

ANGLIA RUSKIN UNIVERSITY

**FACULTY OF HEALTH, SOCIAL CARE AND
EDUCATION**

**How Do Able Male Students' Implicit Theories of
Intelligence Impact On Their Engagement With
Challenging Tasks? An exploratory case study.**

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**A thesis in partial fulfilment of the requirements of Anglia
Ruskin University for the degree of Professional Doctorate
in Education.**

Submitted: August 2016

Acknowledgements

I need to express my sincere gratitude to many people who have supported and encouraged me throughout my doctoral studies. The past five years have been a period of intense professional and personal development, which I could not have completed alone.

Thank you to my supervisors, Dr Geraldine Davis and Dr Philip Howlett, for sharing their research expertise and providing encouragement throughout each stage of my doctoral work. Thanks also to Dr Phil Long, Dr Debbie Holley and Dr Hazel Wright for their advice.

I am grateful to my teaching colleagues for their help during the data collection phase of my study and for their encouragement to keep going when I was trying to manage writing up alongside running the Biology Department. Particular thanks to Robin Bevan, Cathie Bates, Caroline Gaitley, John Hume and the staff of the Science Department.

Special thanks to the students who participated in my study, and to their parents and carers. It was a privilege to work with such articulate young people who were so open in sharing their beliefs, values and perceptions.

Finally, I dedicate this thesis to my family – Jeff, Jonathan, Cameron, and my Parents. Their unconditional love and unwavering support have sustained me every step of the way.

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ABSTRACT

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How Do Able Male Students' Implicit Theories of Intelligence Impact On Their Engagement With Challenging Tasks? An exploratory case study.

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This study explores the impact of implicit theories of intelligence held by academically able, male students on their levels of engagement with challenging tasks. In my workplace, an academy grammar school, levels of challenge in lessons were raised to engage and motivate students, and increase academic attainment. However, some students responded negatively to the challenging tasks and underachieved in assessments. Using the model of Implicit Theories of Intelligence Mind-Sets as a framework, the aim of this study was to elucidate students' intrinsic beliefs, values and conceptualisations about challenge, effort and intelligence. This new knowledge was used to inform school policy and develop classroom practice that supports students to positively engage with challenge. An interpretivist methodology was adopted and case study design used to investigate the research question. Twenty-one Year Eleven students in a GCSE Biology class completed a questionnaire to assign them as fixed or growth mind-set theorists. The students' learning behaviours were video-recorded during two consecutive Biology lessons whilst they completed a challenging problem-solving task. Six students (three fixed and three growth theorists) were selected for interview. During the video-stimulated, semi-structured interviews, students recalled their experiences working on the challenging task and related these to their conceptualisations of intelligence. A more diverse pattern of mind-sets, learning behaviours, goals and concepts of intelligence was found than is predicted by the model. Five students combined fixed and growth mind-set associated beliefs in their conceptualisations of intelligence. Within the boundaries of the case study, the findings did not support a causal relationship between mind-set and response to the challenging task. An alternative framework of understanding that included negative emotional responses to challenge, perceived value of effort within the school and concept of scientific knowledge was constructed to characterise factors raised by the students who responded helplessly in the face of difficulty.

Key words: Mind-sets; able students; case study; challenge; engagement

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Abbreviations used in this thesis

AfL	Assessment for Learning
AS/A Level	Advanced Subsidiary/ Advanced Level
ARU	Anglia Ruskin University
BERA	British Educational Research Association
CPD	Continuing Professional Development
DCSF	Department for Children, Schools and Families
DfE	Department for Education
EFL	English as a Foreign Language
FFT	Fischer Family Trust
FREP	Faculty Research Ethics Panel
GCSE	General Certificate of Secondary Education
G&T	Gifted and Talented
ITI	Implicit Theories of Intelligence
MA	Master of Arts
MAT	More Able and Talented
NACE	National Association for Able Children in Education
Ofsted	Office for Standards in Education
PGCE	Postgraduate Certificate in Education
QCA	Qualifications and Curriculum Authority
SEN	Special Educational Needs
SENCO	Special Educational Needs Co-Ordinator
SIP	School Improvement Plan
STEM	Science, Technology, Engineering and Mathematics
TES	Times Educational Supplement
VLE	Virtual Learning Environment

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Chapter 1: Contextualisation of my research

1.1 Introduction

The research presented in this thesis addresses the issue of students who disengage from their learning when given challenging goals and activities, and who are at risk of academic underachievement. Using the model of Implicit Theories of Intelligence as a framework, the study explores the beliefs, values and conceptualisations about challenge, effort and intelligence among able male students in a grammar academy school. The research was conducted using an interpretivist methodology and case study design, employing questionnaire, observation and semi-structured interview as methods of data collection. The purposes of my research were to contribute new knowledge about the intrinsic factors that affect students' engagement with challenge to the development of pedagogy, school and national policy, and the wider debate about application of theory to classroom practice.

In this opening chapter of my thesis, I have described and explained my reasons for embarking upon a professional doctorate in education. Section 1.2 establishes the rationale behind my decision to conduct doctoral research. My reasoning has been evaluated from the perspective of a critical reflection on my professional practice. To locate the position of importance I have afforded to research as a part of my professional development, I have included a sub-section that explores my understanding of the terms profession, professional and professionalism. These key terms encompass my values and beliefs about teaching and learning.

Section 1.3 outlines the development of a professional research approach to answering my research question. This section describes and explains the critical decisions taken during the planning stage of my study, and provides the background to the methodology and methods chapter that follows later. I have mapped the development of my research question and explained why the final form of the question is pertinent to raising the standards of teaching and learning at my workplace, a boys' academy grammar school. I have included a reflection on the outcomes of presenting my work in progress at a doctoral programme workshop to illustrate the value of constructive criticism to the development of a professional research approach. The practicalities of answering my research question are explored in a discussion of the issues surrounding practitioner based research from the perspective of the contextual factors associated with my professional practice and school setting. The conclusions that were drawn from this discussion influenced my research approach, in particular my decision to conduct a small-scale, classroom-based project.

In section 1.4 I have outlined how the findings of my research contribute to the body of professional knowledge, with particular regard to able students' beliefs about intelligence and the factors that affect their engagement with challenging tasks. The classroom-based setting, able characteristic of the student participants and interpretive methodological approach adopted in my research combine to present a unique case study.

Taken together the three essays that combine to form this introductory chapter set the scene of my research project; as viewed through the lenses of personal and professional development, of understanding an issue affecting practice and of contributing to the body of professional knowledge.

The structure of this thesis is described in section 1.5.

1.2 Context and Rationale

1.2.1 A critical appraisal of my professional practice

In this sub-section, I have critically evaluated all aspects of my professional practice: the roles I fulfil as a Science teacher; my position and values within the organisational structures and culture of my workplace; my practice in relation to statutory teaching standards, and the route I have taken to become a professional practitioner.

I have two main roles: teacher and subject leader of Biology. For students studying Biology through Years Seven to Thirteen, my main responsibilities are to support and direct the learning of students, monitor progress and communicate this to students, parents, colleagues and other stakeholders. As a subject leader, I lead and support teaching colleagues and technicians in the Biology Department. In addition, I work alongside other middle leaders and members of the senior leadership team to implement and shape whole school policies. I can make decisions about changes to departmental policy and practice, although these must be in accordance with whole school policy and guidance on practice, which are bounded by national frameworks (for example, the National Curriculum) and statutory requirements of the Teachers' Standards and Ofsted.

A critical factor in my capacity to shape practice within the Biology Department is the organisational structure of my workplace. The school is organised in a hierarchical structure with a senior leadership team responsible for whole school curriculum, pastoral and financial matters and a larger middle leadership team made up of subject and Year group leaders, and colleagues who hold whole school positions of responsibility (for example, the SENCO). The core subject leaders

(English, Mathematics, Science and Modern Foreign Languages) constitute an additional tier of middle leadership that can be viewed as part of an extended senior leadership team because they are consulted on a wider range of issues affecting teaching and learning.

As a subject leader, I am the interface between whole school aims and policies, and classroom practice. In this respect, my role fulfils values of professionalism I have expressed later in this section; specifically, collaborating with colleagues to interpret policy and apply our professional knowledge to improve the learning of our students. For example, developing differentiated activities for more able and talented (MAT) students within schemes of work has been a product of the collective knowledge and experiences of Biology teaching colleagues, MAT co-ordinators in other departments and the SENCO. Ideas are evaluated in the light of literature about teaching able students (Wallace, 2000; Bachin, Hymer and Matthews, 2009; Eyre and Lowe, 2002) and set within school and national policies and guidelines for practice.

The degrees of power and autonomy my role affords are also affected by the cultural context of my workplace. Within the diversity of factors that contribute to the culture of a school, accountability for raising standards within the Biology Department has significance here. As a consequence of having the power to shape departmental aims and practice, I am accountable for the outcomes of my decisions and actions. I consider accountability as a cultural factor because it affects the attitudes and expectations of all members of the school community and the emphasis on accountability will differ between schools. Accountability places restrictions on my power and autonomy, but also, contributes to maintaining standards of professionalism. As a footnote, my school's conversion to academy status has the potential to influence the accountability of subject leaders, as the school Governors

have greater powers to set teachers' terms and conditions of employment, review job descriptions and allocate funding.

The educational and professional routes that I have taken prior to my current role have shaped my professional practice. After graduating BSc (Hons) in Applied Microbiology from Strathclyde University in 1992, I spent five years as a medical researcher at St George's Hospital Medical School, University of London, investigating immunological responses to the Human Immunodeficiency Virus (Brown et al., 1999). During this time I supervised and tutored medical students in Biochemistry. The enjoyment I experienced through teaching the subject I am passionate about was the impetus to leave the field of medical research and study for a PGCE (Secondary Science) at Anglia Polytechnic University (now Anglia Ruskin University) in 1998.

When I embarked on the PGCE course, my assumptions about education and how students learned were challenged, leading me to construct my own framework of values and beliefs about my role as a teacher. It was during my PGCE studies that I first engaged with education literature, albeit restricted in scope, and became aware of theories of learning and education research. Throughout my career I have pursued professional development opportunities that extend my knowledge of theories underpinning my practice and experience of carrying out practitioner research, particularly in the field of educating more able and talented learners as I have taught mainly in selective schools. My professional development has taken both formal (studying for an MA in education at ARU, graduating in 2008) and informal (reading literature published by practitioner based research bodies and groups such as The National association for Able Children in Education (NACE), The Association for Science Education (ASE) and the Society of Biology) pathways.

1.2.2 Profession, professional and professionalism – a critical evaluation of my values and beliefs about teaching and learning.

The purpose of this reflection is to describe my conceptualisation of the teaching profession in relation to the range of models described in literature. What I understand by the terms ‘professional’ and ‘professionalism’ are developed within my concept of the teaching profession. These meanings are set within the Teachers’ Standards and Ofsted criteria, and my own workplace setting, a boys’ academy grammar school.

Etzioni (1969) categorised teaching as a ‘semi-profession’; lower in status than more traditional professions such as medicine, law and divinity, and implying less influence and power as agents of change. He argued for maintenance of the hierarchy of professions, affording greater specialisation to the professional knowledge of traditional professions. Etzioni (1969), however, did not define what he meant by the professional knowledge of teachers, making the assumption that the reader shared his understanding of the differences between ‘specialised’ and ‘highly specialised’ knowledge. Whilst I would challenge Etzioni’s denial of full professional status to teaching, the concept of professional knowledge is central to my own values about the teaching profession. I expect all professional teachers to have a secure knowledge of different theories of learning, practical teaching methods and shared beliefs regarding the objectives and importance of education for the individual and society, all of which can be considered as components of professionalism. In the following paragraphs, I have compared and contrasted my own conceptualisation of professional knowledge and professionalism of teachers with that of other authors who have described different models, both generalised and specific to teaching.

The nature of professional knowledge was described by Eraut (1994) as a distinct body of knowledge with its own specialist vocabulary. This is a limited idea of professional knowledge as it does not take into account the evolving nature of the professional knowledge of teachers; for example, the developing theories of practice surrounding more able and talented learners. Furthermore, there are issues of autonomy regarding who defines what is professional knowledge, and how this knowledge is generated and communicated among members of the profession. For teachers in England and Wales, the Teaching Standards define the expected professional activities and it is against these that teachers are evaluated in terms of professional competency. Etzioni (1969) may have questioned recognition of teaching as a profession as it is not self-regulatory or free from external interference. I consider this to be an over-simplification of the issues of autonomy, as professional knowledge can be generated and refined through educational research and debate within the teaching profession, albeit within boundaries laid down by the Teachers' Standards.

In an interesting exercise, Evans (2011) defined her own conceptualisation of teaching professionalism and compared this with the Teachers' Standards. She defined professionalism as a series of components under three categories: behavioural, attitudinal and intellectual. This model of teacher professionalism most closely resembles my own conceptualisation, as it gives equal weighting to each component and, as such, recognises the holistic nature of teaching. By holistic I mean that the components described by Evans (2011) are interdependent and each contributes to the success and quality of the relationship between teacher and learner. In her research Evans (2011) found that the majority of the 2007 Q Teachers' Standards described what teachers are expected to do, that is they express

behavioural type objectives, with few attitudinal type standards. As such, the 2007 Teaching Standards resemble a technicist or functionalist model of professionalism. Since the Teachers' Standards are the framework for teacher education and performance management, the imbalance of the objectives reduces the importance of shared values, beliefs and intellectual approaches of the professional practitioner that are associated with being a teacher-researcher and the 'extended' professional described by Hoyle (1975) and Evans (2002).

Evans (2002) has described her own development from a 'restricted' to an 'extended' professional during her teaching career, along what can be considered a continuum of attitude, values and behaviours. Her biographical description parallels those of Andrews and Edwards (2008), who placed the greatest importance on reflexivity as a means to bring an intellectual order and critical awareness to their practice. They described becoming practitioner researchers in their workplace as "making their familiar new", which has resonance with Schön's (1983) reflective practice as a means to transform implicit knowledge into explicit understanding. The ability to cope with the complexities, uncertainties and changing demands made on teachers requires an adaptability of knowledge that must be based upon understanding. For me, the role of the teacher-researcher involving evidence-based, critical reflection upon current practice as a means to improve learning is the vehicle for transition from 'restricted' to 'extended' professional.

Reflexivity and the role of the teacher-researcher impact upon my conceptualisation of professional knowledge by supporting an evolving rather than a fixed body of knowledge. In addition, my conceptualisation of professionalism is also influenced in terms of the teacher's ability respond to the needs of the learners through the processes of critical reflection and evidence-based change. I recognise a conflict

between my conceptualisation of professionalism and the Teachers' Standards as I consider the intellectual and attitudinal components described by Evans (2011) as fundamental to the decisions I make about my actions as a classroom practitioner. To reduce the importance of enquiry and reflection as components of professionalism disengages the professional from their ability to shape the body of professional knowledge. This intellectual endeavour delineates the 'professional' from the 'technician'. As a consequence of the Teachers' Standards being phrased as individual objectives, they are reminiscent of Schön's (1983) critical stance on 'traditional practices' as not appropriate to meet complex and changing demands made on the professional. Eraut (1994), referring in general terms to professional education, and Evans (2011), writing specifically about teacher professionalism, both criticised 'modularisation' as inadequate.

In terms of teacher education (as opposed to teacher 'training', which I consider to reinforce a functionalist model of teaching) I agree with Eraut's (1994) assertion that becoming a 'professional learner' is necessary to become a more effective 'learning professional'. Inherent in his proposal for work-based learning is time for reflection, collaboration with fellow professionals and critical debate to allow reshaping of theories of practice. As stated earlier, I value theoretical knowledge as integral to the professional knowledge of teachers. It follows that my conceptualisation of professionalism encompasses a model of teacher education that is continuous throughout the professional's career and which applies the intellectual and attitudinal components of Evans (2011) model to develop theoretical and practical knowledge.

In his treatise on 'Changing modes of teacher professionalism' Whitty (2008) described a current move toward a "democratic professionalism". Two aspects of his model are pertinent to my own conceptualisations of 'profession' and

‘professionalism’: collaboration and the ‘activist professional’ (as originally described by Sachs, 2003). Whitty extends and applies Eraut’s (1994) tenet of professional collaboration to teachers working with stakeholders – students, parents and other professionals – to improve learning. During my own continuing professional development, working with students (described in literature as listening to the student voice) and fellow professionals have significantly impacted upon my theoretical and practical understanding of teaching and learning. I cannot envisage a profession in which its members work in isolation, ignorant of their students’ experiences and not engaging in discussion with peers.

Whitty (2008) suggested that collaboration would lead to a more “democratic system of education” with resulting increased openness and accountability, both necessary characteristics of a profession as described by Eraut (1994). Professional responsibility is also an attribute of the “activist professional”, a model of professionalism which shares characteristics with Hoyle’s (1975) “extended professional” and exemplified by the role of teacher-researcher. I agree with Whitty (2008) in his prediction of the activist professional being an “agent of change” and, as such, able to influence and contribute to the development of professional knowledge and teacher professionalism.

To summarise, my understanding of a ‘profession’ is a group of practitioners who engage in enquiry, debate and critical evaluation of current practice to develop their professional knowledge, both theoretical and skills-based. There are educational values and objectives, focusing on the learner, that are shared by members of the profession. I recognise that the Teachers’ Standards as a framework for teacher professionalism is contentious, particularly in terms of the autonomy and self-regulation identified in literature as criteria of a ‘profession’, although I accept that it

is possible to exercise Evans' (2011) attitudinal and behavioural attributes to fulfil the role of the teacher-researcher. The central tenet of my conceptualisation of the professional teacher is active learning; seeking meaning within the complexity and changing needs of learners through research and reflexivity. Concomitant with engaging with work-based problems, professionalism also demands taking responsibility for the effectiveness of practice and seeking to raise educational standards. This multifactorial model of professionalism can be considered vocational, when this is taken to mean service to others and is altruistic in nature. Taken together, the professional teacher fulfils the demands of the Teachers' Standards whilst also maintaining a critical awareness of the needs of learners and applying reflective practice to meet those needs.

1.2.3 Reasons for undertaking doctoral research

In this section of the chapter I explain my rationale for embarking upon the professional doctorate in education course. To begin, I have described the diversity of backgrounds, aims and approaches of education researchers, and then located my own reasoning for undertaking doctoral research within the broader picture.

