draw any conclusions from the summary statistics it is

important to note which aspect of the activity the students found difficult. Table 6 contains the percentage distribution matrix for each item in the data analysis and interpretation activity.

When we look at the how the PGDE (S) students responded to Q1a parts i, ii, and iii it is evident that the PGDE (S) students understand and correctly attribute what type of transformation has to occur to make the data more meaningful since 54.1% could correctly state that presenting the data as an average would be useful. Only 35.1% of the PGDE (S) students could go further and suggest that by standardising the data it would make the test scores easier to compare across the five end of topic tests. In addition, 42.1% of PGDE (S) students could give three meaningful points from the raw data with 35.1% of PGDE (S) students able to give two meaningful points. However, 80.4% of BA4 students could not suggest what transformation was required to make the data more meaningful, with 19.1% able to make the correct suggestion but did not explain why. By way of contrast 39.2% of BA4 students could extract three meaningful points of information from the raw data, with 45.1% being able to extract two point.

When we look at the data relating to Q1b (i – iii) we see that 36.8% of PGDE (S) and 33.3% of BA4 students scored nothing for item Q1b (i) *what information does this data provide regarding the attainment of the class?* Only 5.3% of PGDE (S) and 0.0% of BA4 students could score three points for this item with 41.1.1% of PGDE (S) and only 9.8% of BA4 students able to score 2 point for this item. Whereas 24.6% of PGDE (S) students and 58.8% of BA students able to score 1 point for this item. Rather worryingly, 28% of PGDE (S) and 31.4% of BA4 students could not score a point for this item. For item Q1b (ii) *which topic does the class understand best?* 56.1% of PGDE (S) and 64.7% of BA4 students could correctly identify the topic and give an explanation of for the choice, with 36.8% of PGDE (S) and 33.3% of BA4 students unable to score a point for this item. It is interesting to note that the majority of those that scored zero for this item chose the wrong topic because they misunderstood the concept of standard deviation and many chose the topic which had the lower standard deviation rather than the one having the higher mean score. By contrast for item Q1b (iii) which topic does the class understand the least? 73.1% of PGDE (S) and 68.6% of BA4 students could identify the least understood topic and give an explanation for their choice. Whereas, 17.5% PGDE (S) and 27.5% of BA4 students could not score any points for this item with the majority of incorrect answers being due to a misunderstanding of the concept of standard deviation.

Looking at students ability to identify the high and low attainers in the class we find that for Item Q1c (i) *which pupil is the highest attainer?* 84.2% of PGDE (S) students and 88.3% of BA4 students can identify the highest attaining pupil and can give an explanation for that choice. In addition we see a similar trend for item Q1c (ii) *which pupil is the lowest attainer?* With 80.7% of PGDE (S) students and 90.2% of BA4 students being able to correctly identify the lowest attaining pupil and give an explanation for their choice.

Looking at the data relating to item Q1d Reflecting upon the data in Table 2, if this were your class, what does this data suggest about (i) *pupils' attainment?* (ii) *Your teaching?* Only 1.8% of PGDE (S) students and 2.0% of BA4 students could give four points about pupil attainment from the data. However, 42.4% of PGDE (S) students and 17.7% of BA4 students could give 3 points

and 21.1% of PGDE (S) students and 29.4% of BA4 students could give one point. Worryingly, 12.3% of PGDE (S) Students and 41.2% of BA4 students could not give any points.

Figure 7: Examples of two BA4 student responses to item Q1d (i) and (ii)

When we analysed the responses to item 1d (ii) we see that 22.8% of PGDE (S) students and only 5.8% of BA4 students to identify 3 points from the class data that they could make meaning about the teaching of the topics covered in the table, with 36.8% of PGDE (S) and 17. 7% of BA4 students could identify two point and 28.1% of PGDE (S) and 25.5% of BA4 students could identify 1 point. Disappointingly, 10.5% of PGDE (S) students and 41.2% of BA4 students could not identify any meaningful point to make about the teaching of the topics. Figure 7 also gives examples of the types of response to item Q1d (ii).

Moving on to the analysis of the school level to national level data we found that for item Q2, only 5.3% of PGDE (S) students and 3.9% of BA4 students to make 5 meaningful points, with 17.5% of PGDE (S) students and 3.9% of BA4 students being able to identify 4 points. Also, 31.6% of PGDE (S) students and 2% of BA4 students were able to identify 3 points with 36.8% of PGDE (S) and 23.5% of BA4 students being able to identify 2 points. Whereas only 5.3% of PGDE (S) scores identified one or no points with 15.7% of BA4 students being able to only identify one point. What was surprising was that 51.0% of BA4 students could not analyse the graph and making any meaningful points. When we analysed responses to item Q3 it was surprising to note that 98% of BA4 students did not even attempt to answer this item. Whereas 33.3% of PGDE (S) students could make three relevant points in response to this item, with 35.1% being able to make 2 points. Interestingly only 8.9% of PGDE (S) could make one point and 15.8% could not make any relevant points.

From an educational improvement perspective these findings suggest a high proportion of both groups of final year ITE students struggle to adequately analyse and make meaning from classroom level tracking and monitoring data. With PGDE (S) students being marginally better that BA4 students when it comes to classroom level data interpretation. This suggests that despite these students having a mainly positive attitude in terms of being High Potential or Promising across the Cognitive Belief and Affective Control domains of attitude towards the use of data within their reflective practice, as evidence from the Pre and Post questionnaire data, that there is a gap between their perception and their ability to use data to ground their professional judgement.