Those who research education represent a diverse range of specialisms and practice. Consequently, there is a variety of purpose: practitioners wanting to improve practice, academics building or testing theory and policy making at school and national levels (Gardner, 2011). The purpose is not exclusive to these groups; my own research question has led me to explore the impact of fixed versus growth mind-set beliefs on students' learning within the context of classroom-based practitioner research.

The different approaches applied by education researchers fall into two categories: the positivist paradigm, characterised by large-scale, quantitative methods of enquiry, and the interpretive paradigm, where studies are often smaller in scale and employ qualitative methods of data collection. These two approaches can be applied in different contexts, although interpretive research methods are more appropriate to classroom-based projects. This is because the data gathered from a study involving a small cohort of students is not sufficient for statistical analyses, which prevents reliable comparisons and associations to be made between test and control groups. The methodological approach should be 'fit for purpose'; that is the epistemological and ontological principles underpinning the methodological approach and the data collection tools should generate evidence that answer the specific research question (Cohen, Manion and Morrison, 2000).

As a Biologist who has carried out medical research using objective, controlled experiments to generate quantitative data, I found it difficult to accept that reliable, valid and useful evidence could be generated by using qualitative methods.

However, once I embarked upon a small-scale classroom based research project that required recording students' voices and interpreting their responses, I was able to appreciate the limitations of the positivist research methodology to generate understanding in a specific context. Equally, I was able to appreciate the limitations of generalisability and the possibilities of other interpretations inherent in using the interpretive approach.

Building upon my early attempts to investigate my own classroom, I participated in a collaborative action research project supported by Southend Borough LEA. Using the model of practice Building Learning Power (Gornall, Chambers and Claxton, 2005), I evaluated the resilience and perseverance of a class of Year Ten Biology

students when faced with challenging reading resources during lessons. Specifically, the students were given articles from scientific journals to read, extract key ideas and express their understanding in their own words and diagrams. During the project I worked with two practitioner researchers from a partner school to share ideas and provide support through critical discussion and peer review. The project deepened my interest in practitioner research by giving me insight into the diversity of research questions, methods employed and interpretations that could be applied to the data collected. Furthermore, I found that by seeking critical appraisal of my work I was compelled to consider how my ideas related to wider educational debates and if my research met professional education research standards. As a result of participating in the action research project, I decided to develop my professional knowledge of education research and expertise as a practitioner researcher.

Running parallel to my desire to become a professional education researcher, I have an active interest in the factors that influence students' levels of motivation and effort. Having spent most of my teaching career working with able students in selective grammar schools, how to re-engage disaffected and underachieving able students has been a persistent problem and one widely debated among practitioners and researchers (Montgomery 1998; 2009). For me the frustration has been that successive strategies to raise the attainment of disengaged able students have focused on interventions aimed at changing external factors, such as curriculum and assessment approaches, but, these have not addressed the underlying reasons for underachievement. In line with my conceptualisation of the extended practitioner as an agent of change who contributes to the body of professional knowledge, this gap in my understanding presented a conflict of values and a barrier to developing effective practice to meet the needs of students.

Taken together, my reasons for undertaking doctoral research fulfilled both personal and professional development aims. Although my project has been small in scale and practitioner led, because the issues of underachievement are widely recognised and not restricted to able students, the outcomes of my research have potential value beyond my own practice, to contribute to wider educational debates and lead to engagement with the research community. I consider this an important aspect of becoming a professional researcher, particularly to test my competence as a researcher and the value of my research in the field. In addition, I have aimed to generate new knowledge that is useful to classroom practitioners and school policy makers not only because this meets an important criterion of the professional doctorate, but also because this bridges the partition that exists between research, policy and practice. Sutherland (2012) described a lack of communication between researchers, policy makers and practitioners, which posed questions about the purpose of research in education. Sutherland (2012) predicted that the consequence of the disparity of purpose between models derived from research and their application in schools was to risk introducing practices that were contrary to the ideals of the model itself. As a teacher-researcher researching with students in my own classroom, the purpose of the research and its applications are concordant.

1.3 Introduction to the research process

1.3.1 Framing a research question: drawing together context and practice within a theoretical framework

My experience of teaching able students who do not fully engage with their learning and reading of literature have revealed the complex and multiple factors that impact upon able students who underachieve (Montgomery, 2009). This meant that there were a number of potential internal factors that would be worthy of investigation, which contribute to the professional body of knowledge about what motivates able students and impacts upon their level of engagement with their learning. To focus on a specific factor that could be refined to generate a coherent research question, I widened the scope of my reading to explore current developments in pedagogy in the professional literature. I also discussed my research interests with teaching colleagues and reflected upon the theoretical premises underpinning Building Learning Power (Gornall, Chambers and Claxton, 2005), the model of practice that was the focus of my previous action research project. Collectively, these sources of information pointed to Dweck's (2000; 2010b) model of implicit theories of intelligence (ITI) being relevant to my area of interest and its potential as a theoretical framework for investigating the gaps in my professional knowledge.

The introduction of a school improvement plan called Project 2013 coincided with my growing interest in the model of implicit theories of intelligence as a focus for research. The objective of this school wide project was for all students in Year Eleven in 2013 to attain A*/A GCSE grades in all their subjects. The central strategy of Project 2013 was increasing levels of challenge in the classroom. Schemes of work were revised to include more challenging activities and resources, and

colleagues shared their practice through professional development sessions where solutions to problems were discussed and effective classroom strategies identified. The focus on raising challenge was supported in research and practitioner literature, particularly in relation to able learners (Wallace, 2000 and Montgomery, 1998; 2009), as a means to raise levels of engagement, motivation and enjoyment of learning. The focus on challenge was also pertinent to my research interest because the model of implicit theories of intelligence proposes two opposing mind-set stances, fixed versus growth, that describe an individual's beliefs about their intelligence and the learning behaviours in response to challenge that are prompted by these beliefs. The model of ITI mind-sets predicts that students who hold a fixed mind-set will avoid challenging tasks and become disengaged from their learning, leading to underachievement (Dweck 2000; 2010b). Since the theoretical premises and predictions of the model of ITI mind-sets connected the focus on challenge associated with my classroom practice and the problem of underachievement at the heart of my rationale for undertaking research, I concluded that the model was a suitable theoretical framework to use to develop my research question.

An important step was the decision to pose my research question from an exploratory perspective. There were two reasons for setting an exploratory aim. Firstly, to understand the impact on learning behaviours of internal factors, such as motivation, beliefs and values, precedence had to be given to the students' voices. Anything other than a completely open-ended approach to the design of my study would have imposed boundaries on the scope of students' responses and introduced researcher bias. Secondly, an exploratory aim acknowledged the complexity of multiple interacting factors that affects students' learning. Taking the particular contextual factors of the learning situation into account in my research approach also

aligned with an interpretive methodological stance. Consequently, the exploratory aim of my research question determined the most appropriate methodological approach to take and this, in turn, directed the choice of data collection methods that would be fit for purpose (Cohen, Manion and Morrison, 2000). Through discussion with my Supervisors, fellow doctoral students and Head Teacher, I refined my research question and began developing a research approach aimed at generating valid and reliable data. The methodology and methods employed in my study are described and justified in chapter three.

Investigating the values, beliefs and behaviours of students in my own classroom suggested case study was the most appropriate approach. Bringing together the theoretical framework, focus on challenge in the classroom, exploratory aim and case study design, the resulting final form of my research question was:

<p>How do able male students' ITI mind-sets impact on their response to challenge in their Biology classroom?</p>
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In the following sections I have discussed stages of developing a research design that would answer my research question and accommodate the particular contextual factors and sensitivities associated with the student participants, the school setting and my role as teacher-researcher.

1.3.2 Reflection on the value of seeking critical feedback to developing a professional research approach

Reading literature about able students who underachieve, the model of ITI mind-sets and other theories of learning guided me to the research question. As I explored possible approaches to answering the research question in the context of my school setting, I tested my initial, tentative ideas by sharing my work in progress with my Supervisors and fellow doctoral students. I have included this section to illustrate the impact that critical feedback has had on the development of my research design. I have used my presentation of work in progress and the discussion that followed during a doctoral programme workshop on the 24th November 2012 as an example. Throughout the reflection that follows, I have referred to specific numbered slides of the presentation (see Appendix I) and lines of the discussion notes (see Appendix II) in the text.

At the time of the presentation my intention was to use semi-structured individual interviews to ask students to explain their approaches to challenging learning tasks (slide 4). The difficulty with this approach was devising questions that would ensure students' responses focused upon the topic of the research question, but, which did not lead or influence the students' responses (Hobson and Townsend, 2010). It was suggested that I use video recordings of the student participants completing challenging tasks in lessons as a focus for the interviews (lines 9 to 10). This method also had the advantage of prompting students to articulate their thought processes, which they may not spontaneously verbalise, in the order they occur as they watch a sequence of activities. As such, the use of video could be considered as imparting a naturalistic attribute to the research approach, which fits with the interpretive paradigm (Bogdan and Biklen, 2007).

Whilst coding analysis of interview data will reveal themes, patterns and commonalities (Cohen, Manion and Morrison, 2000; Bogdan and Biklen, 2007), the use of video may generate student narratives. Here, there was potential to take a more holistic approach to the analysis of data, which would increase the trustworthiness of the findings (Flyvbjerg, 2011), such that both content and form can be interpreted (Punch, 2009). Given that my research question aimed at exploring the cognitive processes that link students' ITI mind-sets and their engagement with challenging learning tasks, analysing the data as a whole, rather than as fragments, would maintain the integrity of the interactions expressed in students' responses (Coffey and Atkinson, 1996). To identify the most effective analytical methods to employ in my study, I needed to further review the literature and test potential methods using data I had gathered. I have described and justified the method of data analysis that I applied to the data in chapter three, and evaluated the suitability of my approach to the analysis in chapter six.

My initial concern about using video recording was my own technical competence in capturing all the relevant actions and conversations during a Biology lesson. This issue was raised by Bogdan and Biklen (2007) as the reason why researchers can be reluctant to use visual recording. To address my concerns, I recorded sections of a Biology lesson with a class of Year Ten students and evaluated the usefulness of the audio-visual data as an accurate and detailed account of the students' dialogue and behaviour. As a result of trialling video recording the events of a lesson, I realised that filming groups of students working together for periods of between five to seven minutes revealed sufficient details of what was happening such that the clips could be used to prompt questions and stimulate discussion about students' thinking at key points. The trialling also allowed me to check that I was able to use the video and

audio recording equipment during lessons without interrupting the sequence of planned activities and that the presence of the recording equipment was not in itself affecting the students' behaviour (Bogdan and Biklen, 2007). The next steps were to ascertain the type and sequence of questions that would prompt focused responses from the students (Punch, 2009), that the questions were not ambiguous, the time and location of the interviews and suitable prompts to keep the interviews flowing (Hobson and Townsend, 2010).

There were ethical issues surrounding the use of audio and video recordings of students' responses; a question was raised about ethics during the workshop discussion (line 13). The question prompted a wider discussion of the ethical issues associated with researching with children. The key points of the discussion were informed consent, safeguarding and protecting the rights of children who participate in research. Before the data collection stage, consent from parents and assent from student participants would have to be secured. Following ethical guidelines for educational research published by the British Educational Research Association (BERA, 2011), parents and students must be given clear and full information regarding the purposes of the study, methods of data collection and how the data will be used. Furthermore, students must be aware that they can withdraw their participation at any point during the study. With specific reference to the data collection methods, participation must not be detrimental to students. Since I did not intend following an experimental approach, and therefore would not have test and control groups of students, there were no advantageous or disadvantageous interventions applied unequally. Also, I did not consider the subject of the interview questions to place students at risk of psychological distress or to lead to disclosures of a nature that raised safeguarding issues. The workshop participants agreed with

this evaluation (not recorded in the discussion notes). Nevertheless, the confidentiality and anonymity of students' responses had to be maintained such that student participants could not be identified through any reports or publications resulting from my research.

Whilst the published codes of ethical practice (Cohen, Manion and Morrison, 2000, Punch, 2009; BERA, 2011) set a benchmark for my research design, through sharing my ideas with colleagues I was made aware of the need to tailor my approach to suit the specific needs and sensitivities of the student participants, the school setting and me as teacher and researcher (Gallagher, 2009). A description and justification of the measures I have taken to ensure the safety and well-being of the student participants, which adhere to school, local and national safeguarding policies and practice, are given in section 3.5 of the Methodology and Methods chapter.

During the workshop discussion I was asked to explain my reasons for selecting Year Nine students as the research cohort. I argued that the challenge aspect of the research question was fulfilled because these students moved to Key Stage Four at the start of their Spring Term and, so, were being given more difficult learning objectives and activities in lessons. Furthermore, students and parents were informed of GCSE target grades, which are calculated using FFT data and, given the higher ability levels of the students, are A* or A grades. In justifying my choice I realised that the challenge and higher ability characteristics of the cohort were not exclusive to Year Nine. Also, the discussion prompted a more pragmatic review of my initial decision, particularly regarding issues of access and ability of the student participants to articulate implicit beliefs and values. Consequently, I decided to recruit older students, specifically Year Eleven students from one of the GCSE Biology classes that I taught to participate in the case study. The reasons for selecting this group as

the research cohort are explained in section 3.4.1 of the Methodology and Methods chapter. I have also included in chapter three explanations for my decisions relating to questions about sample numbers and selection criteria for interview (line 14).

The last question raised during the workshop discussion was about how I would use the questionnaire data to inform the interview phase of the study (line 15). Slide four of the presentation showed how I intended to use a scaled questionnaire to assign each student as holding a fixed, growth or intermediate ITI mind-set prior to interview. Initially, I had planned not to use questionnaire data in the interviews because this may have affected how I questioned students; that is, knowing that a student holds a fixed or growth mind-set could reveal assumptions I may hold about how their beliefs would affect students' attitudes to challenging tasks. I was concerned that knowing individual student's ITI mind-set stances would compromise the trustworthiness of the interview data (Flyvbjerg, 2011). This approach, however, would lead to the practical problem of selecting students to participate in the interview phase. A third person would have been required to select students for interview. With regard to the issue of trustworthiness, the consensus was that the value of using questionnaire data to inform and focus interviews with students outweighed the potential for assumptions of the interviewer to affect students' responses. After reflection, I agreed with this view and planned the interview questions around students' answers to the questionnaire items. The views of my fellow doctoral students and Supervisors also gave me confidence that I could maintain reliability of the outcomes of the case study even though I would be processing data and selecting students for interview myself.

To conclude, the discussion following the presentation of my initial, tentative research approach raised practical and ethical issues that needed further

consideration before the final design was approved. There was agreement that adopting an interpretive methodology was most appropriate to answering the research question (slides 4 and 6). The critical feedback was most useful for the suggestion of using video recordings of students working on challenging tasks and for prompting further consideration of the balance between focus and influence of the interviewer during student interviews.

1.3.3 Practitioner led research: issues affecting research in my own classroom

In this section of the chapter I have described the issues surrounding practitioner based research and evaluated these in the context of my own practice. This section addresses the usefulness and limitations of practitioner based research, the generalisability of findings and suitability of different methodologies. I have also considered the opportunities and constraints for making changes as a result of my research in the context of my own professional practice. Following on from this, I have reflected upon the potential sensitivities between me as researcher, those participating in my research and how these may affect the integrity of the research.

The usefulness of the outcomes of practitioner based research is highly significant to the teacher researcher whose field of study is their own classroom and research subjects their own students. As the research question has arisen from a problematic issue of practice, the findings have relevance to the specific context of the learning and have an immediacy of application to improve learning. Punch (2009) identified relevance as an advantage of teachers researching in their own classroom, alongside convenience, access, consent and insider knowledge and understanding. However,

relevance may be at the expense of being able to generalise the findings outside of the specific context in which it was carried out.

In the context of my own research, the research question has evolved as a result of three pressures: a school-wide focus to improve the academic results of underperforming students, gaps in my own knowledge of the causes of low levels of motivation and effort, and a desire to further investigate the model proposed by Dweck (2000; 2010b) and Claxton and Meadows (2009). For these reasons, the usefulness of my research may extend beyond my own practice. For example, the findings may have relevance to whole school policies and practice because although my research was carried out in the context of the Biology classroom, it was not necessarily subject dependent. In my planning, I anticipated that the questions put to student participants would use their experiences of learning Biology as scenes they could reflect upon and act as the vehicle to reveal beliefs, attitudes and motivations they were not consciously aware of or had previously expressed. In my analyses of students' responses I looked for generic interpretations and commonalities that had applicability across the curriculum, including relevance to pastoral support practices. Beyond my own workplace, the outcomes of my research contributes to the national debate regarding strategies for teaching able students, and to the international body of evidence and knowledge of the impact of fixed and growth mind-set models on learning.

Associated with generalisability, but looking from a constraining perspective, is the degree of support for my research afforded by members of the school community. If my research was considered limited in scope and usefulness by those whose approval I had to seek for access and consent, then it would have posed a serious constraint on what I wanted to do. Gaining approval was a critical first step in my research,

particularly as I planned to focus on students' responses during interview within a case study design rather than gathering quantitative, documentary or questionnaire data, which are more detached from the research participants. There were potential issues of risk and harm, both in terms of student participants and colleagues who may have perceived a threat to their practice. At the early stages of planning my research approach, I did not foresee a lack of support to be a major constraint because a number of colleagues, including teaching colleagues I worked most closely with, the SENCO and Head Teacher, had expressed their interest and support. This included colleagues acting as 'critical friends', a strategy advocated by Punch (2009). Nevertheless, the potential to meet resistance from colleagues and other stakeholders was present at each stage of my research and, for this reason, I remained sensitive to others' opinions regarding the value of my research.

The purpose of having a 'critical friend' was to improve the validity of my research. The quality of the planning, data gathering, analytical and presentation stages of research can be reduced through researcher subjectivity, bias and having a vested interest in the outcomes (Punch, 2009). These risks are significant to the teacher researcher as the opposing consequences of relevance and knowledge of the students participating in the research. Consequently, my own research was at risk, particularly as the outcomes have the potential to improve my professional knowledge and to contribute to improved learning of students in my department and across the school. Furthermore, I needed to avoid selection of student participants based upon prior knowledge that identified their behaviours as particularly supportive or contradictory to the theories under investigation.

The competence of the teacher researcher, their integrity of purpose and objectivity, has a significant impact upon the quality of the research and its usefulness. At the

stages of planning and gathering evidence, applying the most suitable method is necessary to be able to answer the research question. In the context of my own research, an interpretive, non-positivist paradigm was appropriate to gathering qualitative data that could reveal students' conceptualisations about their own intelligence and how this influences their motivation and actions when faced with difficulty. The intention was to collect in depth data that had features unique to each respondent because it drew upon personal learning experiences, interpretations and beliefs. The suitability of the questionnaire and interview methods chosen were subject to limitations of time, access and resources. For this reason, it was important that I explored alternative methods to ensure that the data collected were useful and the findings of the research made an impact on practice.

Whilst the impact of any research findings can be enhanced by the relevance of the research question and the fitness of purpose of the methods used, there are competing factors that affect how that research changes practice. Significant factors for me were my role as subject leader of Biology and the status of more able and talented (MAT) education at school and national levels.

As subject leader, I can implement changes to schemes of work and define departmental targets to reflect the findings of my research, albeit with the approval of my line manager. It is at the departmental level that there is the greatest opportunity to change practice in the classroom, although any actual change in practice depends upon the degree to which teaching colleagues share my interpretations of the findings and the value of changing current practice. The school focus on raising attainment through increasing challenge in the classroom made it more likely that my research would have an impact across the curriculum, policies

and practice. The decision to implement school-wide changes rests with middle and senior leaders, and the governing body.

Throughout this section I have highlighted issues surrounding research which affect research participants and colleagues. To conclude this section, I have explored the sensitivities between me as researcher and the researched, and how these may affect the integrity of my research. Hertz (1997) highlighted the importance of the researcher locating their own personal and professional stance as essential to understanding how they impose their own interests and perspective upon the research. Starting with an appraisal of my own position, as both teacher and researcher, I have identified critical issues in my relationship with research participants that could affect my research.

Reinharz (1997) proposed a concept of the researcher as the “key fieldwork tool” and a “created self”; a persona that is a product of the social norms of the research setting, the interactions with research participants and the personal perspectives of the researcher (described by Reinharz as the “brought self”). Using the concept of the researcher as a composite of multiple ‘selves’ as my theoretical framework, I evaluated the ‘selves’ I will bring to the research project, using categories of “personal self”, “teacher self” and “researcher self”. I identified commonalities between the attributes in the categories, for example pursuit of knowledge. This overlap of my personal, teacher and researcher selves would strengthen the relevance and usefulness of my research. On the other hand, a less distinct separation of my ‘researcher’ self from the other selves could lead to bias and subjectivity.

The most significant issue to arise from my reflection on ‘self’ is the impact of the different relationships I have with the student participants, as their teacher and as the

researcher. Students' perceptions of the power and status I have as a teacher may persist to influence the relationship when it changes to researcher – participant. This could have resulted in students trying to give the answer they thought I was looking for or students guarding their responses, either because they felt compelled to participate or fear that their responses would be used to judge them. As my intention was to gather rich, in depth data about students' intuitive understandings, it was critical to rebalance the power and status within the relationship between me as researcher and the student participants. To put this into practice, I communicated and maintained transparency of purpose with the students, their parents and carers, and my colleagues at school. The responsibilities and expectations associated with the roles of researcher and participant were set out in documents given to the students and their parents and carers. Overall, the power to participate in or withdraw from the study lay with the student participants. Given that my research involved children, I was required to seek ethical approval for the design of the case study from the Anglia Ruskin University Faculty Research Ethics Panel (FREP). A full description and discussion of the ethical issues associated with the case study, including meeting criteria set out by the FREP, are given in section 3.5 of the Methodology and Methods chapter. Ethical approval from the FREP acted as quality assurance for my research approach.

1.4 Contribution to knowledge

Although I have discussed in later chapters how the outcomes of my research contribute new knowledge, it is useful to outline the key areas of contribution in the introduction. The three key areas to which my study findings contribute encompass theory, approaches to education research and professional practice. It is important to stress, however, that the specific contextual factors of the study mean that findings are not directly applicable outside the boundaries of the case. Consequently, the outcomes of my research have raised questions rather than reached definitive answers about the value of theory as a guide to classroom practice and presented practice-based evidence that contributes to the body of professional knowledge about provision for able students who underachieve.

The exploratory nature of the research question and the interpretive methodology adopted in my case study design are examples of an under-represented approach to studying ITI mind-set in the literature. Most of the published studies I have cited in later chapters have followed a positivist methodology, where the authors have gathered quantitative data and applied statistical tests to look for correlations. In only two papers have the researchers taken an interpretive approach to investigating students' ITI mind-sets (Quihuis et al., 2002; Mercer and Ryan, 2009). The participants in this case study, able students in a boys' academy grammar school, and the specific contextual factors of their learning environment combine to create a unique research setting. To date, there have been no similar studies conducted in the field of ITI mind-sets.

From a wider perspective, the outcomes of this case study contribute to an ongoing debate in education about the value of using theory as the basis of classroom

practice. With a particular focus on theories that have originated in the field of psychology, educationalists have criticised the application of theory in education as an attempt to over-simplify complex issues and find a panacea for all problems encountered in the classroom (Carr, 2006 and Thomas, 2007). More recently, O'Brien (2015) writing in the Times Educational Supplement (TES) magazine argued against the application of the model of ITI mind-sets in schools in the UK. The outcomes of this case study present the practice-based evidence that O'Brien (2015) called for to inform practitioners about the possible benefits and potential drawbacks of using the model of ITI mind-sets as the theoretical framework for understanding why some students are disengaged from their learning.

1.5 Structure of thesis

In this introductory chapter, I have contextualised my workplace, roles and professional development to set the scene of my doctoral research project. I have established the importance of research to my conceptualisation of what it means to be a professional practitioner and explained how the evolution of my research question was borne out of the desire to understand why some able students underachieve. Chapter one also introduces the methodology and methods I have employed to answer the research question, and outlines the areas of professional knowledge to which my research outcomes have contributed.

Chapter two describes and evaluates the theoretical frameworks that are the bases for my research approach. I have reviewed the literature relating to the model of ITI mind-sets and critically evaluated the empirical evidence presented in support of the model's theoretical premises and predictions. Given that my research question has arisen from a problem affecting some of the students I teach and that the purpose of my study is to better understand the mechanisms that lead to disengagement with learning, it was pertinent to include an analysis of how the model of ITI mind-sets is being applied by practitioners and policy makers in schools. In my argument I have selected examples from literature that are indicative of generic pedagogical issues, such as Master's (2013) treatise on assessment, and articles that relate to able students.

The methodological stance and methods I have used to answer the research question are described in chapter three. The research approach I have taken is compared and contrasted with those of other researchers in the field, and justified on the grounds of a conflict between the epistemological and ontological assumptions underpinning the

positivist paradigm adopted by most researchers in the field and the interpretive methodological approach I have chosen. Since my study involved research with children, chapter three includes an examination of the ethical issues associated with the methods of data gathering and handling of data, and of my roles as teacher and researcher.

In chapter four I have presented the findings of the case study. These are divided into sections: questionnaire results and analysis of lesson observations, students' interview responses about their engagement with the challenging problem-solving task, and students' responses to questions about their ITI mind-set in the context of their experiences solving the challenging problem. To reflect the personal nature of each student's interview responses and the exploratory aim of the research question, the findings have been reported as student narratives. The seven key findings that emerged from the data are collated at the end of chapter four.

The seven key findings are discussed in chapter five. The conclusions drawn from this discussion are presented as a proposed framework for understanding the intrinsic and extrinsic factors that affected the students' engagement with the challenging task. The potential impact of the case study findings, including the usefulness of the proposed framework, is evaluated from the perspectives of changing policy and classroom practice in my own workplace, contributing to wider educational debates, and the influence of research involving student voice to bring about educational improvements. Chapter five concludes with a reflection on the impact of the case study findings on my own professional development.

Chapter six is a critical evaluation of the design of the case study and my role as a teacher-researcher. The interpretive methodology and methods employed in the case

study are reviewed, using evidence from the data to justify my research approach and identify areas for improvement. The section that deals with my role as teacher-researcher evaluates to what extent this dual role affected the reliability and validity of the students' interview responses. The thesis concludes with a discussion of potential further research and development opportunities arising from the outcomes of my research.

Chapter 2: Review of Literature

2.1 Introduction

In a recent report entitled “The most able students: an update on progress since June 2013”, Ofsted identified areas where the needs of the most able students in non-selective secondary schools were not being met. The report highlighted three key areas of provision: raising boys’ attainment, supporting disadvantaged able students and challenging students to achieve the highest levels of scholarship. These findings were supported by NACE, Potential Plus UK and the Sutton Trust who has also found that in some cases most able students were not being encouraged to apply to the top ranked universities. The chairman of the Sutton Trust, Sir Peter Lampl, expressed his profound concern about the quality of support for able children in English schools. He called for a refocusing of efforts in the provision of education for able students to avoid the life limiting consequences of underachievement.

To provide an effective education for able students, practitioners and policy-makers need to understand why some able students underachieve. To date, policy and practice have focused upon extrinsic factors such as curriculum rather than intrinsic factors such as students’ values, motivations and beliefs. In this chapter I have critically reviewed the published theory and research evidence relating to implicit theories of intelligence (ITI), a theoretical model that addresses the impact of intrinsic factors on achievement. The overall purpose of this review of literature is to present a coherent framework of current understanding of the issues of underachieving able students, how the model of ITI mind-sets has influenced school

policy and practice, and establish the gaps that exist in our knowledge of how the model of ITI mind-sets informs teaching and learning in schools.

In section 2.2, I have described the term ‘underachievement’ in the context of able students, and evaluated the range of potential reasons for underachievement cited in literature. To conclude this section, I have explained how reading the literature has contributed to my personal framework of understanding of able underachievers and reflected on how this has influenced my research. Section 2.3 is an explanation of how the model of ITI has evolved from a social-cognitive perspective of motivation theory (Dai, Moon and Feldhusen, 1998; Pintrich and Schunk, 2002). This section includes a critical evaluation of the empirical evidence relating to ITI, with a particular focus on the significance of research findings to able underachievers. The impact of the model of ITI mind-sets on school policy and practice has been reviewed in section 2.4. The universality of the model of ITI mind-sets is discussed in terms of the current breadth of applications of the model in school settings. In the final section, 2.5, contradictory evidence from studies of students’ ITI mind-sets and learning behaviours, and gaps in the literature relating to able students are identified. In the concluding part of 2.5, I have explained how my research question addresses a lack of empirical evidence from classroom-based research and contributes new knowledge to understanding why some able students are disengaged and at risk of underachieving.

2.2 Able underachievers

2.2.1 What is underachievement?

Montgomery (2009) described underachievement as “the estimated potential of an individual not realised in their achievements”. This simple description encompasses Smith’s (2007) notion of underachievement as an outcome that is particular to the individual, affecting learners across the range of abilities. She goes further by delineating the ‘underachiever’ and the ‘low achiever’; in the context of able students, attaining B grades at GCSE level is not a low achievement, but, if their predicted grades were A*/A then they have underachieved.

By establishing what is meant by underachievement it should be easier to identify those students who are underachieving relative to their potential. However, the precise definition and method of measuring underachievement used by researchers differs according to purpose. Smith (2003) described comparisons of summative assessment data (for example, percentage A* to C GCSE grades) and psychological studies that looked for discrepancies between students’ performances in mental ability tests and examination grades. She argued that these definitions and measurements are too narrow and simplistic, distorting the distribution of underachievement across cohorts, and proposed a model that encompasses contextual and academic factors to identify those students who are underachieving. Overall, a complex picture of meanings and measurements emerges from literature. The following paragraphs illustrate difficulties that arise when trying to establish an accurate profile of underachievement among secondary school students.

In the context of my workplace, a boys’ academy grammar with an ethnically diverse student population and lower than the national average proportion of students entitled to free school meals, a brief discussion of the reported distribution of

underachievement in relation to gender, ethnicity and economic factors is relevant. Montgomery (2009) highlighted the uneven distribution of underachievement among different groups. Drawing upon assessment data over a number of years, Smith (2007) identified these groups as boys, black, some Asian and mixed heritage students, and students from poorer homes. More recently, researchers at the NCSR on behalf of the DCSF applied statistical analyses to quantitative data to identify students with declining attainment between Key Stages three and four (Callanan et al., 2009). They, too, identified boys and poorer students as groups with greater proportions of underachievers, but in contrast, found that those with a white British heritage were the predominantly underachieving ethnic group. A recent report published by the parliamentary Education Committee (2014) also identified poor, white British students as the group most at risk of educational underperformance, but, emphasized that underachievement was not specific to boys. Their analyses highlighted poor, white British girls as the lowest performing major ethnic group.

What is clear from a review of literature over the past ten years is that the pattern of underachievement amongst secondary school students in Britain is complex and changes over time. To increase the accuracy of identifying underachieving students, Smith (2007) advised looking at the data behind the statistics, for example scrutinizing examination data for individual subjects. Gorard, Rees and Salisbury (2001) demonstrated this in their findings from a large-scale, six year study of patterns of attainment across all Key Stages. At GCSE level, they found few significant differences between boys' and girls' attainment in Chemistry, Physics and Mathematics, although gaps in attainment at higher grades were seen for other subjects, including English and Biology. The researchers concluded that it is incorrect to perceive boys as low achievers, and argued for a refocusing of attention

on the issues of higher ability boys' underachievement at GCSE level. These findings support my own research focus of able male students in the context of their learning in Biology.

In the two studies described above, the researchers used students' GCSE outcomes to make comparisons. To be trustworthy, the identification of groups of students who have lower attainment depends upon comparison of reliable, precise and equitable systems of assessment. For example, whilst GCSE papers are scrutinized to ensure gender neutrality in questions, Smith (2007) reported incidents of gender bias in favour of girls. This may be significant for my own subject area, Biology, as both the curriculum and assessments at GCSE level require more language based skills than Chemistry and Physics, which may disadvantage boys. For this reason, the scope of my research will not extend to include students' achievements in other subjects, to avoid distorting outcomes with invalid comparisons.

2.2.2 What are the potential reasons for underachievement?

Following their identification of underachieving groups, Callanan and his colleagues (2009) extended their research to elucidate the reasons for underachievement. They gathered qualitative data from interviews with students, parents and school staff, which allowed the researchers to assess students' disengagement with their learning. In this way, the researchers were emphasizing the connection between attitudes (for example, motivation), behaviours (for example, effort to complete work) and achievement.

Although Callanan and his colleagues included internal factors such as attitude in their definition, their findings focused mainly upon factors that are external,

including curriculum, work load, coursework, school and classroom environments, peer and teacher relationships, family context and life events. As the questions put to participants were not published in the report, it is difficult to ascertain whether the findings represent a consideration of all possible factors. Since the report was commissioned by the DCSF, it may be that the focus on external factors affecting underachievement, particularly school-based ones, allow for interventions and subsequent measurement of their effects. The drawback with this approach is that it can lead to implementation of interventions aimed at modifying isolated factors when underachievement is widely recognised as being a consequence of many factors (Smith, 2007; Callanan, 2009; Montgomery, 2009).

In her model of the factors that contribute to able students' underachievement, Montgomery (2009) identified external factors: culture, assessment, creativity and challenge, and internal factors: motivation, personality and SEN. These were extrapolated from the characteristic features of able underachievers reported by a number of researchers, such as Whitmore (1980) and Wallace (2000). Some overlap exists between the reasons for underachievement identified by Callanan and colleagues, and the external factors for Montgomery's model. For example, the cultural factor encompasses students' peer relationships, particularly those amongst teenage boys. Smith (2007) also proposed that the influence of peer group is a possible explanation for boys' underachievement. Here, she described an 'anti-school' ethos amongst boys, which is a product of a collective masculine identity that rejects academic effort as a female trait. However, her assertion was questioned by Hymer (2009) who proposed that able male students may be less affected by anti-school attitudes and more driven to achieve academic success. Support for this idea came from Csikszentmihalyi, Rathunde and Whalen (1997) who reported strong

achievement motivation among more able male and female students compared to their peers of average ability.

In the context of able students, issues of social perception and adjustment of behaviours have been developed into the 'stigma of giftedness' paradigm (Coleman, 1985). Using this as a theoretical framework, Cross and Coleman (1993) analysed questionnaire responses from gifted students to questions about peer relationships and their behaviours in specific school situations. Key findings included a majority of respondents who perceived themselves as intellectually different from their peers and more than half reporting making adjustments to their verbal and behavioural interactions with peers. Being consistent with Coleman's stigma of giftedness paradigm, the authors reasoned that gifted students may apply coping behaviours to maintain normal social interactions.

The conclusions of Cross and Coleman (1993) partially support Tannenbaum's (1983) assertion that some gifted students opt for underachievement rather than be socially isolated from their peers. However, it cannot be assumed that students' coping behaviours would lead to underachievement since only high achieving gifted students participated in the study. Furthermore, conflicting evidence has come from a later study in which none of the academically gifted students surveyed reported lower social self-perceptions than those in a control group (Ablard, 1997), although questioning in this case did not focus exclusively on peer relationships. Overall, the potential that peer relationships, as an example of a cultural factor, impacts upon underachievement of able students remains to be established.

In his essay on understanding and overcoming underachievement among able male students, Hymer (2009) acknowledged the complex and unique interaction of factors

contributing to the underachievement of individual students. Similarly, Smith (2007) warned against accepting an oversimplified dichotomous view of boys' achievement in relation to that of girls. These perspectives align with my understanding of what underachievement is and the possible causes of underachievement. By using Montgomery's (2009) definition of underachievement, "the estimated potential of an individual not realised in their achievements", emphasis is placed on the student rather than groups of students. The notion of estimating the individual's potential is both pragmatic and realistic, reflecting my own approach to assessment of student progress. In practice, this means using a range of assessments, rather than using a single test, alongside consideration of the contextual factors impacting on each student's academic and personal worlds. Also, by referring to achievements rather than attainment, Montgomery is broadening the scope of measuring success, in particular beyond the GCSE and A Level examination results cited in government reports and by the media.

The strengths of Montgomery's (2009) model of underachievement are twofold. Firstly, she describes the internal and external factors as 'contributory', thus avoiding the suggestion of a direct causal relationship between underachievement and any one of the factors. Secondly, the model is constructed to place emphasis upon the interactions of the factors that result in underachievement. Of significance to my research, the model describes a three way interaction between challenge, motivation and personality. In the following section 2.3 I have focused on these interactions to locate the development of the model of implicit theories of intelligence (ITI) as a framework for understanding why able students underachieve.