What was clear from these findings is that the BA4 primary education students could not bring their own Numeracy skills to bear on this simple data set. Data handling and analysis is a key aspect of the Numeracy Experiences and Outcome (E&Os) and is an important aspect of the Mathematics for Understanding element of the BA (Hons) Primary Education programme but when the data is contextualised within a school context i.e. a class set of end-of-topic assessments, they are not able to apply the knowledge and skills that they have learned within this activity. What is more worrying is that these BA4 students would be expected to teach data handling and analysis as part of numeracy lessons going forward into the Teacher Induction Scheme (TIS). Likewise for the PGDE (S) students, these findings provide stark evidence that both groups of final year ITE students are not able to effectively handle educationally relevant data to drive forward data-informed reflection of pupils 'attainment or their own teaching practice.

Table 6: Percentage distribution matrix for each item in the Data Analysis and Interpretation activity

Available Points	Q1a (i)		Q1a (ii)		Q1a (iii)		Q1b (i)		Q1b(ii)		Q1b (iii)		Q1c (i)		Q1c (ii)		Q1d (i)		Q1d(ii)		Q2		Q3	
	PGDE (S)	BA4	PGDE (S)	BA4	PGDE (S)	BA4	PGDE (S)	BA4	PGDE (S)	BA4	PGDE (S)	BA4	PGDE (S)	BA4	PGDE (S)	BA4	PGDE (S)	BA4	PGDE (S)	BA4	PGDE (S)	BA4	PGDE (S)	BA4
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.8	0.0	-	-	0.0	0.0	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0.0	0.0	5.3	3.9	0.0	0.0
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.8	2.0	1.8	0.0	17.5	3.9	7.0	0.0
3	-	-	-	-	42.1	39.2	5.3	0.0	3.5	2.0	7.0	0.0	8.8	0.0	8.8	0.0	15.8	9.8	22.8	5.8	31.6	2.0	33.3	0.0
2	-	-	35.1	0.0	35.1	45.1	42.1	9.8	56.1	64.7	73.1	68.6	84.2	88.3	80.7	90.2	42.4	17.7	36.8	27.5	36.8	23.5	35.1	2.0
1	96.5	94.1	54.4	19.6	12.3	11.8	24.6	58.8	3.5	0.0	1.8	3.9	1.8	3.9	3.5	2.0	21.1	29.4	28.1	25.5	5.3	15.7	8.9	0.0
0	3.5	5.9	10.5	80.4	10.5	3.9	28.0	31.4	36.8	33.3	17.5	27.5	5.3	7.8	7.0	7.8	12.3	41.2	10.5	41.2	3.5	51.0	15.8	98.0

Note: - means no data

Qualitative analysis

Final year ITE students' reflective practice.
In this section, we will outline the preliminary findings of the analysis of the final year student teachers lesson plans, evaluations and reflections from each teaching placement sequentially and in summary.

Lesson evaluation and reflections from teaching placement one.
Analysis of the student teachers lesson plans, evaluations and reflections for teaching placement one indicates that there is a large variation within the student teachers reflections on practice over the course of placement one. In general, the lesson reflections were poor quality in terms of content and context description and shows that these students' lacked perception, awareness, attention and focus in terms of the general purpose of the reflections i.e. the incremental improvement of teaching practice.

> When compared to my explanations and questions from the last lesson and this lesson, I think I have improved, as the responses from the class were quicker and more detailed. I dealt with the low-level disruptions well by firstly reminding the class of what they should be doing before targeting individuals. The next time I teach this class, I will focus on asking individuals that avoid questions and also directing different levels of question to different members of the class to meet their abilities **PGDE (S) 4 (TP1).**

> I was reasonably effective during this lesson, however my tone and lesson organisation needed improvement **PGDE (S) 1 (TP1).**

> I feel the students achieved most of the desired learning although they did not complete the experiment. We ran out of time to carry out the room temperature experiment. The students were mostly competent carrying out the experiment although they needed a lot of guidance **PGDE (S) 5 (TP1)**

The above examples support the notion that these students struggle to sufficiently articulate their thoughts on their practice. In addition, 41 out of the 64 students struggled to generate sufficient depth within their reflections to make any quality judgements about pupils' learning or their own developing pedagogical practice. Most reflections focused upon describing issues such as managing and dealing appropriately with pupil behaviour within lessons rather than on whether learning occurred for pupils. Also, while the student teachers could identify aspects of practice that requires improvement, most of them struggled to offer suggestions on appropriate next steps for improving their teaching practice. In terms of evidence used to justify claims, PGDE 4 hints at the use of formative assessment using questioning however as we looked more closely at the range of reflections submitted, the students draw on quite a narrow range of formative assessment techniques in placement one.

In terms of the heuristic of professional judgement within the teaching placement one reflections, most students managed to reflect, to varying degrees, upon advice given by school-based mentors and other teachers but did not go into sufficient detail within their reflections in terms of what that advice was or how they proposed to act on that advice. In so far as the number time individual students mention such advice, they tend to mention other teachers only once or twice within their reflections.

Following discussions with the class teacher, I will now ensure I set out experimental equipment before the start of school each day and have the associated PowerPoint's loaded on the computer ready for the start of the day **PGDE (S) 5 (TP1).**

After discussing the feedback received from the classroom teacher with my mentor, in future, I will start the recap slide by asking questions on states of matter first, and then build on this. I will set up questions to make it clearer what kind of response I am looking for **PGDE (S) 7 (TP1).**

The reflections also indicated some awareness of the need to read policy and curriculum based literature but in a non-specific manner. However, none of the students explicitly or implicitly drew on their wider professional reading nor could they relate theory learnt on campus to their developing teaching practice.