The theoretical basis that underpins challenge as good classroom practice is Vygotsky's (1978) concept of the zone of proximal development. In this theory of

learning, students must make an effort to develop knowledge and understanding that is beyond their current levels of independent learning. In the context of teaching able students, Herzog, Klein and Katz (1999) described the zone of proximal development as “a level that extends beyond their [students’] comfort zone”. The notion of making an effort to achieve increasingly higher levels of attainment is fundamental to there being a positive correlation between challenge and motivation. Montgomery (2009) named challenge as a motivating factor, Wallace (2000) describe the joy experienced by able students when they are challenged, and Reis (2009) has predicted the consequences of an unchallenging learning environment as inducing boredom and disaffection in students. At the same time, however, these authors acknowledged that some students respond in a negative way to challenge. Montgomery (2009) described the cycle of decline in motivation when learners do not achieve target grades and perceive themselves as failures. This assertion is supported by the findings of a number of researchers who have reported that underachieving able students often hold a low academic self-concept (Butler-Por, 1993; Clark, 1988; Dowdall and Colangelo, 1982; McCoach and Siegle, 2003; Reis and McCoach, 2000; Whitmore, 1980). Alongside a low academic self-concept, Delisle (1992; 2008) and Delisle and Galbraith (2002) characterised what they termed the ‘conventional’ able underachiever as “insecure about his ability to do well, cautious about pursuing new topics [and] self-deprecating...” They also defined another character type of able underachiever they called the ‘selective consumer’ where the student has a high academic self-concept and enjoys learning, but, exhibits selective participation in school work based on his interests. These proposed motivational reasons underlying the conventional and selective consumer types share similarities with the beliefs associated with the growth and fixed ITI

mind-sets. Specifically, the conventional underachiever's belief that they are not as smart as others is concordant with the fixed mind-set theorist's concept of intelligence being unchangeable and the determinant of success. In the case of the selective consumer type their learning goal orientation is a key motivational factor associated with the growth mind-set. However, the model of ITI mind-sets predicts that growth theorists are engaged learners who are more likely to achieve their potential, which is at odds with the underachievement outcome of the selective consumer. The overall picture of able students and the motivational factors that impact on their learning and achievement is complex and does not align fully with the precepts of the model of ITI mind-sets.

The third interacting factor, personality, was defined by Montgomery (2009) as an individual's characteristic traits. She raised the issues of introverted able students who are unable to cope with failure and extrovert able students who blame others when they fail. The behaviours of these two personality types are included in the model of ITI mind-sets as characterising students who avoid challenge because they view their intelligence as a fixed entity. Licht and Dweck (1987) found in their study of sex differences in achievement orientations that boys were more likely than girls to attribute their failures to a lack of effort on their part. In the model of ITI mind-sets, this response to failure is associated with those who are growth mind-set theorists. At the same time, Licht and Dweck (1987) also reported that boys were more likely to attribute their success to ability, which is defined as a fixed mind-set belief. It would be wrong to try to combine these two patterns of attribution to elucidate a common characteristic of able male students, since the foci (able introverted and extroverted versus male and female) were different. What is suggested from the conclusions of Montgomery (2009) and Licht and Dweck (1987)

is that the pattern of attributions made by students to explain their successes and failures is an outcome influenced by a number of factors particular to the individual. Indeed, it may be more helpful to consider attribution more as a behavioural outcome than an isolable personality trait.

My review of the literature relating to the three domains of challenge, motivation and personality, in the context of able students, has revealed complex interactions within and between each domain. In addition, there are overlaps between these domains in Montgomery's (2009) model of the internal and external factors contributing to underachievement and the premises and predictions of the model of ITI mind-sets. Locating my research within the overlap of the three domains has provided a theoretical framework of understanding of why some able students do not achieve their potential, which has informed my research design and approach to the analyses of data.

2.3 Implicit theories of intelligence (ITI): a model for understanding underachievement

2.3.1 Development of the model of ITI mind-sets

Students' responses to challenging learning tasks can be defined in two ways: the helpless response and the mastery (or learning) response. These patterns of behaviour have been observed in school students (Diener and Dweck, 1978; 1980).

When given challenging problems to solve, some students' abilities to apply effective problem-solving skills and their focus on the task were reduced. In addition, these students expressed negative feelings such as anxiety and self-doubt. Other students expressed positive feelings about challenge and demonstrated perseverance, flexible approaches to problem-solving and focused on success rather than a possibility of failure.

To explain the helpless and mastery responses, an achievement goals based theory was proposed by Elliott and Dweck (1988). The theory hypothesises that the mastery response is driven by a learning goal; a drive to increase knowledge, understanding and skills. In contrast, helpless responders have a performance goal, which manifests itself as seeking the top grades and avoiding negative judgements. In both cases, the student has a desire to achieve, although the reasons for pursuing success differ. For this reason, the theory is one of achievement goal-orientation (Pintrich and Schunk, 2002). Other researchers have defined similar goal-orientations, which have common features such as valuing the learning process (mastery) and avoiding failure (performance) (Ames, 1992; Maehr and Midgely, 1991; Nicholls, 1984).

Later, Dweck and her colleagues developed their model of implicit theories of intelligence as a means to draw together personal and social-contextual factors, self-processes and achievement behaviours to explain underachievement (Dweck and

Leggett, 1988; Dweck, 2000; 2006; 2009; Hong, Chiu and Dweck, 1995). The model proposes two opposing implicit theories of intelligence: the fixed (entity) theory where intelligence is conceptualised as unchanging, and the growth (incremental) theory where there is potential to increase intelligence. The model predicts that the entity theorist will be performance goal oriented, and together, these beliefs lead to negative attitudes towards effort and challenge. Consequently, the entity theorist is at risk of underachieving. Conversely, the incremental theorist holds mastery goals, is challenge seeking and associates effort with success. The model of ITI mind-sets is summarised as a diagram in Figure 2.3.1.

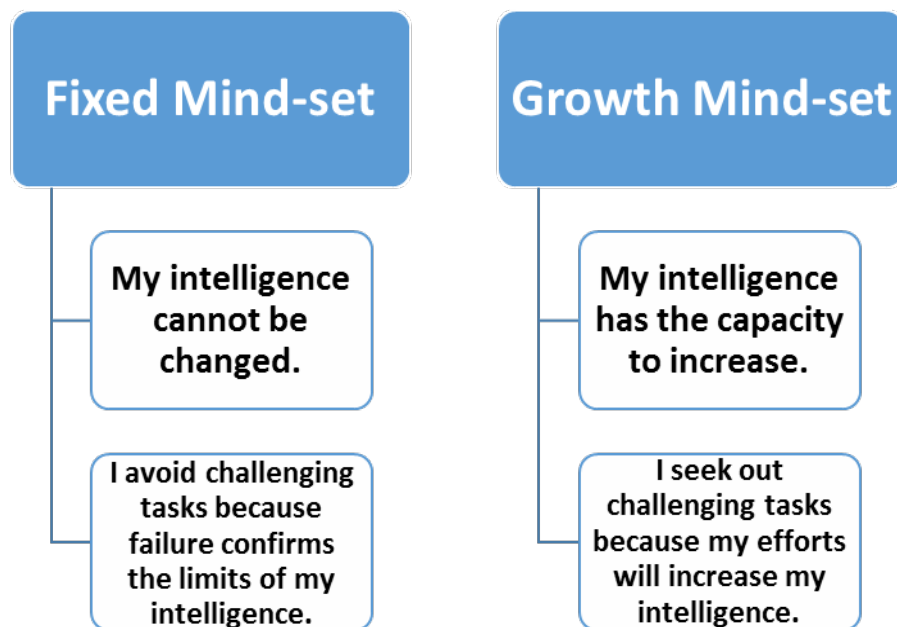


Figure 2.3.1 Summary of the beliefs and responses to challenge associated with the fixed and growth mind-sets predicted by the ITI model.

2.3.2 Empirical evidence supporting the model of ITI mind-sets

Research has focused upon different aspects of the inter-relationships between the components of the model of ITI. Also, the proposed causal relationship between these components has been challenged by researchers. In the following sub-sections, the research findings relating to these inter-relationships are compared and evaluated in terms of significance to able learners.

2.3.2.1 How do implicit theories of intelligence relate to goal orientation?

Studies of the relationship between students' implicit theories of intelligence and their goal orientation have employed questionnaires to reveal correlations. Whilst Roedel and Schraw (1995) found that students in their study whose responses characterised an entity theory of intelligence tend to hold performance goals, they did not find a similar correlation between incremental theory of intelligence and learning goals. Conversely, other studies did not find this positive correlation between students' entity theory of intelligence and performance goals, but rather, that those whose beliefs encompass an entity theory of intelligence are not learning goal oriented (Dupeyrat and Escribe, 2000; Dupeyrat and Mariné, 2001). Where Spinath and Stiensmeier-Pelster (2001) did find correlation between students' incremental theory of intelligence and learning goals, the statistical significance was weak. Taken together, these studies present a conflicting pattern of the inter-relationships between implicit theories of intelligence and goal orientation.

There are a number of potential reasons for the different outcomes of the studies mentioned above. Firstly, differences between the cohorts of each study may have a significant impact upon students' ITI mind-set, goal orientations or the relationship between the two. For example, the age of participants was found to be a significant

mediating factor in a study comparing the implicit theories of elementary and high school students (Ablard and Mills, 1996). In this case, the older high school students were more inclined to believe that an individual's intelligence is fixed. Change to individuals' implicit theories of intelligence over time was also an outcome of the work carried out by Gonida and colleagues (2006), although they found that students moved toward more incremental beliefs over time. The opposing outcomes of these two longitudinal studies may be due to the former being American and the latter Greek. Thus, cultural and societal characteristics, and differences between educational systems, such as curriculum and assessment structures, may influence the development of students' ITI mind-set. Furthermore, and of significance to my own area of interest, Ablard and Mills (1996) focused upon academically able students whereas student participants in the Greek study represented a range of academic prior attainment.

A more recent study carried out by Ablard (2002), which also focused upon able school students in the USA, used questionnaire scales to measure the strength of respondents' beliefs about their own intelligence and their goal orientation. A wide range of achievement goals were reported by participants, with a positive correlation between strength of learning goals and beliefs that intelligence increases with effort. Of particular note, is the difference between the percentages of respondents classified as performance goal oriented in this study (4.4%) and respondents reporting a fixed intelligence belief in the previous study (9%) (Ablard and Mills, 1996). This suggests that the proportion of potential underachieving students, as predicted using the model of ITI, is not a constant for all able student populations. Given the range of definitions of giftedness (Gardner, 1983; Clark, 1983; Borkowski, 1985; Tannenbaum, 1986; Sternberg, 1986; Renzulli, 1986) and methods

of identifying able students (Montgomery, 2009), the criteria for selection of participants differs between studies. This could contribute to the different proportions of potential underachievers. It follows that data about students' perceptions and beliefs need to be reported and interpreted in the context of both the ages of the participants and the criteria used to identify able students.

Taken together, the uncertainty surrounding the relationship between ITI mind-set and achievement goal orientation, and the potential for ITI to be modified over time, questions the proposed causal relationship at the centre of Dweck's model. Studies have relied upon questionnaires and statistical tests to elucidate significant correlations. Whilst these studies have the advantage of reliability through large numbers of participants, causal relationships cannot be established from quantitative data. Apart from a limited number of examples of using structured interview (Carr, Borkowski and Maxwell, 1991; Bempechat and London, 1991), an interpretive paradigm has rarely been adopted by researchers to investigate the potential causal relationships between ITI, goal orientation, learning behaviours and achievement. Two studies that have followed an interpretive research design are reviewed later in this chapter, in section 2.6, because they form a poorly represented area of study in the field of ITI mind-set and learning behaviours.

2.3.2.2 How does an individual's implicit theory of intelligence and goal orientation relate to their achievement?

Researchers have used goal orientation descriptors to look for relationships with a range of students' learning behaviours and judgements in an achievement setting. In this sub-section, key studies are described and their findings evaluated with reference to the model of ITI and their relevance to able underachievers.

In 1988, Elliott and Dweck took an experimental approach to testing their predictions; that learning goals promote a challenge-seeking response from students, and performance goals promote a helpless response. They assessed students' responses to given tasks, focusing upon task choice, effectiveness of problem solving strategies and the spontaneous verbalisations of students during the tasks. By matching students' commentaries with their observed actions and behaviours, the researchers concluded that those who were categorised as having learning goals demonstrated the predicted mastery (learning) oriented response to the challenge of the given tasks. Conversely, those expressing a performance goal belief were more likely to rate their ability as low, demonstrate deterioration in their selection of appropriate problem solving strategies and seek to attribute their failure to an external factor outside their control.

The outcomes of Elliott and Dweck's (1988) study appear to support an association between an individual's goal orientation and their learning behaviours. However, by taking an experimental approach, which required the task and its physical setting to be controlled, the conclusions drawn may not be a true representation of students' responses and behaviours in the classroom. Furthermore, the researchers manipulated the students' goal orientations and perceived abilities in relation to the task by using scripted statements. Whilst this approach allowed the researchers to test their theory by controlling the variables of goal orientation and perception of difficulty, a consequence may be that students' responses became disconnected from the real-life cognitive and contextual factors that impact upon their perceptions and behaviours. An experimental approach to researching relationships between students' beliefs and learning behaviours has been criticised in literature (Bråten and Strømsø, 2004).

Following the work done by Elliott and Dweck (1988), researchers looked for associations between students' goal orientations and their learning behaviours in different educational contexts and within different groups of students, including cohorts of able students. Clark and Tollefson (1991) used questionnaire to gather data about able students' attitudes, motivation and confidence in their creative writing abilities and their goal orientations. In contrast to other studies, Clark and Tollefson (1991) used teacher assessments to categorise each student as either mastery (learning) or performance goal oriented. Although this method generated some qualitative data, it was used primarily for allocating students to different goal orientations, which excluded elucidation of potential causal relationships between the variables. The study showed that students categorised as mastery oriented were more likely to feel confident in their writing abilities and reported higher levels of motivation. Each of these findings supports an inter-relationship between learning goals and the pursuit of challenging learning objectives. Specifically, higher levels of confidence and motivation can be interpreted as examples of cognitive states that are associated with challenge seeking behaviours. However, it is the finding that the mastery oriented group were more confident in their abilities to improve their creative writing skills that offer the most significant supporting evidence for a link between ITI and goal orientation.

Although Clark and Tollefson's (1991) research findings appear to make a link between the three constituents of the model of ITI, they cannot be considered as evidence of a causal relationship. The conclusions drawn are tentative due to the contextual specificities of the study, such as the focus upon creative writing skills. For this reason, subsequent studies that found associations between the mastery goal orientation and positive learning behaviours among able student cohorts are

important additional sources of supporting evidence. One such study analysed students' goal orientations and their application of self-regulated learning strategies, as a means of developing a framework to predict those at risk of underachieving (Ablard and Lipschultz, 1998). In this study, able students reported making use of a wide range of self-regulated learning strategies, but, the greatest use of these strategies was made by students who reported mastery goal orientation. Interpreting their findings in the context of the model of ITI, the authors concluded that students who have mastery goals are less likely to underachieve, and so, goal orientation can be used as a predictor for underachievement. Their focus on students' self-regulated learning strategies, including engagement with academic tasks for personal interest and being an active participant in their own learning, is applicable across the curriculum (Zimmerman, 1989). For this reason, it may be more acceptable to generalise the outcomes and use them to test the model of ITI. However, to accept the validity of using goal orientation as a predictor of achievement, significant correlation between performance goal orientation and restricted application of self-regulated learning strategies would need to be demonstrated. In addition, performance goal oriented students would need to be shown to underachieve compared to their mastery goal oriented peers in standardised academic assessments.

In an earlier study carried out by Carr, Borkowski and Maxwell (1991) elementary students' awareness of their reading skills, as a metacognitive attribute, and the strength of their belief that they could improve their reading abilities through effort were assessed. Students' beliefs were compared to their reading attainment to elucidate any associations between them. Although goal orientations were not assessed in this study, the outcomes contribute to the body of evidence supporting the proposed relationships between ITI, goal orientation and academic achievement.

In the study it was found that a low level of self-awareness of reading skills is correlated with students' underachievement, which could be interpreted as evidence supporting the conclusions of Ablard and Lipschultz (1998). However, this assumes that self-awareness of reading skills can be included in Ablard and Lipschultz's definition of self-regulated learning strategies, and that the association between mastery goal orientation and application of self-regulated learning strategies would also be true for the student cohort tested by Carr and his colleagues (1991). Further uncertainty arises when the contextual differences between the two studies are considered; in particular, the differences in ages and range of academic abilities represented by the cohorts.

Research using school students across the ability range have shown that mastery goal orientation is associated with greater efforts and persistence in academic tasks (Miller et al., 1993; 1996). Whilst these studies lend support to the mediatory effects of goal orientations as predicted by the model, they fall short of demonstrating a direct relationship between goal orientation, effort and achievement. This issue was addressed by Harackiewicz and colleagues (1997), albeit using college students as their research subjects. In line with the notion of inter-relationships between goal orientation, effort and achievement, the researchers found that students who adopted work avoidance goals had low levels of achievement. However, they also found that performance goal oriented students, in comparison with mastery goal oriented students, gained higher final grades on their courses. The latter outcome seems to oppose the predicted relationship between goal orientation and achievement, whilst the former outcome is in support. The picture becomes even less clear when the findings of a more recent study, focusing upon adult learners who have returned to college, showed that students who held mastery goals were more likely to expend

effort and achieve higher grades whereas performance oriented students avoided effort and underachieved (Dupeyrat and Mariné, 2005). As before, contextual factors must be taken into account when trying to draw meaning from contrasting pieces of evidence. In this case, the achievement goals of college students and returning adult learners may not be comparable, given the different reasons they may have for pursuing their education and the pressures to achieve. Taking a wider perspective, societal and cultural attitudes to the purpose of education may also affect students' beliefs and goals.

In a more recently published study, Wang and Ng (2012) provided an insight into the relationship between students' ITI and perseverance, within a performance goal culture. Using questionnaires to test Chinese students' beliefs, and using teacher assessments to rate perseverance when doing school work, the researchers found that the stronger an individual student's belief that intelligence cannot be changed, the more helpless their response to school work. The researchers acknowledged, however, that students participating in the pilot stage of the study questioned the significance of ITI given that school performance rather than intelligence is the dominant focus for them. For this reason, the researchers proposed a model of implicit theories of school performance to be tested in parallel with the model of ITI. In their model, students believe that school performance can be changed or they believe that it cannot be changed. Independent of students' beliefs about intelligence, the study showed that the stronger the individual's belief that school performance cannot be changed, the more helpless their response to schoolwork. Interestingly, the study revealed that more Chinese students thought that intelligence could not be changed than thought school performance could not be changed. The greater proportion of fixed intelligence theorists is at odds with the model, particularly given

the reported high levels of academic achievement among Chinese students (Smith, 2007). It is possible that contrasting cultural attitudes and values towards education affect the relative impact of students' beliefs about intelligence, knowledge and the nature of learning.

2.3.2.3 How do students' epistemological beliefs relate to their goal orientation and achievement?

The model of ITI predicts that learning behaviours and attitudes to learning are a consequence of the student's ITI and goal orientation. It is possible, however, that an alternative causal relationship exists; students' beliefs about learning determine goal orientation and ITI. For this reason, research literature focusing on students' epistemological beliefs was included in this review. The conclusions of two studies that contribute to the body of knowledge about ITI are discussed here.

In their study of Norwegian student teachers, Bråten and Strømsø (2004) claimed that epistemological beliefs had a greater impact upon goal orientation than ITI. They based their conclusion upon strong statistically significant correlations in their data; for example, students who valued quick learning were more likely to report performance goals. In a later study, Schommer-Aikins, Duell and Hutter (2005) found a correlation between belief in quick learning and attainment of lower than average grades among school students in the USA. Taken together, the conclusions drawn by the authors of these studies suggest an alternative model in which epistemological beliefs, mediated by goal orientation, predict academic achievement. This assumes, however, that students' epistemological beliefs and ITI mind-set are independent conceptualisations. This assumption can be challenged on the grounds that a belief in quick learning is related to the entity theorist's belief that making an

effort to learn signifies a lack of intelligence. In addition, since the two studies were conducted in different countries, one involving adults and the other school students, the cohorts cannot be assumed to be comparable. Of particular note was the limited use of summative assessment and guaranteed job at the end of the course for the Norwegian students. The authors of the study described this as a non-performance goal setting and acknowledged that their findings may be specific to this context. For this reason, further research involving students in different academic contexts is needed to elucidate the influence of epistemological beliefs on achievement.

2.3.2.4 Qualitative studies

A positivist methodological approach to investigating students' ITI mind-sets has predominated in the studies that have produced supportive evidence for the premises and predictions of the model of ITI. In many cases, scaled questionnaires were used to assign growth or fixed mind-set to individual students and also measure their beliefs, values and learning behaviours. The correlations that emerged from statistical analyses of these data have reinforced the mutually exclusive categories of the model.

One of the aims of Karwowski's (2014) study of creative mind-sets was to explore the potential that growth and fixed mind-sets could be held simultaneously. Using Likert-type scaled questionnaires, Karwowski surveyed four hundred and ninety two Polish participants aged between sixteen and sixty years of age to test for correlates between their different mind-sets and creative self-concept, self-efficacy and personal identity variables. He also looked for relationships between mind-sets and problem solving. The weak negative correlation between fixed and growth mind-set variables led Karwowski to conclude that the model descriptors represented

opposing ends of a single continuum of beliefs about intelligence, effort and challenge. Similarly, the correlation between growth mind-set and problem solving was found to be weak. The findings of his study prompted Karwowski to recommend further work be conducted that addresses participants' motivational orientations and problem solving strategies. Furthermore, to clarify if fixed and growth mind-sets are exclusive categories or the extreme ends of a continuum of beliefs and behaviours, Karwowski advocated the use of interviews to explore the nature of creative mind-sets.

The conclusions drawn from the study conducted by Karwowski (2014) are significant to my research because motivation as a contributory factor to successful problem solving aligns with the model proposed by Montgomery (2009) that I have adopted as my theoretical framework. Secondly, Karwowski was describing an interpretive methodological approach to reveal more detailed data that are not restricted by the boundaries of the items in a questionnaire. This reasoning agrees with my rationale for selecting the interpretive paradigm in my research strategy (see chapter one, section four). My research approach also shares commonalities with two studies that followed an interpretive methodology and employed semi-structured interviews with students to delve more deeply into students' beliefs about their intelligence (Quihuis et al., 2002; Mercer and Ryan, 2010). These two studies stand out from the body of research relating to ITI mind-sets not only because they contribute to an under-represented methodological approach in the field, but, were also small-scale projects involving a limited number of students. The significance of the outcomes of both studies to the design of my own research is discussed in the following paragraphs.

Quihuis and her colleagues (2002) set out to investigate students' ITI mind-sets across academic domains, specifically relating to English, Mathematics and Science. The authors also highlighted the ethnicity (first generation Mexican American) and low family income characteristics of the students participating in their study as unique in the field of ITI mind-set research. Fifty seven high school students aged between fifteen and eighteen years of age completed a Likert-type questionnaire to assess their ITI mind-set in each of four domains: general intelligence, English, Mathematics and Science. After assigning each student as entity (fixed) or incremental (growth) mind-set theorists in each of the domains, thirteen students were selected for interview. During the interviews the students were given their previously completed questionnaires and asked to explain their responses to the items.

The most significant of Quihuis and her colleagues' (2002) findings was a mismatch between students' questionnaire assigned ITI mind-sets and the beliefs they expressed later during interview. They proposed that entity (fixed) theorists, in situations where a good performance was important to future opportunities, could exhibit the behaviours associated with the incremental (growth) mind-set. To explain why their finding was at odds with the predicted behaviours of students who hold the fixed mind-set, Quihuis and her co-workers identified the different methodological stance underpinning their research compared to previous studies located within the positivist paradigm. Consequently, the interpretive approach taken by Quihuis and her colleagues was inclusive of the contextual factors that were a part of the student participants' school settings and, they surmised, these would have affected how the students expressed their beliefs. The acknowledgement of the importance of contextual factors that play a part in the development of students' personal

frameworks of understanding (in this case about their intelligence) is pertinent to my research approach. From my perspective as a classroom practitioner, I want to know how students' ITI mind-sets relate to their responses to challenge in an authentic learning situation. However, Quihuis and her colleagues did not include an evaluation of the learning behaviours of the participants in lessons. They acknowledged that this was a limitation of their work.

In a more recent study, Mercer and Ryan (2010) also adopted an interpretive approach to studying students' ITI mind-sets. Their focus was students' beliefs about the role of natural talent in learning English as a foreign language (EFL). In this case, the authors' conceptualisation of natural talent was equivalent to the fixed mind-set associated belief that success is dependent upon innate ability. In the context of Mercer and Ryan's (2010) study, innate ability was described as being a 'naturally gifted language learner'.

Mercer and Ryan (2010) stated an exploratory aim for their study. Specifically, to explore the concept of ITI mind-sets held by EFL students studying at universities in Austria and Japan. To fulfil their exploratory objective, the researchers chose semi-structured interview as their method of data collection. In common with the study carried out by Quihuis et al. (2002), Mercer and Ryan (2010) conducted their research with a small student cohort. In contrast with other studies in the field, they did not use a scaled questionnaire to assign students as fixed or growth mind-set theorists, but instead applied a grounded theory approach to construct a framework of themes and associations interpreted from students' interview responses. This approach to investigating students' conceptualisations of intelligence was unique in the field, where the predominant approach had been to identify correlations that aligned with the relationships within the fixed and growth mind-set characterisations.

Mercer and Ryan (2010) found that, in most cases, the students expressed beliefs about effort and talent in the context of EFL learning during their interviews that were associated with both fixed and growth mind-sets. This finding was in agreement with the conclusions drawn by Quihuis and her colleagues (2002), even though the student cohorts participating in these studies differed in age, nationality and phase of education. Taking into consideration other differences, such as subject specific areas of learning, it could be argued that the blending of fixed and growth mind-set beliefs is a fundamental part of cognitive processing, separate from and unaffected by the contextual factors specific to the individual's learning environment. From this perspective, the outcomes of the two studies lend support to Karwowski's (2014) proposed alternative continuum structure of the model of ITI. However, for three reasons the outcomes of the two studies are not conclusive evidence for a restructuring of the model of ITI mind-sets as proposed by Dweck and her colleagues (2000).

Given the small number of students who participated in the research conducted by Quihuis et al. (2002) and Mercer and Ryan (2010), the findings may not be representative of all learners or even the wider populations of students who share similar educational, social and cultural contexts. Consequently, it would be invalid to generalise the outcomes. This limitation of case study is well documented (Cohen, Manion and Morrison, 2000; Punch, 2009) and is relevant to my own research strategy. For this reason, I have taken into account the limited applicability of the outcomes outside the boundaries of my case study in the conclusions and evaluation sections of this thesis.

Although the use of semi-structured interview yielded more detailed explanations than could be gained through using questionnaire, the questions posed by Quihuis

and her colleagues (2002) and Mercer and Ryan (2010) employed different terminology. Of particular note was the use of ‘intelligence’ in the earlier study and ‘talent versus effort’ in the latter study. These terms are closely related in the model of ITI mind-sets, but, refer to distinct components. According to the model of ITI mind-sets, conceptualisation of intelligence as either unchangeable or malleable is the determinant of the value afforded to effort. Consequently, the outcomes of the two studies are not directly comparable because they are addressing different components of the model. Despite this, each study could be viewed separately as supportive of fixed and growth mind-sets being extreme ends of a continuum of beliefs and behaviours. This may, however, reduce the combined strength of two studies that have investigated the same phenomenon reaching the same conclusions.

Up to this point, I have interpreted the outcomes of the research carried out by Quihuis et al. (2002) and Mercer and Ryan (2010) from the perspective of the degree to which they support Karwowski’s (2014) continuum model of ITI mind-sets.

However, this relies on the assumption that the model represents a true causal relationship between the learner’s beliefs about intelligence, the value of effort and their subsequent response in the face of difficulty. I have argued that the correlations reported in literature linking students’ assigned ITI mind-set, achievement goal orientation and epistemological beliefs are not evidence of a causal relationship between the variables. Consequently, the combined fixed and growth mind-set related responses reported by Quihuis et al. (2002) and Mercer and Ryan (2010) could be viewed as evidence that argues against the theoretical premises underpinning the model of ITI.

The conclusions drawn by Quihuis and her colleagues (2002) and by Mercer and Ryan (2010) have raised questions about the structure and theoretical basis of the

model of ITI mind-sets. Since these studies and my own research have adopted an interpretive methodology and employed semi-structured interview as a method of gathering data, collectively they form an under-represented approach to researching ITI mind-sets. At the same time, my research extends the work carried out by Quihuis et al. (2002) and Mercer and Ryan (2010) because I have included assessment of the student participants' responses to a challenging problem solving task in their normal classroom setting. This additional stage was recommended by Quihuis and her co-authors (2002) as the means to confirm whether fixed mind-set theorists are capable of employing learning behaviours associated with the growth mind-set character.

As well as contributing new knowledge to the field using a novel research approach, my case study design involved academically able male student participants in an academy grammar secondary school. The able characteristic of the research cohort and the performance goal oriented ethos of the selective school fulfilled a gap in literature identified by Ablard (2002). Furthermore, UK-based studies about students' ITI mind-set are lacking in the literature. Evidence for the need to locate research in the UK came from another outcome of Mercer and Ryan's (2010) study. Specifically, the authors reported that the interview responses of the Japanese university students were more homogeneous than those expressed by the students attending university in Austria. The authors suggested that the variation between the groups was due to cultural differences, particularly those pertaining to the relative values placed on effort and talent. It may also be the case that particular values and beliefs are promoted, directly or indirectly, by different educational systems through curricula, methods of assessment and teaching practices. Consequently, my case

study is also bounded by the characteristics of the systems and structures at school and national levels, and by cultural and societal factors.

2.4 How has the model of ITI mind-sets impacted on school policy and practice?

2.4.1 Education theory and practice.

Quihuis and her colleagues (2002) found that the students in their study could hold different ITI mind-set associated beliefs in the context of different academic domains. Although the model of ITI mind-sets does not explicitly exclude the possibility that the same individual can hold a fixed mind-set in one subject and a growth mind-set in another, the notion that mind-set is an innate and constant feature of a student's response to challenge in every learning situation is a misconception among educators that could affect how the model is applied to school policy and practice. The risk of this occurring was highlighted in a recent critique of the model of ITI mind-sets in which the author raised concerns about schools using questionnaires to assign students are either fixed or growth mind-set theorists (O'Brien, 2015). O'Brien argued that this was another form of labelling students and for those identified as fixed mind-set theorists this would trigger targeted intervention that may further marginalise individuals who may already be demotivated and disengaged from school work. In her reply to O'Brien's criticism, Dweck (Wiggins, 2015) explained that the model was intended to be used as a means of understanding the factors driving avoidance of challenge and facilitate development of support strategies.

O'Brien's (2015) critique of using the model of ITI mind-sets to guide school policy and practice exemplified the wider debate about the validity of applying theory in real classrooms. In his treatise on education and theory, Thomas (2007) made a distinction between the application of theory in science and its application in education. Scientific theory deals with phenomena that can be treated as isolable

variables. Consequently, scientific theory can be tested by changing and controlling different variables during an experiment and measuring the outcomes. It is not possible to test education theory in the same way because the internal processes of learning cannot be reduced, isolated and manipulated like scientific variables. Similarly, given the complexity of external contextual factors affecting the learner, it is contestable to what degree these factors can also be studied in isolation. Pring (2002) summarised the argument when he asserted that it was wrong to construct theory before practice because theory and practice are not related in that way.

Thomas (2007) warned against the assumption that basing practice on theory will lead to improvements and cited examples where theory based practices declined when unanticipated damaging outcomes were reported. Despite the concerns raised by O'Brien (2015) describing potentially damaging consequences of applying the model of ITI mind-sets in schools, there is an extensive body of literature describing a wide variety of applications of the model to educational policy and teaching practices. This may be a result of what O'Brien (2015) referred to as the temptation to oversimplify complex issues, which echoed Dewey's (1920) concern that "the impulse to generalise or abstract restrains our capacity to examine the individual..." Nevertheless, a simplified, universal theory that explains students' behaviours in any given learning situation would be compelling to policy makers and practitioners.

In the following sub-sections, I have selected examples of how the model of ITI mind-sets is being applied to developing school policy and practice. This is intended to illustrate the wide range of applications rather than construct a comprehensive account. Presenting an overview of how the model of ITI mind-sets has impacted on teaching and learning is relevant because my research question arose from issues related to my classroom practice. Furthermore, by including the practical

applications of the focus of my research I have acknowledged the professional doctorate requirement to demonstrate the impact of my research on practice.

2.4.2 The application of the model of ITI mind-sets to classroom practice and intervention strategies.

With a focus on raising achievement in Mathematics and Science, Dweck (2008) set out her recommendations for ways in which educators can create a growth mind-set culture in the classroom. Her first recommendation was to teach students about the plasticity of the human brain. This involves making a direct link between the theoretical premises of the growth mind-set model, that intelligence can be increased, and development of new neural pathways in the brain during cognitive activity. This approach to establishing an understanding of the principles and predicted outcomes of the growth mind-set model in students' minds has been developed by Dweck and her colleagues into a programme of online interactive student workshops called Brainology©, which is marketed by a company called Mindsetworks®. The establishment of sites on social media platforms dedicated to discussion of the Brainology© programme is an indicator of its wide-reaching popularity.

From a biological perspective, a direct relationship between increasing intelligence and the formation of new neural pathways in the brain can be challenged on the grounds that changes in the structure of the brain are stimulated by a number of factors, such as aging, stress, diet and hormone levels (Kolb and Whishaw, 1998). Furthermore, the effect of learning on brain plasticity has been shown to be specific to the type of task and does not transfer to similar tasks (Green and Bavelier, 2008).

It could be countered that the idea of brain plasticity is used in this context simply as a vehicle to promote the growth mind-set model. Indeed, simplifying a complex process to facilitate students' understanding is a teaching strategy common across consecutive Science based curricula.

Using a neurobiological argument in support of the posited relationship between conceptualisation of intelligence and the value of effort can also be evaluated from the perspective of imparting trustworthiness to education theory. Thomas (2007) described the “kudos of the natural sciences being borrowed by educators” that fulfilled a desire to adopt more scientific methods in teaching (Thomas and Pring, 2004). Presenting a scientific basis may afford reliability to the model of ITI mind-sets and its practical applications in the classroom.

In his article comparing education and scientific theories, Thomas (2007) warned against accepting ideas promoted by education theory and moving straight to application without testing them in practice. The impact of the Brainology© online interactive programme on mind-set, resiliency and a sense of mastery was evaluated by Donohoe, Topping and Hannah (2012). Student participants, aged thirteen to fourteen years of age, were allocated to either an intervention group who completed the programme or a comparison group who did not enter the programme. Using data from scaled questionnaires and student focus groups, the researchers reported an increase in pre- to post- programme mind-set scores for the intervention group, with no significant changes to mind-set for those in the comparison group. However, follow-up data showed that the growth mind-set beliefs of the intervention group had declined, leading the researchers to conclude that the impact of the intervention programme had not been sustained. No significant changes were found in either group relating to students' resilience or sense of mastery. Taken together, the

outcomes of this study question the effectiveness of the intervention programme to establish beliefs and values associated with growth mind-set. However, the conclusions drawn by Donohoe and her colleagues (2012) are tentative and limited in their applicability to other situations due to the small sample size and case study design. Furthermore, the outcomes are at odds with the findings of two earlier studies (Blackwell, Trzesniewski and Dweck, 2007; Good, Aronson and Inzlicht, 2003). Both studies used an experimental approach with test and control groups of students to investigate the effect of participation in workshops that promoted the growth mind-set. Using pre- and post- workshop data from questionnaires, performance in Mathematics tests and teacher assessments of students' motivation in lessons, the authors of the studies concluded that participation in the workshop programme had raised levels of student motivation and improved test scores in Mathematics. Overall, the evidence upon which to evaluate the effectiveness of growth mind-set programmes to raise levels of effort, motivation and achievement is limited. Further research is needed to clarify the usefulness of applying the model of ITI mind-sets in real classroom situations.