The resources I will use in order to keep my delivery variable will be from "Science Formative Assessment: 75 Practical Strategies for Linking assessment, instruction and learning" by Page Keeley. I feel this book has helped me hugely will a number of ideas for the classroom **PGDE (S) 12 (TP1).**

The ability to draw on wider professional reading is an important aspect of professional reflection that is taught within the PGDE (S) programme prior to teaching placement one but these findings indicate that after placement one, the students require more support within this aspect of professional reflection to help them to make better use of their wider professional reading.

Lesson evaluation and reflections from teaching placement two.
Analysis of the student teachers' lesson plans for teaching placement two indicates that there was a modest improvement in the quality of reflections in terms of their depth of description and detail in terms of context and content. In addition, the student teachers made a greater effort to evaluate their lessons effectiveness relative to the stated learning objective for the lesson.

In terms of learning objectives 1 and 2 pupils were able to answer the questions posed by me throughout the lesson. They all had a note in their jotters of the correct answers to the written questions therefore when the time comes to revise, a model answer will be there for them. Pupils all seemed to be able to answer the closed questions posed but when questioned using some examples from Bloom's that promote more in-depth and higher order thinking, many of the students could not apply their knowledge **PGDE (S) 8 (TP2).**

LO1: All pupils successfully managed to subculture bacteria from a solid to a liquid using aseptic technique. The inoculating loops were sterilised correctly, removal of the inoculum and the inoculation method were satisfactory **PGDE (S) 9 (TP2).**

However, what these examples show is that student teachers evaluations still focus on generalities in terms of pupil learning. With regards to how the students use their understanding of their pupils learning to reflect upon their pedagogical effectiveness, students' struggle to relate their growing knowledge of their pupils learning to make sound judgements about their teaching practice. For example, when PGDE (S) 8 and PGDE (S) 9 reflecting upon their teaching practice in relation to the above evaluation they wrote

Overall, decent first lesson. Pupils very quiet but supporting teacher made comment on my good use of questioning albeit pupils were reluctant to take part. This may be due to the fact I am a new teacher. The supporting teacher suggests that my link to prior learning was good, the film-clips worked well with this class but ask them to answer specific questions using the video **PGDE (S) 8 (TP2).**

> In this lesson, I provided a safe and well-organised environment for all pupils (SPR 3.2.1). I reiterated health and safety expectations within the laboratory, for example, wearing the appropriate PPE (Lab coats). I carried out a demonstration at the start of the lesson, showing how the experiment should be done safely. I also lit each pupil's Bunsen burner individually using a lighter, as the torch lighters were not working. Throughout the practical, I circulated around the room to check that pupils were following instructions and also to provide any assistance if required. I used a mixture of interesting facts about microorganisms (bullet points) and video-clips on microbial disease to sustain the interest of all learners (SPR 3.1.2). I also tried to get the learners involved by asking them [the pupils] questions, for example, what do they think the top cause of death is worldwide? **PGDE (S) 9 (TP2)**

These example shows that these students did not make connections between their evaluations of pupils learning, relative to the stated learning objectives for the lesson, nor do they explicitly relate how effective their teaching was in relation to the lesson taught or how they know that learning actually occurred. Worryingly from an ITE tutors perspective is the fact that these students did not make reference to their use of formative assessment techniques beyond questioning as a source of evidence for their reflections. In the case of PGDE (S) 8 they seem to rely heavily on the advice of the observing teacher as opposed to how they perceived the lesson. This is a theme that was prevalent across most of PGDE (S) 8s lesson reflections during teaching placement 2. It is important to note that depending on the school-based mentors approach some student teacher may be more controlled than others to the point where their reflections become stifled.

In the case of PGDE (S) 9, this student made an attempt to relate their reflection to the GTCS standard for registration. However, on closer inspection of the reflective account it is clear that this student has used the wording of the SPR to frame their claims but provides no clues as to how they used the SPR to benchmark what they are doing within their class practice in terms of content, context and analysis of practice. Neither does this example give an indication as to how the student is using the SPR to assess the effectiveness of their practice. This example is typical of the way in which students apply the SPR to support how they are meeting the standard in a superficial way. Incidentally, level of reflection within these students teaching file resulted in an unsatisfactory grade when assessed by the science subject tutor during their classroom observation.

Lesson evaluation and reflections from teaching placement three.
In general terms, the lesson evaluation and reflections from students across teaching placement three were in many respects qualitatively more detailed than those from teaching placement two in that while they were still descriptive, the depth of detail had increased and there was a marked increase in the number of reflections which contained knowledge claims backed up by evidence. This finding was supported by the statistical analysis of the number of time a code is mentioned by a student within their written reflections.

Unfortunately, few student teachers could draw upon literature to support their reflections and of those that did, they did so in a piecemeal and unsystematic way, and in a non-specific manner.

> I am currently reading "the craft of the classroom by Michael Marland and the chapter 'Records and Registers'. In this it describes keeping records of work that have been completed by students. This way I will be able to see who needs to get caught up on what specific works. **PGDE (S) 13 (TP3)**

From the example above, we can see that (for this student at least) they do not develop the context for using the cited text to any extent. This student also does not identify how they intend to use the text or what the potential impact on their practice might be. This lack of specificity is a feature of the reflections across all three teaching placements.

In terms of reflections upon policy, the student teachers tended to focus heavily on the GTCS Standard for Registration (2012), which is understandable given that this particular policy document is at the forefront of their minds. What is rather strange is the fact that the student teachers only made fleeting reference to curricular documents such as the experiences and outcomes, the principles and practice document or the subject benchmarks and made no reference at all to important curricular guidance documents such as subject documents from the Scottish Qualifications Authority (SQA).

Quantitative analysis of reflections across the three teaching placements.

When we perform a simple count of the number of times a code is assigned to participants reflections on lessons taught, relating to one of the elements of Gillies Heuristic of Professional Judgement we see that in teaching placement one, the student teachers make statements about their practice without backing up their claims with supporting evidence. This trend continues throughout the written reflections over teaching placement two and three (no significant difference between TP1, 2 and 3). However, over the course of the three teaching placements, the average number of statements that have supporting evidence increases significantly between teaching placement 1 and 3 ($p=0.011$) within the student teachers lesson reflections.

As shown in Figure 9, in the overarching themes of others - peers, partners and pupils as a source of information for reflection are barely, if even mentioned by the student teachers within their written lesson evaluations and reflections. However, the student teachers do mention taking advice from their mentors and other teachers within their written reflections as highlighted above.

Figure 9: Median number of mentions per theme within Gillies (2016) Heuristic of Professional Judgement.
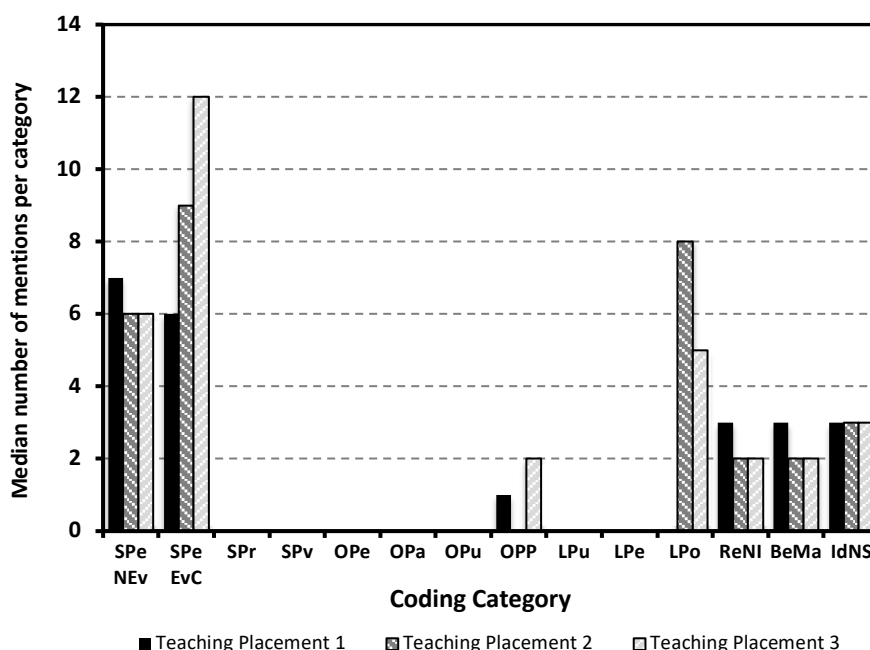
Student teachers focus and attention when reflecting on teaching.
Our findings suggest that the PGDE (S) student teachers in this research focus on describing classroom experiences by attending to issues of classroom organisation and management, dealing with pupil behaviour and the mechanics of their lessons. What is more disconcerting from an ITE tutors perspective is that these students tend to make a lot of claims within their reflective writing that they do not back up with evidence. As Figure 9 indicates, the median number of claims without supporting evidence remains constant over the three teaching placements. However, what is more encouraging is that the median number of claims within the reflections increases significantly from 6 to 13 between teaching placement 1 and 3, which suggests that the students are responding to the advice given by their ITE tutors regarding this aspect of their reflections and that the students are improving their ability to evidence their claims.

Figure 9 also indicates that the student teachers were able to recognise aspects of their practice that needed improvement - mainly issues to do with the mechanics of the lesson, classroom organisation & management and dealing with pupil behaviour. From the perspective of improving classroom practice, the fact that students' are able to identify next steps for pupils' learning and their teaching practice across reflections from all three teaching placements was encouraging. However, there was no specific detail within these reflections as to how the student identified next steps would be taken forward in terms of actions nor was there any discussion as to how they might draw on their wider professional reading to support those next steps.

What was striking was the lack of focus on and use of the literature - pedagogical research, reports, policy and curricular guidance documents within students' reflections. This is an odd finding since our students are regularly exposed to a large range of different types of research, policy and curricular literature within all of the teaching sessions while on-campus. This may suggest that the students do not know how best to integrate their wider professional reading into their lesson evaluations and reflections on teaching or they simply do not see this as important. We would suggest that both scenarios may be true and that this could be an indicator of the theory practice gap.

Quality of student teachers reflective practice.
A recurring theme from the analysis of students' written reflections across all three teaching placements was their descriptive nature. This is unsurprising since the students were strongly encouraged to use Gibbs (1988) model of reflection which is a staged approach to written reflection that encourages students first to describe the lesson in terms of context and content, highlighting critical incidents that occurred within the lesson. Second, it encourages them to reflect upon their feeling about the experience and to explore their professional values. Third, the students are encouraged to evaluate what was good or bad about the experience and how they know. Fourth, students then analyse the lesson to see what sense they can make from the situation relative to their professional reading. Fifth, they are then asked to draw tentative conclusions about the experience and to consider what else they could have done. Finally, they are then encouraged to identify next steps or actions.

It could be argued that this model of reflection represents a techno-rational approach to professional reflection but we suggest that at least this model provides a starting point for student teachers that supports their engagement with the complexities of professional reflection. It also acts as a framework that provides prompts that helps their reflective writing.

Our findings suggest that despite having this model of reflection to support them, the quality and depth of reflections, particularly those reflections from teaching placement one are poor, lack contextual detail and critically do not focus on the analysis of either their pupils learning or their developing teaching practice.

These findings lead us question the utility of Gibbs model of reflection as a way of supporting beginning teachers to develop their reflective practice. They also prompt us to reflect on how reflection is taught, supported and assessed as part of students' initial teacher education. Kelsey and Hayes (2015) have suggested that while frameworks and models of reflection are useful for scaffolding reflective practices for students, they can also at times stifle creative thought and risk making the whole process an academic exercise thus failing to fulfil the purpose for which reflection was intended - improvement in practice.