Despite a lack of evidence demonstrating real and sustained improvements in achievement as a result of interventions promoting growth mind-set, I have found many examples of primary and secondary schools in the UK where classroom practice is based upon the theoretical premises and predictions of the model of ITI mind-sets. Similar approaches to creating a culture of growth mind-set in the classroom have been adopted by teachers in schools in the UK and USA, and are summarised in table 2.4.2.

Growth mind-set objectives	Examples of Practice
Belief that intelligence can be increased through effort emphasises the relationship between effort and success.	<ul style="list-style-type: none"> • Teaching students about brain plasticity (Ricci, 2013).
Praising effort rather than attainment encourages resilience and perseverance in the face of difficulty.	<ul style="list-style-type: none"> • Increasing the use of written and verbal feedback to students and greater use of formative assessment (Masters, 2013).
Failure stimulates greater effort and diversity of strategy use in the growth mind-set theorist; failure prompts avoidance of challenging tasks in the fixed mind-set theorist.	<ul style="list-style-type: none"> • Create a ‘wonder wall’ for students to display and share their mistakes; schedule reflection time during lessons for students to revise and improve their work (Smith and Henriksen, 2016). • Display acrostic poster: First Attempt In Learning (FAIL) in all classrooms (Hymer and Gershon, 2014). • Reshaping students’ self-evaluative comments, e.g. ‘I got it wrong’ becomes ‘What have I missed?’ (Stewart, 2015)
Growth mind-set beliefs enable all students to make excellent progress, regardless of their abilities and dispositions.	<ul style="list-style-type: none"> • Setting personalised challenging targets based on prior attainment and encouraging students take an active role in setting their own growth-oriented goals (Masters, 2013; Stewart, 2015).

Table 2.4.2: Summary of strategies used to promote a culture of growth mind-set in classrooms.

The widespread adoption of teaching practices aimed at developing in students the attributes associated with the growth mind-set model reflects the apparent universality of its application to all students in all schools. Nevertheless, O’Brien

(2015) counselled against using the model as a solution to all teaching and learning problems. As discussed in section 2.4.1, another risk of applying education theory to practice is the potential for misconceptions to arise about its purpose and place alongside existing practice. Briceño (2015), addressed five misconceptions about growth mind-set, which would impact on the way the model is applied in practice. Three of the five misconceptions discussed by Briceño (2015) are related to the practices described in table 2.4.2:

- “Praising students for their hard work will lead them to develop a growth mind-set”. Briceño (2015) reiterated the growth mind-set assertion that praising students for their efforts, rather than their ability, would encourage them to associate effort with achievement. However, this strategy on its own would not cultivate the growth mind-set in learners.
- “All that matters is what’s in the mind”. Here, Briceño (2015) made a distinction between the approach taken by the researchers who contributed to the development of the model of ITI mind-sets and how the model should be perceived by researchers and educators working to implement the model in practice. Specifically, early work on the model focused on mental processes whereas later studies have acknowledged the importance of contextual factors in the learning environment.
- “Improvement is all about changing beliefs and not doing anything else”. Briceño (2015) argued that an all-encompassing approach was required to successfully foster a growth mind-set culture in the classroom. In practice, this means changing curricula, pedagogy and assessment to embody growth mind-set beliefs, values and behaviours.

Taken together, Briceño's (2015) article communicates an important message about translating the growth mind-set model into classroom practice: embedding growth mind-set requires revision of all aspects of teaching practice. In their review of social-psychological interventions in education, Yeager and Walton (2011) viewed mind-set interventions as complementary to, rather than replacements of, established good practice. They highlighted the context-dependent nature of psychological interventions, which was later reiterated by Dockterman and Blackwell (2014) and Briceño (2015). Overall, a more refined picture is emerging of the limitations and mediating factors that affect growth mind-set interventions.

2.4.3 The application of the model of ITI mind-sets to national policy.

The model of ITI mind-sets seeks to explain why students respond differently to challenging learning tasks and has potential as the basis for intervention strategies for underachieving students. From a national policy perspective, application of the model has relevance to the Academies and Free Schools (DFE, 2015), and the Educational Excellence Everywhere (DFE, 2016) government papers. It is, therefore, important to consider how national policy influences the context of my case study.

The 2010 to 2015 government policy: academies and free schools document (DFE, 2015) defined the greater level of autonomy afforded to academies compared to schools under local authority control. Decision-making powers such as how to deliver the curriculum and budget allocation were intended to enable school leaders and governing bodies to address the particular learning needs of their students thereby closing attainment gaps. Up to the beginning of September 2015, it was reported in a House of Commons research briefing paper that forty one percent of

state-funded secondary schools had converted to academy status, with an eighty five percent conversion rate for grammar schools (Bolton, 2015). These statistics indicate that significant numbers of secondary schools are in the position to choose their own intervention strategies to raise the attainment of underachieving students. Given the extensive body of research and practice-based literature that support and promote the application of growth mind-set principles in the classroom, there is potential for school leaders to identify the model of ITI mind-sets as the vehicle for closing attainment gaps between students in their schools.

The likelihood that intervention strategies based upon the model of ITI mind-sets are applied by a school is greater when considered in the light of the Education Excellence Everywhere policy paper (2016). In particular, aims of ‘Building character and resilience in every child’ (p94) and ‘Stretching both the lowest-attaining and most able’ (p98) have direct links to the model of ITI mind-sets and examples of practice defined in literature (see Table 2.4.2). Furthermore, the use of language in this policy document mirrors that of the model; an example is given where a school aims to build students’ character and resilience through ‘Mastery lessons so that students are fluent writers, avid readers, and thoughtful problem solvers’. The research question at the centre of my case study brings together these policy intentions, namely resilience in the face of difficulty and challenging more able students.

Whilst the Educational Excellence Everywhere (2016) policy paper supports the increased autonomy of academy status schools, ‘...there are many different methods [to build character and resilience] and the government has no intention of mandating a particular approach’ (p95), there is also reference to supporting an evidence-informed teaching profession. Sections 2.54 and 2.55 of the policy place the onus on

teachers and school leaders to decide which strategies to apply in the classroom, and promotes access to high quality evidence as the basis for decision-making. The difficulties faced by teachers in accessing and applying research to their teaching practice are acknowledged (section 2.59). These issues are also pertinent to the design of my research because setting the study within the classroom and adopting an interpretive methodology was intended to bridge the gap between theory, evidence and practice. Of interest is the use of language in this area of the policy document where the use of evidence and evidence-based practice are emphasised. There is a subtle contrast with the language used in a quote from the government commissioned report, 'Building Evidence into Education', where the author specifies '...collecting better evidence' (Goldacre, 2013). It could be interpreted that Goldacre is extending his concept of evidence-based practice to include the role of teacher-researchers. From this perspective, my dual role of teacher and researcher complies with the Educational Excellence Everywhere (2016) policy and goes further to address the problematic nature of applying theory in practice.

2.4.4 The application of the model of ITI mind-sets to school policy.

Whilst there is an extensive body of literature relating to the application of a growth mind-set approach to classroom practice, the range of scholarly articles focusing on the development of school policy is more limited. It may be the case that schools in the UK are choosing to evaluate small-scale growth mind-set interventions before implementing school-wide changes that are formalised in policy documents. In my workplace, one of aims of the current School Improvement Plan (SIP) is to promote resilience through application of the growth mind-set model to teaching and learning. The impact of my case study findings on this policy and on classroom practice is

discussed in section 5.3.2. Here, I have selected two examples from the literature that illustrate different purposes and approaches to developing policy based on the growth mind-set model. In both cases, the authors have addressed issues surrounding the education of able students.

In the first article, Hill, Corbett and St.Rose (2010) presented recommendations for policy changes aimed at increasing the number of female students studying Science, Technology, Engineering and Mathematics (STEM) courses in schools and colleges in the USA. They advocated creating a growth mind-set environment to raise girls' low self-assessment of Mathematics ability and reduce the effect of negative stereotypes about women and Mathematics. The evidence that supported adoption of the growth mind-set model in this context came from a longitudinal study carried out by Good, Dweck and Aronson (2007). Female university students enrolled on a Mathematics course were questioned to ascertain their mind-set stance, the mind-set they perceived others in their class held and their sense of belonging in the Mathematics group. They were also asked about their intention to study Mathematics in the future. Good, Dweck and Aronson (2007) reported that female students who held a growth mind-set were less affected by negative stereotyping of women in Mathematics, had a sense of belonging in the group, intended to continue their study of Mathematics and maintained higher grades throughout the course. For those female students identified as fixed mind-set theorists, the researchers reported the opposite effects.

The work of Good, Dweck and Aronson (2007) was particularly significant to the aims of Hill and her colleagues (2010) because of their shared focus: able female students. As a consequence, growth mind-set principles were applied in the recommendations from the perspective of the needs of able female students. Whilst

some of the recommended actions related to the fundamental components of growth mind-set, such as “praise children for effort” and “teach children that intellectual skills can be acquired”, others called for revision of existing strategies to align with the growth mind-set model. For example, the authors advocated that “Gifted and Talented (G&T) programmes should send the message that they value growth and learning”. It could be inferred from this statement that the authors considered that current provision for more able female students did not emphasise ‘growth and learning’ and was more concerned with attainment. As an initial step toward refocusing G&T provision along growth mind-set principles, the authors proposed changing how language that relates to able students and their education is used. In her reflective conversation about self-theories and giftedness, Dweck (2000) highlighted the potential for an able student who believes that their intelligence cannot be changed and whose self-esteem is closely linked to their identity as gifted and talented to avoid challenge because they fear failure. For this reason, Dweck (2000) argued against labelling students as gifted and talented.

Focusing on the language used to describe able students and the particular provision for their learning was also a theme of policies developed for a consortium of three high schools in New Orleans, USA (Sparks, 2013). In contrast with the issues faced by the able female students in the earlier article, poverty was the principle difficulty for the able students attending the New Orleans high schools. Student attainment and levels of expectation were low. To re-engage able students in their learning, school policy makers banned the word ‘smart’ from the school campuses and changed their entry criteria for advanced placement (G&T) classes. Instead of using prior attainment levels to identify able students, any student could sit an entry test that involved writing an essay to answer a question that was above the ability level of

even the most able students. Consequently, the teachers were assessing the students' responses to the challenge rather than focusing on the students' grades. Sparks (2013) explained the rationale behind this approach as a means to ensuring that their advanced placement students didn't believe that they had gained their place only on the strength of their abilities. On the one hand, this policy regarding provision for able students does embody a growth mind-set principle. This is, however, at the disadvantage of students who are assessed as holding a fixed mind-set and are, therefore, excluded from accessing the more challenging classes. The potential negative outcomes of this policy appear to give credence to O'Brien's (2015) fears that labelling students as fixed mind-set theorists could result in further marginalisation of some disaffected students.

2.4.5 The application of the model of ITI mind-sets to assessment.

Masters (2013) described three approaches to assessment and feedback, and evaluated each one in terms of their effect on learning outcomes. The rationales behind the different assessment strategies were compared and contrasted from the perspective of the degree to which the relationship between effort and success is promoted through each approach. Masters (2013) described the aim of first assessment approach as creating a "successful experience" for students by setting tasks within their capabilities. Consequently, it is more likely that the student is successful in the task, which creates a positive cycle of increasing self-confidence and engagement through praise. Masters (2013) pointed out the lack of challenge limiting students' learning and use of praise that would not encourage students to connect effort and achievement. Similarly, he concluded that fixed mind-set beliefs

were inherent in the second assessment approach where each student's performance is measured against standard levels of attainment. According to these interpretations, neither assessment strategy would provide appropriate stretch and challenge for able students.

To address the limitations and flaws he had described in the previous assessment approaches, Masters (2013) proposed an alternative strategy that focused on progress made by students rather than their level of attainment. Based on the principles of growth mind-set, the third approach required that each student's current attainment is established and personalised targets are set that are challenging. Assessment methods then focused on the progress each student made over time toward his or her targets. Dweck (2010a) proposed that providing challenge for students of all abilities and praising their efforts would raise the achievement of disengaged and marginalised groups of students. From the perspective of assessing able students, Masters' (2013) approach is concordant with Matthews and Folsom's (2009) "mastery model" for meeting the learning needs of gifted students. Specifically, by redirecting praise for ability to praise for effort the link between effort and achievement is reinforced. This notion was encapsulated in the title Dweck's essay, 'Even Geniuses Work Hard' (2010a).

In practice, the success of this approach to assessment relies upon regular, accurate and detailed appraisals of each student's learning. In a recent government report (DfE, 2015), the results of a nationwide survey of teachers' views on how to reduce unnecessary workload found sixty three percent of the forty four thousand respondents stated that the extensive level of detail required made some tasks burdensome. Another factor noted by respondents was lack of time to complete the volume of work, particularly in relation to marking students' work. Specific tasks

reported as being burdensome included recording, inputting, monitoring and analysing data (fifty six percent of respondents) and the excessive depth, detail and frequency of marking (fifty three percent of respondents). Twenty one percent of teachers surveyed also reported the setting and continual reviewing of pupil targets as creating additional unnecessary work. The issues raised by the results of the workload survey highlight a potential problem of implementing Masters (2013) growth mind-set assessment approach in UK schools.

As well as contributing to the already problematic issue of workload, teachers in the UK may criticise the components of Masters' (2013) growth mind-set assessment approach as having already been established in current practice. The rationale behind many of its components have been described by Black and Wiliam (1998) and promoted by the Qualifications and Curriculum Authority (QCA) through the Assessment for Learning (AfL) national strategy that was implemented in 1999. Indeed, the principles of Masters' (2013) growth mind-set assessment approach have been incorporated into the Teachers' Standards (DfE, 2011). The statutory responsibilities of teachers includes setting targets that challenge all students, regardless of their abilities and dispositions, using formative assessment to secure students' progress, using data to monitor progress and set targets, and give students regular verbal and written feedback. Teachers in the UK, therefore, may view a growth mind-set assessment approach as a repackaged strategy that fails to address the problems of how to implement its ideals consistently and effectively in the classroom.

2.5 Conclusions

The majority of research studies in the field have adopted a positivist methodology that revealed correlations, but not causal relationships, between students' beliefs about intelligence, achievement goals and learning behaviours. Where an experimental design has been used to investigate the impact of ITI mind-set on learning, the applicability of findings to the real life setting of the classroom is reduced because it does not take into account the potential impact of contextual factors.

For studies focusing upon able students, the range of criteria applied by researchers to select suitable participants makes it difficult to compare the outcomes of different studies or use these as a basis for intervention or policy change. Wider cultural, societal and political factors may also impact upon students' beliefs and goals. In England and Wales school performance tables are widely published, Ofsted have used numbers of students achieving five A* to C GCSE grades to evaluate schools and the successive Education Secretaries have called for more academic rigour in the National Curriculum and examination system. Combining these factors with targets set at A*/A grades for able students, selective schools are examples of performance goal oriented institutions. Studies focusing upon able students are limited in number and studies of able students within a performance goal oriented academic context are lacking. The body of evidence from studies that have adopted an interpretive methodological approach to studying the impact of students' ITI mind-sets on their learning is an under-represented area in the field.

Chapter 3: Methodology and Methods

3.1 Introduction

This chapter describes the design of my study and explains how the methodology and methods employed were appropriate to answering the research question. The chapter begins with a discussion of the evolution of my research question within the context of my workplace and professional development. Outcomes of published studies that have helped to refine the research question are cited in the discussion and form the body of current knowledge within which my research question is located.

Section 3.3 establishes the interpretive research paradigm and methodological stance I have adopted in my research. Here theories of learning, motivation and implicit theories of intelligence are discussed as contributors to the conceptual framework shaping my research approach. The methodologies adopted by others in the field are critically evaluated with respect to the reliability and applicability of their research findings.

Following on from the discussion and justification of locating my research within the interpretive methodology, section 3.4 describes the methods I have employed to gather and analyse data. The choice and application of research tools at each stage of the study are discussed compared to those employed by others who have also investigated the applicability of the model of ITI mind-sets in educational settings. Potential difficulties and bias associated with the chosen methods are explored from the perspective of maintaining the reliability and validity of my research findings.

Section 3.5 is a discussion of the ethical issues surrounding research involving children and identification of the requisite safe-guarding measures in the design of

the study, including arrangements for the maintenance of confidentiality and secure storage of data. This section of the chapter includes a reflection on my responsibilities as teacher and researcher to ensure the students are not harmed or disadvantaged by their participation in the study.

3.2 The Research Question

How do able students' ITI mind-set impact on their engagement with a challenging problem-solving task in the classroom?

My research question has evolved from both professional experience and my reading of educational literature about the problem of underachievement of able students.

Specifically, I am interested in understanding why some able students in secondary school are not engaged with learning even though the curriculum and learning activities have been designed to raise the level of challenge. With challenge widely recognised as a motivating factor for able students and promoted as a strategy to raise educational standards, it is clear that current teaching approaches are at odds with the learning needs of some able students (Montgomery, 2009; Reis, 2009; Wallace, 2000).

Callanan and colleagues (2009) interviewed secondary school students, parents and staff to elucidate the factors contributing to disengagement and underachievement as part of a study commissioned by the DCSF. They reported a number of extrinsic factors, including curriculum, teaching methods and relationships with teachers, as contributory and proposed changes based upon these factors. However, Callanan and his co-workers did not give equal weighting to potential intrinsic factors, that is students' values and beliefs that affect their learning, in their conclusions.

Nevertheless, they and others have acknowledged that underachievement is multifactorial and a consequence of the interactions between both intrinsic and extrinsic factors (Smith, 2007).

Montgomery (2009) has proposed a model that describes the interaction of intrinsic factors (motivation, personality and SEN) and extrinsic factors (culture, assessment, creativity and challenge). The model has overlapping domains, like a Venn diagram, and has significance to my interest in the contributions made by students' beliefs to their engagement with learning because it describes a three-way interaction between challenge, motivation and personality. It is within this overlap that I have located the model of Implicit Theories of Intelligence (ITI mind-sets) as a framework for understanding why able students underachieve.