Qualitative analysis of the lesson evaluation and reflections against the modified Gillies heuristic of reflective judgement indicates that there are a number of areas of the heuristic that this sample of student teachers struggle to engage with and others that they do not touch upon at all. For example, the students make no mention within their lesson evaluation and reflections of personal reading or principles and values [theme of Self]; peers or pupil feedback [theme of Others]; and Publications [theme of Literature]. However, they do touch on areas related to personal experience, with and without supporting evidence [Self]; Pedagogy and Policy [Literature]; and professionals [Others]. It is important to acknowledge at this point that the student teachers were exposed to the thinking that lies behind Gillies' (2016) heuristic for reflective judgement in the reflective practice sessions of the PGDE (S) programme and as such it is not surprising that the students written reflections only touch on a few elements of his framework. That said, Gibbs (1988) model of reflection explicitly encourages students to reflect upon and to analyse their feelings; to relate the experience to their professional reading and plan actions, which will support improvements in practice. We suggest that there is sufficient alignment between Gibbs model of reflection and Gillies' (2016) heuristic for reflective judgement to draw some useful conclusions regarding the quality of student teachers` reflective practice. However, we need to also consider the impact of the act of assessing reflective practice on the quality of the writing within the students' reflections.

For example, Moniz et. al., (2015) investigating the assessment of reflective writing in medical students call into question the feasibility and utility of using reflective writing as an assessment tool in undergraduate medical education as they found that assessing students reflective writing was time consuming; that assessing a single piece of reflective writing did not predict performance on another; and that it took 14 pieces of reflective writing per student to obtain a stable measure of reflective writing performance. In addition, they suggest that the act of assessing reflective writing changes the nature of what and how the student writes their reflections in that they write to perform rather than to 'reflect'. This is an interesting line of thought in that it suggests that the nature of reflective practice shifts from process to outcome since that act of assessment and the assignment of a grade (Satisfactory or Unsatisfactory) introduces the element of performativity to reflective practice.

Written reflections as a way of demonstrating student teachers knowing.
Our findings suggest that (for this sample of students at least) the main patterns of knowing drawn upon within the reflective writing are the personal and the aesthetic patterns of knowing.

As previously stated, Carper (1978) suggests that the 'personal' is concerned with knowing, encountering and actualising of the concrete, individual self and the 'aesthetic' response is always influenced by the person of the student teacher and the degree to which they are prepared to be engaged with their pupils. The knowing of self, in contrast to Gillies (2016) illustration of self, involves three inter-related components – (1) the perception of the individuals feelings and prejudices within the situation [*related to the individuals 'frames of reference'*]; (2) the management of the individuals feelings and prejudices in order to respond appropriately [*management of behaviour within the situation*]; and (3) the management of anxiety and sustaining the self (Johns, 1995).

In a number of student reflections they discuss issues with behaviour management of pupils; classroom organisation and interactions with other teachers but they never talk about their feelings or emotions within their reflections. This could be due to the fact that they are fully aware that their ITE tutor will view their reflections or their school-based mentor could ask to see them and therefore would not commit to writing such thoughts. What is interesting is that when observed during teaching practice, student teachers are able to articulate their thoughts, feelings and emotions during debriefing sessions with their ITE tutor. The research team has direct experience of supporting student teachers in this regard and in particular has interviewed a number of the student teachers within this sample and can affirm that these students are able to articulate other patterns of knowing, particularly the ethical and the socio-political. This suggests that we must be cautious when making judgements regarding how student teachers demonstrate their ways of knowing through classroom experience while on placement as their lack of discussion of their feelings and emotions within their reflective writing possibly demonstrates their growing socio-political awareness and their acute understanding of the power relationships that exist within the strictures of practicum and their developing professionalism

The most pressing issue to emerge from this research is that most of the students sampled struggled to draw upon their wider professional reading within their reflection. This is not to say that they do not implicitly draw upon their wider professional reading within their teaching practice or within their reflective musings but that their use within the post-lesson evaluation and reflections does not capture this aspect of reflective practice very well. This may suggest that this skill requires both explicit instruction within ITE on how to integrate wider professional reading into written reflections and more practice. Also, this may indicate that this aspect of reflective practice might be as Meyer and Land (2003) suggest a threshold concept. Where a threshold concept is "akin to passing through a portal or conceptual gateway that opens up previously inaccessible way[s] of thinking about something" (Meyer and Land, 2003, p.1).

If we [as ITE tutors] are to support beginning teachers efforts to become better reflective practitioners, (as is required by the General Teaching Council of Scotland (2012) Standard for Registration) then the findings from this research provide some useful baseline data that direct our own professional reflections upon both the content and teaching of reflective practice within initial teacher education. These findings will also facilitate the construction of a more meaningful curricular experience for student teachers focused in this vital area of their professional education.

Conclusion

The conclusion section of this report is structured around the answers to the research questions posed by the research team to help meet the aims of the UWS project.

RQ1. Do final year ITE students' attitude towards the use of data differ according to programme of study?

Our findings indicate that there are significant differences in students' attitude profiles towards the use of data as part of their professional reflective practice according to the programme of study taken on entry to teaching. Findings from the Pre and Post questionnaires suggest that a higher proportion of PGDE (S) and BA4 students have high Self Efficacy and low Anxiety (the Affective Control domain) towards the use of data compared to PGDE (P) students.

In terms of the Perceived Control domain of attitude towards the use of data, the Pre data shows that 25.9% of PGDE (S) students, 25% of PGDE (P) students and 24.4% of BA4 students identify as High Potential. Whereas, 65.9% of BA4 and 56.9% of PGDE (S) students identify as Promising in that they have High Self-Efficacy but also High Context Dependency compared to 33.3% PGDE (P) students. Statistical analysis suggests that the reliability of the questionnaire items is strong with Cronbach Alpha in excess of 0.8. Unfortunately, due to sample size being less than 510 in total (the number of participants required to test validity) we are not able to do any form of test for validity using explanatory or confirmatory factor analysis.

RQ2. What factors impact upon final year ITE students' attitudes towards the use of data?

Correlational analysis of the attitudinal subscales within the Pre and Post questionnaire suggest that Context Dependency correlates significantly with Self-Efficacy and that Context Dependency is an important factor in determining attitude towards the intention to use data within final year ITE students' reflective practice. In addition, our findings show that for PGDE (S) students, 72.3% Pre and 74.9% Post tend to totally disagree or are neutral towards enjoying using data compared with 82.5% Pre and 81.9% Post of PGDE (P) students and 82.7% Pre and 82.8% Post of BA4 students. From these findings it is possible to conclude that all three groups of final year ITE students do derive any great enjoyment from using or handling data.

Further statistical modelling is required to determine the relationship between the relative importance of the different elements of the theoretical model used to profile student teachers attitude towards the use of data to understand, make meaning and come to know their pupils and make professional judgements about teaching. We hope to add to this data set in the coming academic session sufficiently enough to be able to conduct this type of analysis.

It is unsurprising that context dependency has emerging as an important element of final year ITE students' attitude towards the use of data, given the social nature of both the learning process and the act of teaching. Also, there are a host of complex social interactions and contextual factors within the school that impact on many activities relating to classroom practice.

Further targeted support is required to help student teachers understand how best to handle educationally relevant data. This will provide the context for both greater understanding of what such data has to offer student teachers in terms of useful information about their pupils learning as well as how the effectiveness or otherwise of their teaching was.

RQ3. Is it possible to improve final year ITE students' attitudes towards the use of data, through focused teaching sessions?

Our finding indicate that it is possible to make modest shifts towards improving ITE students' attitude towards the use of data within their teaching practice. However, just because attitudes can shift towards being more Promising and High Potential in terms of the Cognitive Belief, Affective State, Perceived Control and Affective Control domains of attitude, the ability to use data is a different prospect.

In terms of developing student teachers' attitude towards using educationally relevant data is concerned, we suggest that ITE programmes needs to go further, by supporting final year ITE students to integrate what they have learned, particularly about the principles of assessment and how different types of assessment help teachers come to know in terms of their growing knowledge of their pupils and how they construe their practice within the realm of their developing pedagogical content knowledge. We suggest that by scaffolding this learning for final year students, they will come to understanding the potential benefits to them and their pupils of systematically gathering and analysing formative and summative assessment evidence, as well as the other contextual information that will enhance all pupils' educational performance.

By grounding this work within the theory and practice of reflection, we may suggest that final year ITE students might see for themselves that when they apply this learning within school placements, they may get more from that experience when viewed from the perspective of how they come to know and make meaning from that classroom experience.

In this regard, the ITE programmes within UWS will endeavour to look more closely at how each programme explicitly supports the integration of educational theory, in particular assessment theory and practice, by asking students to more explicitly engage with different forms of data and other relevant evidence within their school experience placements in order to facilitate their development of awareness of the importance of being data literate and to support their growing pedagogical awareness as they ground their practice in more concrete forms of evidence.

RQ4. To what extent can final year ITE students' analyses and interpret educationally relevant data as part of their reflective practice.

Our findings indicate that BA4 Students struggle to analyse educationally relevant data in a number of respects. In particular, when it comes to analysing and making inferences from school level to national level data. However, BA4 students also struggle to make full use of tracking and monitoring data relating to what that data has to say about pupils' learning and what inferences they can take from the data to make comments about teaching.

In terms of the PGDE (S) students with a high Self-Efficacy and low Anxiety – those with highly positive attitude in the affective control domain – it is important to note that 95.5% of the sample come from a STEM epistemological background, which we would argue is steeped in a tradition of data analysis and interpretation. Even these students struggled with the analysis of educationally relevant data. For example, while PGDE (S) students could making a number of meaningful points about how best to transform the data, and about what the data has to say in general about the attainment of the class, 36.8% of PGDE (S) students could not identify which topic was best understood. In common with BA4 students, the PGDE (S) students had issues with the concept of standard deviation. The data was presented to students in the form of a table with each column representing the class results for each end-of-topic test and each row representing the individual pupil results for the year, with mean and standard deviation for the each test and pupil.

It was clear from students' explanations that both groups of students did not understand that standard deviation is a measure of the variance of the data, despite an explanation give for what standard deviation was being given on the activity sheet. This was particularly surprising given the predominance of PGDE (S) students with a STEM background. In our preliminary analysis of the Pre and Post questionnaires we found that having a STEM background had no significant impact of attitude toward the analysis of data as part of their reflective practice (data not shown but can be provided on request).

Taken as a whole, when we analysed the data analysis and interpretation activity, our findings show that 58.1% of PGDE (S) and 100% of BA4 students scored ≤50% which suggests that they could not effectively analyse educationally relevant data. When we look specifically at classroom level tracking and monitoring data, 36.8% of PGDE (S) and 90.2% of BA4 students scored ≤ 50%, with 63.8% of PGDE (S) students and only 9.8% of BA4 students able to score ≥ 51% in this activity. Even those students in PGDE (S) and BA4 that score above ≥51% in the data analysis and interpretation task struggled in terms of making simple observation about the data. This suggests that these final year ITE students need further support to engage in effective analysis and interpretation of classroom level data.