The model of ITI mind-sets has been proposed by Dweck to unite the psychological and behavioural characteristics she and her co-workers have observed in school students who are given challenging learning tasks. Initially, Diener and Dweck (1978; 1980) described two distinct patterns of behaviour in the school students they observed: the helpless response and the mastery response. To explain these responses, Elliott and Dweck (1988) developed an achievement goals based theory. Their theory predicts that the helpless responder who has difficulty applying effective problem-solving skills and remaining focused upon challenging tasks has a performance goal orientation that leads to seeking top grades and avoiding negative judgements. The mastery response, which is characterised by perseverance and application of flexible approaches to solving challenging problems, is driven by a learning goal-orientation that manifests itself as a desire to increase knowledge, understanding and skills.

The model of ITI mind-sets was developed by Dweck and her colleagues to explain the beliefs that underpin students' achievement goal orientations (Dweck and Leggett, 1988; Hong, Chiu and Dweck, 1995 and Dweck, 2000, 2006 and 2009). The model focuses upon students' beliefs and understanding about their own intelligence.

It proposes two constructs: the entity (or fixed) theory where the student conceptualises their intelligence as finite and unchanging, and the incremental (or growth) theory where the student believes that their intelligence has the potential to increase through effort. The model predicts that students who hold the entity theory will avoid challenging tasks because they fear failure, whereas those who hold the incremental theory will seek challenging tasks and associate effort with success.

In my workplace context, challenging learning objectives and activities are an integral part of the curriculum and culture of the school. The students are selected on the basis of academic ability and, as such, are predicted to achieve A* and A grades at GCSE level. However, there are a proportion of the students who do not engage with challenging tasks and, on the evidence of summative assessment data, are underachieving. My research question asks: how do students' implicit theories of intelligence impact upon their engagement with challenging learning activities? The question seeks to extend current knowledge relating to students' ITI mind-sets, which is largely limited to correlational rather than causal relationships.

Researchers have found correlations between students' ITI mind-sets, their achievement goal orientations and learning behaviours (Elliott and Dweck, 1988; Clark and Tollefson, 1991; Miller et al., 1993; Roedel and Schraw, 1995; Ablard and Mills, 1996; Miller et al., 1996; Dupeyrat and Escribe, 2000; Dupeyrat and Mariné, 2001; Spinath and Stiensmeier-Pelster, 2001; Ablard, 2002; Gonida, Kiosseoglou and Leonardi, 2006; Wang and Ng, 2012). Furthermore, researchers have attempted to use ITI mind-sets assigned to individual students to predict their levels of achievement (Zimmerman, 1989; Ablard and Lipschultz, 1998). In each of the above cited studies, researchers have measured students' ITI mind-sets using Likert-type scaled questionnaires. The purposes of these questionnaires are to categorise

students' conceptualisations of intelligence into entity (fixed) or incremental (growth) types and to produce data that can be statistically analysed to test the strength of each correlation. The approaches follow the tenets of the scientific method and, as such, are encompassed by the positivist research paradigm.

In the following section I have argued that the studies cited above cannot reveal causal relationships between students' ITI mind-sets and behaviours such as engagement with challenging learning activities. This is because of a dissonance between the ontological and epistemological premises of the positivist paradigm and the demands of my research question.

3.3 Methodology

Of the studies that have been carried out to date, that of Elliott and Dweck (1988) most closely relates to the aims of my own research question. They investigated the relationship between students' achievement goal orientations and their levels of challenge seeking behaviours by taking an experimental approach, which required the task and physical setting to be controlled. The researchers used scripted statements to manipulate students' achievement goal orientations and perceived abilities. Whilst this approach allowed the researchers to control variables, the validity and reliability of the outcomes have been compromised because the students were responding outside their usual cognitive and contextual parameters. Bråten and Strømsø (2004) have criticised the experimental approach to researching relationships between students' beliefs and their learning behaviours.

The viewpoint that controlling variables would reduce the validity and reliability of findings is counter to the central tenets of the positivist research paradigm. However, the critical differences are the ontological and epistemological assumptions made about the phenomena being studied. In the context of my research question, if students' ITI mind-sets are considered as externally imposed beliefs that can be acquired, then an experimental approach would be appropriate. Without influence from a student's individual consciousness or personal experiences, ITI mind-set could be studied and measured as an isolable variable.

The reasons why I do not consider students' ITI mind-sets and their responses to challenging learning tasks as a direct outcome of extrinsic factors are based upon theory and empirical evidence. Firstly, the model of ITI mind-sets evolved from a social-constructivist perspective of achievement goal orientation theory. Specifically, the social-constructivist stance emphasises the interactions between multiple

contextual factors in shaping and driving an individual's goal orientation (Pintrich and Schunk, 2002). It follows that an individual's goal orientation and, by extension, their ITI mind-set, are personal constructs that cannot be disconnected from cognitive and contextual factors. Therefore, the ontological assumption must be that students' ITI mind-sets are products of individual consciousness, which gives rise to the epistemological assumption that students' personal experiences shape their ITI mind-set.

Taken together, these ontological and epistemological assumptions align with an interpretive methodological stance. Writers have described this as a research approach in which the beliefs and values of humans are considered as individual and complex, requiring the application of qualitative instruments of measurement and analysis (Burrell and Morgan, 1979; Cohen, Manion and Morrison, 2001; Punch, 2009).

Identification of the interpretivist paradigm as appropriate to answering my research question is also supported by theories of learning. Specifically, Kolb (1984) proposed that the construction of knowledge involves stages of experience, abstract conceptualisation, reflection and transformation. At each stage, the factors that characterise the learner's specific context impact upon how the learner thinks and how they feel about, in this case, their own intelligence. According to Kolb's learning cycle, students' ITI mind-sets are complex personal constructs, not acquired knowledge from external sources. With respect to the challenge aspect of my research question, Vygotsky's theory of learning (Daniels, 2001) also adds weight to following an interpretivist methodology. Here, the theory proposes that learning occurs when the learner is compelled to deconstruct their prior knowledge and reconstruct new or deeper knowledge through solving increasingly more difficult

problems. As before, this model emphasises the centrality of the learner's thought processes and experiences in the construction of knowledge, and the personal, unique nature of knowledge.

Further to a theoretical basis for adopting an interpretivist paradigm to answer my research question, empirical evidence from studies relating to students' ITI mind-sets contributes to my chosen methodological stance. Across the studies where students' ITI mind-sets have been assessed using the scaled questionnaires devised by Dweck and her co-workers, different proportions of fixed and growth mind-set theorists have been reported. In addition, conflicting patterns of correlational relationships have been shown. According to Burrell and Morgan's (1979) framework of social reality, the variability of these outcomes suggest that students are acting as initiators of their own actions, known as voluntarism, as opposed to responding in a pre-determined manner to their environment. Where students' relationships with their environment are assigned as voluntarism, the authors identify the interpretivist methodology as the research stance to investigate the nature of the relationship.

Given my argument in support of an interpretivist research paradigm, significant parts of my data collection and methods of analysis are qualitative. These methods are described and their application to answering the research question justified in the following section. However, my research question also demanded the use of a quantitative research tool to make initial measurements for assigning students' ITI mind-sets. This provided the base-line data to make comparisons with levels of engagement with the challenging task and, most importantly, form the framework for the interview questions aimed at elucidating rich, in depth data about the impact students' ITI mind-sets have on their learning behaviours.

From the perspective of the types of data gathering tools employed in my study, the methodological approach could be described as mixed methods (Burke Johnson, Onwuegbuzie and Turner, 2007; Bryman, 2008; Punch, 2009; Hammersley, 2012). Furthermore, the main advantage of using a mixed methods approach is that the demands of the research question take precedence over remaining within a particular research paradigm (Punch, 2009). Cohen, Manion and Morrison (2000) described this as “fitness for purpose”. Given the exploratory characteristic of my study, removing the restrictions that limit choice of methods within one paradigm or another could be considered as allowing the research question to dictate the design of the study. Whilst the pragmatic principle of placing the demands of the research question above other considerations when choosing methods is necessary for the collection of valid data, it does not automatically follow that every research question can be answered using both quantitative and qualitative data gathering tools.

Although I have used both quantitative and qualitative methods within my research design, the methodological stance I have adopted is wholly interpretive rather than a mixed methods approach. My argument in support of this conclusion focuses on how the data gathered at each stage of the study has been used. The quantitative data gathered using the scaled questionnaire preceded the collection of qualitative data during lesson observations and student interviews. The questionnaire data were processed to give each student a mean score that determined whether their ITI mind-set was categorised as fixed, growth or intermediate. If the purpose of my study had been to reveal correlations between the students’ ITI mind-sets and their responses to a challenging task then the questionnaire data would have directly contributed to answering the research question. Since my study had an exploratory aim, the qualitative data gathered from observations and interviews were used to directly

answer the research question. As the mean scores and questionnaire items only informed the interview stage of the study and did not directly contribute to answering the research question, I have concluded that my research approach was defined within the interpretivist methodology. This aligns with Punch's (2009) definition of mixed methods research as an approach that combines qualitative and quantitative data to answer a research question.

3.4 Research Design

3.4.1 Case Study

Creswell (1994) and Thomas (2011) have linked research questions that seek to “explore a process” to a qualitative research approach; specifically, a case study research design. This relates to my research question because my aim was to investigate students’ cognitive processes, values and beliefs associated with the model of ITI mind-sets in relation to their engagement with a challenging task. In other respects it was appropriate to apply a case study design to my research. Since case study is defined by boundaries of location, participants, time-scale and phenomena being researched, the focus of my research on one class of students in a single school and their responses to a specific challenging task over two Biology lessons fits the description.

An advantage of using a single case study was the collection of rich, in-depth data, which could be analysed using holistic methods from different perspectives to ensure validity and reliability of the research outcomes (Hamilton, 2011). Also, the findings from my case study are directly applicable and useful to me as a practitioner in my school. For example, the outcomes will contribute to curriculum provision and development of teaching practices that support able students to be resilient and persevere in the face of difficulty. From a wider perspective the case represents a gap in the literature, in terms of the able characteristic of the student cohort within a performance goal orientated culture (Schommer-Aikins, Duell and Hutter, 2005). Furthermore, only two other studies of students’ ITI mind-sets have adopted the interpretivist methodological stance (Quihuis et al., 2002; Mercer and Ryan, 2009) so my research will contribute new evidence to an under-represented body of knowledge.

The research carried out by Quihuis and her colleagues (2002) and by Mercer and Ryan (2009) were also small-scale case studies. Whilst combining the outcomes of these case studies with my own research can build a body of new knowledge about the impact of students' ITI mind-sets on their learning, singly or together these studies are restricted in their applicability to other contexts (Bassey, 1999; Lincoln and Guba, 2000). Using a case study design could, therefore, be criticised because of its lack of generalisability and this may affect the wider impact of my research findings, such as usefulness to practitioners in other schools and contributions to educational debates about applying psychology-based theories in educational settings. Although it can be viewed as a drawback of the case study design, the specific contextual factors associated with my research are integral to the exploratory aim of the research question. Consequently, the onus for making a decision about the extent to which my case study findings can be applied to the learning situations of students in other schools rests with the reader.

Within a case study framework, the sample selection and application of data collection and analysis instruments are influenced by issues concerning trustworthiness of the data. To ensure trustworthiness, the methods of sample selection, data collection and analysis must be systematic and fully described. Here, Year Eleven students, aged between fifteen and sixteen years, in one Biology class were selected to be the research cohort (twenty-one students in total). There were three reasons for selecting this group of students. Firstly, each student had a target grade of A* or A for their GCSE Biology examination, so they represented an able cohort of students. It could be argued that being students in a selective academy grammar school meant that they were already identified as academically able, but, given the subject specific setting of the case I judged that the student participants

should also be expected to achieve high grades in Biology. The second reason for choosing this class was that I had taught them since the beginning of their GCSE Biology course, at the start of Year Ten. Consequently, I had built working relationships with the students that meant I had assessed their knowledge and skills such that I was able to make a professional judgement about the type of task that would stretch and challenge their abilities. The third reason for focusing on these students was also related to being their class teacher. From a practical perspective, accessibility and communication with the students were easier because we had timetabled lessons four times a fortnight. This also facilitated observing the students working during lessons.

The case was also bounded by the time frame for the data gathering stages. Since the interview questions were based upon both the students' questionnaire responses and their experiences of working on the challenging problem-solving task, the period of time between each of these stages had to be minimised to aid recall. The schedule of data gathering stages in the case study are shown in Figure 3.4.2, at the end of the methods of data collection section. The specific challenging task given to the students to complete during the observed lessons and the contextual factors associated with the classroom location were also particular characteristics of the case. Taken together, the boundaries of the case study presented a unique and authentic learning situation within which to explore how the students' ITI mind-sets impacted upon their responses to a challenging task.

3.4.2 Methods of Data Collection

3.4.2.1 Assigning students' ITI mind-sets using the scaled questionnaire, Implicit Theories of Intelligence Scale for Children – Self Form (for children aged 10 and older)

The form of the questionnaire that was used to assign students' ITI mind-sets contained three statements (items), each of which depicted entity (fixed) mind-set associated beliefs about intelligence (see Appendix IV). The students indicated the strength of their agreement or disagreement with each statement on a Likert-type scale (from one – strongly agrees, to six – strongly disagrees). In their validation study of the scaled questionnaire, Dweck, Chiu and Hong (1995) found that respondents universally agreed with incremental items, an outcome they suggested was due to a compelling or socially desirable characteristic of the items. Although Levy, Stroessner and Dweck (1998) further developed the scale to include incremental items, I have used the three item entity theory scale to reduce the possibility that the students selected responses they thought might be 'correct' or that would elicit a favourable judgement of their attitudes, values and beliefs. This was a particular concern in this case study because of my dual role as teacher and researcher. It was possible that the power associated with my role as teacher would put pressure on the students to give what they perceived to be acceptable answers. This would have reduced the reliability of the questionnaire data.

Another consideration of using the entity theory item scaled questionnaire was the assumption that disagreeing with the statements indicates holding incremental (growth) mind-set associated beliefs about intelligence. Levy, Stroessner and Dweck (1998) claimed that the assumption is valid after finding strong negative correlations between entity and incremental items. Also, the authors recommended using the

three item entity theory scale for longitudinal studies. This gave me the option of retesting the students after the initial stages of the case study, as an extension of my research.

In all studies carried out to date using the Implicit Theories of Intelligence Scale for Children, the questionnaire has been administered individually, with respondents completing it in private. To comply with this method of administration, I presented the questionnaire on the school's VLE so that the students were able to complete it online. This had two advantages: students were not able to access each other's responses, maintaining individuality and confidentiality, and automatic processing of data to calculate mean scores for each student. Students who had a mean score of three or less (indicating overall agreement with the entity items) were assigned as fixed mind-set theorists, whereas those with a mean score of four or greater were identified as growth mind-set theorists. Those who had mean scores between three and four were not included in the selection of students for the interview stage of the study because they did not hold a clearly defined ITI mind-set.

3.4.2.2 Lesson Observations

During the second stage of data gathering, the students were observed as they worked to solve a challenging problem. The observations took place over two consecutive Biology lessons in the normal timetabled classroom. The purpose of the observations was to gather evidence that would be used to classify each student's response to the challenging task as positive or helpless. Diener and Dweck (1978; 1980) defined a positive response as one where the student is not hindered by failed attempts, but, is motivated to use different strategies to solve the problem.

Conversely, the helpless responder is restricted in their application of problem solving skills, is put off pursuing the task when a strategy is unsuccessful and may

use avoidance behaviours. To ensure that my assessments of the students' responses were reliable, each lesson was video recorded by me using a small, hand-held video camera that recorded both sound and visual data. The video recordings were reviewed after the lessons to identify evidence of the behavioural responses of each of the students. The use of video in this case reduced the chance of researcher bias because my role as teacher meant that I had prior knowledge of each student's learning behaviours and this could have influenced my judgement of their responder type in the context of the case study.

During the first lesson, the students were randomly allocated to small groups to carry out the practical stage of the problem-solving task. The intended learning outcomes were for the students to be able to carry out two different investigation methods to collect quantitative data about the movement of water into and out of plant tissue. The students were given a protocol to follow and directed to the equipment they would require. The practical stage presented a challenge to the students because it involved the use of two different methods of gathering data to ascertain the concentration of sugars inside potato cells. The students had previously learned about the mechanism of osmosis and knew that there would be no net movement of water into or out of cells when they are placed in an isotonic solution. Although they were given the methods, the first difficulty for the students was making a link between their theoretical knowledge and measureable variables that indicated the direction of movement of water into and out of the potato cells. Where the first method directly measured change in mass of potato tissue, the second method involved an indirect measurement, speed of rise or fall of drops, that required the students to realise that water moving into or out of the solutions in which the potato tissue were suspended would result in a change in the density of those solutions. As

such, the second method demanded that the groups worked co-operatively to execute a methodical approach and were precise when observing and recording the direction and speed of droplets.

In the following lesson, the groups of students worked together to process their investigation data and reach a solution to the problem. The intended learning outcomes were for students to apply their theoretical knowledge of osmosis, density and speed to process the data from the previous lesson and identify the concentration of sugars in the potato tissue (that is, the isotonic concentration). Each group was given rough paper to use for working, graph paper and calculators, but, were not given instructions as to how to process their data. This stage of the task presented a challenge to the students because there were several logical steps the students needed to connect between speed of the droplets, density of the solution and osmosis, which then directed the processing of data. At the same time, the students needed to use a different strategy of data processing for the results of the first method. Sutherland (2008) identified problem-solving tasks that demand application of numeracy and reasoning skills as an area of learning that can be used to develop challenge for able students. During the plenary, each group explained to the whole class how they reached or tried to reach a solution to the problem. Overall, the task was designed such that it included an appropriate level of stretch and challenge for the students' knowledge and skills, and provided several opportunities to observe the level of effort and range of learning behaviours demonstrated by the students (see Appendix V). Furthermore, the group-task structure of the activity and the necessity for discussion and co-operation between group members aligned with a social constructivist perspective of learning (Vygotsky, 1978).

3.4.2.3 Semi-structured student interviews

For the third stage of the case study, the questionnaire assigned mind-set data and observed responses to the challenging task were used as the basis for the selection of six students for interview. Specifically, three fixed mind-set theorists and three growth mind-set theorists were selected. The number of students selected for interview was chosen for reasons of expediency; limitations of time required a balance to be struck between the number of students interviewed and the need to gather rich, detailed data. Comparison of the lesson observation outcomes with the assigned mind-set data showed different patterns of response to challenge and ITI mind-set stance than the dichotomous, opposing correlations predicted by the model. To reflect this diversity, I did not purposely select those students whose response and ITI mind-set fitted the pattern predicted by the model. My rationale for sample selection was to choose six students who, collectively, represented the range of questionnaire and learning behaviour responses. The quality of video footage was also taken into account during the selection process to ensure that there were sufficient examples of each student's response to the challenging task to prompt and support their answers during interview. After ascertaining that each of the selected students were still willing to participate in this stage of the study, a mutually convenient time was arranged for interview. The interviews took place during lunchtime and were conducted in a Physics classroom. Each interview did not exceed thirty minutes. Audio recordings were made of each interview that were subsequently transcribed for analysis.