These findings also indicate that there is a need to present more authentic types of evidence to primary students. We believe that part of the issue with the BA4 students' lack of ability to analyse the class level data, is possibly more a consequence of a lack of familiarity with that type of data presentation, which suggests an issue with the face, ecological and construct validity of the data analysis and interpretation activity for this group of ITE students.

RQ 5 What type's information/evidence/data do final year ITE students draw on as part of reflections on lessons taught during episodes of teaching practice?

Our findings indicate that PGDE (S) students draw specifically on three lines of evidence within their reflective practice. The first being from observations made by class teachers and mentor. The second being from teacher directed activities such as formative assessment. The third being from pupil work such as homework and class activities that involve written responses. In many respects, these findings are is not surprising, but it is important to note that when it comes to the systematic and consistent gathering of evidence, the PGDE (S) students seemed to gather

evidence more systematically in placement one. Again this is not surprising when you take into account that the PGDE (S) students have to do a small scale piece of professional enquiry into the validity and reliability of two formative assessment techniques as part of the placement to provide evidence for their subject studies assignment.

As they moved on to placement two, they were less likely to draw on a wide range of formative assessment technique as was apparent in the teaching placement one reflections. There was good evidence in the reflections that they rely heavily on oral questioning as a way to evidence pupils' learning. In addition, these students did not seem to draw so much on that evidence in a critical way. Their reflections were too descriptive, lacked analysis and did not draw enough on wider professional reading to support their developing awareness of pupil learning or on how their classroom actions are developing as part of their teaching over the course of the placement. This was despite of explicit advice given to them by their placement tutors to draw more systematically on concrete forms of evidence and on their wider professional reading.

In many respects these findings parallel a range of research findings that look specifically into the way that student teachers engage with reflective practice. These findings also highlight the struggles to effectively operationalise professional reflection in a way that can be used to improve practice. We would suggest that these struggles sum up the tensions that student teachers experience as their awareness of issues that impact greatly on teaching practice grows over the year. These students experience a steep learning curve and the need to grapple with the complexity of reflective practice is part and parcel of the learning form experience element of the programme. Indeed, Jay and Johnston (2002) argue first, that ''reflection'' is an ambiguous term, that is difficult to conceptualise, where its use does not always connote a shared understanding. They suggest that it is important to outline how reflection is understood within the profession (i.e. teaching) for a more consistent understanding of the concept to emerge. Second, they suggest that the complexity of the concept of reflection can be difficult to articulate in a way that helps pre-service (student) teachers learn the skill, which has led to many techno-rational prescriptions that purport to support student teacher reflective practice. In an effort to scaffold student teachers reflective practice, we have to avoid falling into the techno-rational trap of providing a writing frame that narrows their reflection by reducing the complexity of everyday classroom practice, while at the same time helping them to focus their reflections on aspects that will be of benefit both to their pupils learning and to their own teaching practice.

To support student teachers in this regard, the research team aims to develop a reflective practice framework to help student teachers draw more systematically on a number of key areas of teaching practice. This will provide ideas for how they can gather a range of data focused on pupils learning and other forms of evidence from the classroom context that might support their reflection. It will also attempt to scaffold their think about aspects of their classroom organisation and management to help students focus on the mechanics of the lesson and how they come to know that learning has occurred. In addition, we hope to suggest an approach that may help them to draw on their wider professional reading to better support their developing teaching practice at the technical, pedagogical and curricular level of classroom practice.

RQ6 To what extent do final year ITE students use data to improve pupil's learning and their teaching?

Our preliminary findings from the PGDE (S) students' reflections on lessons taught indicate that while the student teachers in our sample draw on a range of data and other forms of evidence to fulfil their goal of meeting the GTCS (2012) SfR, they do not do so consistently. In many cases they rely too much on formative assessment and rarely draw on summative assessment. In this regard, we would like to offer a few words of caution when interpreting the finding relating to the written reflections. In addition, we would also like to offer some comment on what we believe ITE might be able to do to better support ITE students to reflect better. Finally, we give make a few points that have come up as part of the semi-structured interviews conducted so far that might have a bearing on this research question.

First, we have only presented the findings for the PGDE (S) students that participated in the study and as such the findings presented relate only to this student group. We intend to draw on more PGDE (P) and BA4 students in the next academic session. Having said this it is clear that that PGDE (S) students' reflective practice develops over successive teaching placements and that as they gain more teaching experience, their reflections qualitatively improve as they use more evidence to support their claims within their written reflections.

Second, it is not common for student teachers to explicitly reflect on summative assessment within their everyday reflections on teaching episodes, due in part to the fact that summative assessments such as end-of-topic test are generally not part of their everyday teaching. Summative assessments are designed to summaries the teaching and learning of that topic and as such provide data that once analysed and interpreted provides insight into pupils' learning. Teaching of the topic leads pupils towards the assessment therefore one should only expect a student teacher to reflect on these after the assessment has been completed, marked and interpreted. However, given the fact that there is little evidence of such assessments being reflected upon by these students while on teaching practice, this does not suggest that such reflection has not occurred in other forms elsewhere while on placement. For example, during departmental meeting or in conversation with class teachers or during mentoring meetings.

Third, written reflections on lessons taught tend to be a demand that is placed on student teacher as formal requirement of their ITE programme and often fails to capture the many opportunities for reflection that occur with the school day. We would argue that the richness of such opportunities to reflect on practice are not adequately captured within written reflections. Also, as many practicing teachers will attest, it is rare for in-service teachers to be asked to keep reflective logs in the same manner that we expect student teacher to do. As consequence, it can be argued that written reflections tend to be narrow, descriptive accounts of episodes of practice which are given by student teachers as artefacts of performance (hoops to be jumped through) in order to be assessed a satisfactory or unsatisfactory by an ITE tutor.

We suggest that ITE programme staff need to think of more creative and find more innovative ways to capture reflection that does not privilege the written word as the only way that students evidence their ability to reflect. Given the complex nature of reflection, we ought to provide a range of media through which student teachers can capture their thoughts, feelings and understanding of what has happened during their teaching placements.

When we take these findings together with the findings from the data analysis and interpretation activity, it is clear that PGDE (S) and BA4 students are not able to make sufficient meaning from tracking and monitoring data and that it is likely that ITE tutors and school-based mentors need to work with students teachers to support and develop their awareness of the importance of such data and its utility as part of their professional knowledge base.

As part of the semi-structured interview schedule, we ask students questions that probe their experience while on teaching placement of the type of data they use when on placement, in what way was data used, and who used data the most in school. We also ask them questions to probe what data they use on placement, how they use data while on placement, what was purpose did that data serve. In the responses to these questions it emerged that most students (sampled so far) make a clear distinction about what they consider data to be, and how they distinguish data from evidence. Of the PGDE (S) students interviewed, both suggested that homework, end-of-topic and a range of formative assessment was the predominant evidence used by teachers but greater emphasis was placed on end-of-topic test results to track and monitor pupils' progress. Whereas the PGDE (P) and BA4 students mentioned the use of SIMD data and standardised assessment data as well as formative assessment evidence being the most used form of data in school, particularly by their class teachers.

However, most of the primary education students claimed in their interviews that many classroom teachers did not feel comfortable sharing their classroom assessment evidence. In one interview with a PGDE (P) student, they indicated that in their placement school, the head teacher used the data more than the class teachers and that the class teacher was held accountable for the trends in the data and that this produced a negative atmosphere around the use of data. Whereas the three BA4 students interviewed all described data, in particular that assessment data was used in different ways depending on the school culture. One BA4 student described a situation where the class teacher was reluctant to share the classroom level data with them and used that data to focus discussion during a parents evening with specific parents. In this description, the student suggested that the teacher did not feel comfortable discussing this data but did not disclose why except to suggest that the class teacher was very aware that such data said something about how the class was progressing and her teaching and felt very defensive about it.

Given this information, we would argue that student teachers are becoming more aware of the rising prominence of data and its use in schools, perhaps as a consequence of the implementation of improvement plans under the auspices of educational policies such as the NIF, and that over time they will need to engage in a more focused way with such data, if they are to thrive within this changing educational environment.

Taking ideas forward

As a project team, we believe that it is important that we reflect on the findings reported here and disseminate the main messages that have emerged so far with our colleagues in Initial Teacher Education. In terms of what the UWS research team takes forward over the next two academic sessions, we feel that it is important from a research informed teaching perspective, that we split our efforts in three main directions…

- Extending the sample,
- Improving the connection between on campus teaching and learning and school experience in terms of data literacy, and
- Development of a reflective practice framework.

First, we would like to extend the research to recover the work that was disrupted by the onset of the COVID-19 pandemic by adding to the sample described here in terms of completing the quantitative and qualitative elements of the research. In particular, we would like to add a PGDE (P) group to the data analysis and interpretation activity data set and expand the PGDE (S) and BA4 data set. This would allow us to extend and firm up our analysis to publication quality.

In addition we would like to gather more participants to add to those that we already have for the semi-structured interviews. This would add an explanatory element to the descriptive data from the questionnaires and will bring an element of authenticity to our analyses by adding the student voice. We feel that this is an important aspect which will enhance the inferences made from the other elements of the research.

Second, in terms of the institutional element of the UWS research project, we feel the findings from the data analysis and interpretation activity suggest that the data literacy workshops need to be extended and amended to make that activity more reflective of the types of classroom and school level to National level data that the different groups of final year students would be expected to interact with to make this activity more authentic. Emphasis will be placed on how this type of data can be used to direct improvements in learning and teaching. This will involve working in partnership with local authorities to design more authentic data sets for our students to work with.

In particular, we will focus on how best to support the BA4 and PGDE (P) students to make full use of assessment evidence and to not rely too heavily on teacher directed formative assessment as their only source of evidence for learning. To this end, the research team will design a number of teaching sessions to help all ITE students (but particularly PGDE (P) and BA4 students) to understand the role and value that valid, authentic and learning-focused summative assessment has to play in informing their professional judgement. Since there was a strong feeling among the BA4 students that engaged in the data analysis and interpretation task that summative assessment was of limited utility to their understanding of pupils learning in the primary setting.

This view runs counter to the NIF and needs to be challenged in a professionally sensitive way. There was also a view expressed by many BA4 students during the data literacy teaching sessions that suggest BA4 an ideological opposition to basing their professional judgement on summative assessment data.

As part of our school experience modules across all ITE programmes at UWS, we will build in activities to students school placement file activities that will mandate students to engage in a collaborative way with their school-based mentors, in tasks focused on how teachers use different forms of classroom and school level evidence (data / information) to drive improvement in the educational outcomes for all pupils. We feel that this will help ITE students to make better connections between how practicing teacher use these lines of evidence (data / information) within their practice, and might also support efforts to develop in our ITE students a more professional attitude towards the use of evidence (data) to inform their professional judgements and decisions as part of their reflective practice.

Third, the research team aims to design a reflection practice framework to better support final year ITE students' with different forms of reflective practice. It is intended that this work will support the further development of a set of focused reflective questions deigned to scaffold ITE students' reflections and lesson evaluations. In addition, we will explore other ways that ITE students might evidence their reflection, for example a vlog (video log) or podcasts in order to help students to demonstrate their ability to reflect on lessons taught and school factors that might be relevant to the class context.

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