Student interview has been used as a method in previous studies of ITI mind-sets. Bempechat and London (1991) and Carr, Borkowski and Maxwell (1991) conducted structured interviews to assess students' implicit theories. As such, they used student

interview as an alternative method to using a scaled questionnaire because they shared the same purpose. Quihuis et al. (2002) and Mercer and Ryan (2009) employed semi-structured student interviews in their case studies. In common with my research, these studies also stated an exploratory objective and used open-ended questioning to answer their research question. To reveal the detail of students' beliefs and values associated with intelligence and to explore any links between these and their response to the challenging task I used open-ended questions based upon the questionnaire items and observation data. Silverman (1993) supported the use of open-ended questions because it allowed respondents to express their personal and unique views of a particular situation.

Whilst I have argued that posing open-ended questions during semi-structured interviews was the most appropriate method for revealing the students' beliefs and values, there were some potential drawbacks of using this approach. Oppenheim (2000) cited two sources of bias that are relevant to this case study. Changes to the wording of questions could have affected the meaning and, therefore, the answers given by different students. The risk of this introducing bias to the data was reduced because the phrasing of core questions, such as 'Why did you agree/ disagree with the statement...?' that were based upon the student's questionnaire responses, were consistent because they were pre-prepared. The issue of leading questions was pertinent, particularly where the question was asking the student to explain their rationale for their behavioural responses to the challenging task during the observed lessons. This related to my dual role of teacher and researcher in the case study. It was possible that I had preconceived opinions about the reasons underpinning each student's particular response and this could have influenced my questioning such that the questions sought affirmation of my opinion rather than allowing the student

to freely express their own ideas. To reduce the chance of posing leading questions, video clips of the student working on the task were replayed during the interview before asking the student for their explanation. This focused the question on the action rather than my interpretation of the action and prompted the student to describe and explain their behaviour from their own perspective.

During each interview video clips from the observed lessons were shown to the student for two further reasons. Firstly, the selected clips helped the student to recall their thoughts, actions and emotional responses as they worked through the task. This allowed me to check that my assessment of their level of engagement with the task was accurate. Secondly, replaying parts of the lesson provided a real experience for the students to relate to when describing their conceptualisations of intelligence and how these might affect their behaviours when faced with difficulty. Using video-stimulated semi-structured interview allowed the students freedom to describe and explain their beliefs and values beyond the limitations of structured interview or questionnaire methods and, at the same time, maintained a connection with real experiences in an authentic learning context. Robson (2011) described the use of video recordings as a 'tool to support thinking'.

The reasons for using video recordings during the student interviews were to aid recall, prompt reflection and focus the discussion. However, there were some potential drawbacks of using this device. Although she was referring to research with young children, Robson (2011) described negative aspects of using video data that are also pertinent to this case study. As the operator of the video camera and reviewer of the recordings, I determined what was filmed, the position and duration of shots and, afterwards, which clips to replay during the interviews. Sole control of the video recorded data meant that the decisions I made could have imposed my own

interpretations and value judgements about what actions were worthy of discussion. Consequently, the students' interview responses could have been affected by my selection of video clips. I reasoned, however, that the possibility of researcher bias being introduced as a result of using the video recordings was outweighed by the benefits of its use, particularly regarding the potential to stimulate rich, detailed narratives. Nevertheless, I remained attentive throughout this stage of the case study to the issues of researcher bias surrounding the making and use of video recordings.

The following figure 3.4.2 summarises the three stages of data gathering carried out during the case study. The timings of each stage are indicated. It was important to keep to this plan because increasing the length of time between stages could have negatively impacted on the students' recall of their experiences of working on the challenging task. Furthermore, extending the time frame of data gathering could have infringed on the students' time for examination preparation.

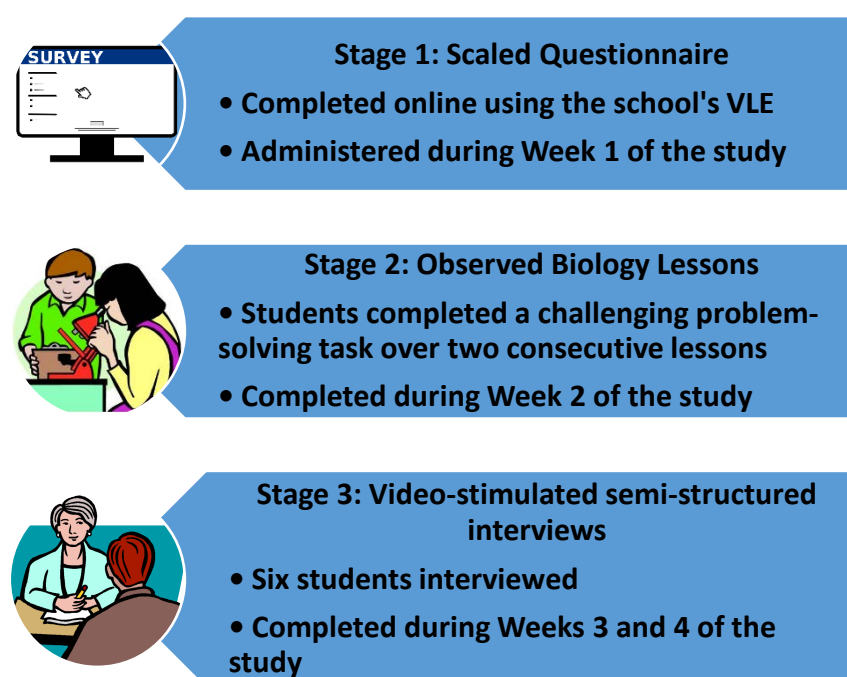


Figure 3.4.2 Schedule of data collection stages of the case study

3.4.3 Data Analysis

The quantitative data from the questionnaire were processed to give a mean score for each student in the class. Given that the ITI mind-set type boundaries were pre-determined (Dweck, 2000), this removed the possibility that researcher bias could affect the assignment of students' ITI mind-set. However, these data were only used to inform the selection of students for interview and to provide the basis for the interview questions. Similarly, the lesson observation data contributed to the selection of the students for interview. Although the criteria for categorising the students' responses to the challenging task were established by Diener and Dweck (1978; 1980), assessing the behaviours of the students against the criteria was a subjective judgement and, therefore, at risk of researcher bias. To reduce the chance that my prior knowledge of the students' learning behaviours affected my assessment of their response to the challenging task, I used the video records of the lessons to translate the behaviours and interactions of the students into short written descriptions. The descriptions were then analysed to identify features that could be interpreted as positive or helpless characteristics. To check that my judgement of the students' responses to the challenging task were accurate, I reviewed the video clips of each of the selected students to ensure that no conflicting behaviours had been missed and to gain a more holistic view of their overall response. Later on during the interviews, each student was asked to evaluate their response to the task and this provided an additional check that my assessments were fair.

The audio recordings of each student interview were transcribed for analysis. Given the exploratory objective of the research question, I did not have pre-determined coding categories as this would have restricted the scope of my findings and introduced researcher bias into the analysis. Consequently, the first round of analysis

of the interview data involved close scrutiny of the students' responses to draw out meaning. Rather than fragmenting each response into coded sections, the students' accounts were interpreted from a holistic perspective. Punch (2009) described this interpretive approach as narrative analysis and Saldaña (2013) recommended applying this method to the interpretation of qualitative data from exploratory studies. The advantage of taking this initial approach to the analysis of the transcribed interview data was that both the form and the content of the student's responses were preserved.

For each student interview, my interpretations of the key responses and the topics they related to were collated as a mind-map. The second round of analysis used the mind-maps to connect ideas and make links with implicit theories of intelligence and theories of learning and motivation. To maintain the exploratory aim of the case study, my approach to this stage of the analyses was driven by the themes emerging from the data. The themes were used as a framework for writing each student's narrative, which are presented in the Findings and Analysis chapter. The narratives were constructed around my interpretations of the students' responses that revealed their beliefs, values and perceptions about challenge, effort and intelligence. In addition, each student's narrative included details of the other topics they discussed because these were identified as important by the student themselves and, given the exploratory nature of the study, were valid inclusions. Writing the narratives was an integral part of the analysis; the process of writing to learn (Coffey and Atkinson, 1996; Punch, 2009). Punch (2009) described this model of writing as most appropriate where the intention is to develop a complete picture of the data. Bringing together all the strands of each student's learning experiences, beliefs and values in writing clarified the overall story. Comparing the students' narratives revealed

similarities and differences between their beliefs and values that defined collective characteristics of the case study cohort. Taking into account the limited generalisability of the case study findings, tentative comparisons were made between the outcomes of the case study and similar studies published in the literature.

Taking a holistic approach to the analysis raised issues of reliability, primarily through using myself as the sole interpreter of the data. This does not affect analysis of quantitative data where reliability can be verified by repeating the test under the same conditions. The same patterns would be expected if the data were reliable. It would have been inappropriate to apply this strategy to test the reliability of the qualitative lesson observation and interview data. The case study could not be repeated at a different time or involve another observer/ interpreter, as recommended by Denzin and Lincoln (1994). In the first instance, the specific contextual factors of the case could not be replicated. For example, the student participants would be responding to the same questionnaire items for a second time and would have already explained their statement choices. Also, repeating the same task would mean it was no longer stretching the students' abilities. Repeating the case study using the same questionnaire, challenging task and interview schedule, but, with a different cohort of students could not replicate the specific contextual factors of the learning environment of the first case study. From this perspective, applying the same research design with another cohort could not provide reliable evidence of the type generated through repeating a scientific experiment. However, as the study outcomes have been presented as exploratory and particular to the context of the case, this negated the need to demonstrate reproducibility as a means to establish reliability. The conclusions drawn from the case study findings are not claimed to be directly applicable to other learning situations.

In contrast with a scientific conceptualisation, reliability of the outcomes have been considered from a perspective that is concordant with the interpretivist methodology and case study design. This has been achieved by keeping the student's voices at the centre of my analyses and writing; the students' interview comments have been quoted verbatim alongside my interpretations. Through maintaining the transparency of the data itself and of my analyses of the data, the reliability and validity of the conclusions I have drawn are open to scrutiny and criticism. This approach to evaluating the reliability and validity of the case study outcomes relies upon the advantage of being familiar with the students' nuanced behaviours and verbal expression to the detailed analyses of the data outweighing the disadvantage of the potential for bias as the sole interpreter. For this reason, the video recordings of the students working on the challenging problem provided opportunities to compare and contrast my evaluation of each student's learning behaviours with the student's own assessment. Also, using the video clips with the students to review key incidents during the lessons provided a focus for the subsequent discussion and, therefore, reduced the likelihood of my own interpretation influencing the student's recollection. These features of the design of the case study were included to minimise the potential for my role as teacher and researcher to introduce bias in the collection and analyses of the data.

3.5 Ethics

This section of the chapter explores the ethical issues associated with the design of research that involves children and identifies the potential risks to the students in the case study cohort. The measures taken to reduce the risks are described and evaluated from the perspective of my dual role as teacher and researcher. Since the class of students selected to participate in the case study were between fifteen and sixteen years of age, ethical approval to carry out the research was required. I referred to the BERA Ethical Guidelines for Educational Research (2011) when appraising and planning for the ethical issues related to my research project.

The first step was to secure the consent and access necessary to carry out my study from the Head Teacher, the Pastoral Deputy Head and the Leaders of both Year Eleven and the Science Department. These colleagues were the gatekeepers responsible for ensuring that the best interests of the students, staff and school community were not adversely affected by their participation in and association with my research. Discussions with colleagues were guided by the key ethical issues surrounding research in schools described by Alderson and Morrow (2004) and addressed the nature of the topic of my research, the potential impact that participation might have on the students' wellbeing and learning, how the students would be recruited, how data would be collected and the value of my research to teaching and learning in the school. Having established that my ethical stance in the design of the case study agreed with the values, policies and procedures of the school, the Head teacher formally agreed access in writing, which was submitted as part of my application for ethical approval to the Anglia Ruskin University Faculty Research Ethics Panel (Faculty of Health, Social Care and Education). The

discussion that follows addresses the key considerations and actions taken that were presented to the ARU FREP and endorsed through the granting of ethical approval.

The nature of the topic and the questions put to students were evaluated for their potential to raise sensitive issues. The questionnaire and interview questions focused upon students' conceptualisations and beliefs about their own intelligence and how these affected their engagement with a challenging activity. Although these questions were not intended or expected to elicit personal or sensitive information about the student, there was a risk that a student may have disclosed this type of information. This may have also indicated potential or actual harm to the student. As a teacher with eighteen years' experience as a classroom practitioner, I have the knowledge and skills to make informed judgements and act appropriately should any information be disclosed during the course of data collection that needs to be passed on, for example, a child protection or safeguarding issue. In practice, this meant adhering to the school's policy and procedures on child protection. Specifically, sections of the policy that referred to confidentiality and mechanisms for reporting and recording disclosure or indicators of abuse, and the appropriate procedures for avoidance of potentially damaging situations. In all instances, disclosure of information indicating a potential or actual child protection issue would have been immediately passed onto the designated senior member of school staff and an accurate record made of what was said or seen. In accordance with the school's policy on child protection and professional teaching standards, when actual or potential harm to a child has been disclosed the teacher cannot guarantee confidentiality and must report the incident to the relevant authority.

The study was anticipated to be low risk. The potential risks to me as researcher were no different to those encountered in my usual daily work. For the third stage of the case study, the interviews required that I would be alone with a student in a classroom. This could have created a situation in which I was vulnerable to accusation of inappropriate behaviour. For this reason, the student interviews were conducted in accordance with the school's child protection procedures, part (v) "avoiding potentially damaging situations". Specifically, that the interviews took place in a room where there was a clear view of both the student participant and interviewer through a window in the door and colleagues were aware that the interviews were taking place. Teaching colleagues from the Science Department and the Leader of Key Stage Four were notified of the days, locations and times when students were completing the questionnaire, being videoed during their lessons and being interviewed. The Physics classroom where the interviews took place was chosen because of its proximity to the Science Department staff room. This meant that colleagues frequently walked past the classroom door and could see into the room where I was conducting the interviews. Being able to contact another member of staff quickly if a student became upset or was uncomfortable during the interview provided additional protection for both the student and myself.

Given my roles as the students' Biology teacher and as the Leader of Biology, there was a risk that the student participants perceived a power imbalance between themselves and me as the researcher. This could have resulted in students feeling obliged to participate in the study. For this reason, careful consideration and planning was given to how the purpose and procedures of the study, and the method of recruitment were presented to students and their parents or carers. Since the students were academically able adolescents I assumed that they could comprehend

the questionnaire items and interview questions, negating one of the problems of researching with children that was raised by Alderson and Morrow (2004).

Furthermore, the particular characteristics of the student cohort and my already established relationships with them facilitated explaining the purposes and value of the research. The aims and methods were explained to the students as a brief presentation at the end of a Biology lesson. During the introductory presentation, it was clearly stated that students were not obliged to participate and that their participation would not affect their school studies in any way. Each student was then given an envelope to take home that contained separate information sheets for them and their parents or carers, and a form to be completed giving parental consent and the student's assent to participate in the study. Facsimiles of these documents are in Appendix III.

The information sheets contained clear and full information about the data collection methods being employed during the case study. Each document stated that should the student feel uncomfortable about being recorded or watching themselves on video, they were under no obligation to participate and, even if they had given their assent to participate, they could withdraw their participation at any time. The right to withdraw from the study was reiterated in the consent form and again later when the students were informed of their selection for interview. The methods and duration of each stage of data collection were described, and consent to participate was sought for each separate stage. This ensured that students and their parents or carers were fully aware of the required activities and time demands that would be placed upon the students if they participated in the study. No incentives to take part in the study were offered to the students as this may have put pressure on them to participate and

offer responses to the questions that they thought would elicit a positive judgement on my part. However, the potential benefit to the students of gaining insight into the purposes and methods of research was described in the letter sent to parents and carers (Cohen, Manion and Morrison, 2000). In the time period between issuing the written information and the deadline for indicating consent to participate in the study, the students had further opportunities to discuss with me the purpose and design of the research. Contact details were provided in the information sheets to allow parents and carers the opportunity to make further enquiries about the study. This helped to clarify my role and responsibilities as researcher and the implications of participation in the study.

The practical approach I adopted in the recruitment of student participants was informed by the ethical guidelines published by BERA (2011) and the ethical dilemmas discussed by Punch (2009). The latter resource was particularly useful because it explored the ethical issues associated with researching in my own classroom setting. Although issues of access and consent were made easier by being both teacher and researcher, adhering to the key ethical tenet of gaining informed consent was essential as this had implications for the rights of the students and their parents or carers, and the reliability and validity of the data gathered. In addition to seeking the informed consent of the students' parents or carers, I also sought the informed assent of the students themselves. This step acknowledged that the students were older children who routinely made their own decisions about participation in school activities. Securing the student's assent in addition to parental consent also contributed to redressing the student-teacher power imbalance and emphasised the central importance of the student voice in the research.

Taking a pragmatic approach to the ethical design of the case study was supported by Tisdall, Davis and Gallagher (2009) who argued that codes of research ethics are limited where assessing possible harm requires that the specific contextual factors of the research setting and participants be taken into account. This perspective was pertinent to my research because of the importance of the contextual factors to the interpretive methodology adopted in the case study design. For this reason, I took the BERA ethical guidelines (2011) relating to informed consent, confidentiality and anonymity as the standardised model and then reflected upon the effectiveness of applying them to the safety and wellbeing of the participants. This process also involved discussions with teaching colleagues, in particular the gatekeepers identified earlier who offered insight into the possible conflicts of interest that could arise between protecting the students and gathering detailed data about them.

Although consent and assent were sought in the full knowledge that video and audio recordings would be used during the study, there was a risk that the participants would feel self-conscious and uneasy about being recorded as they worked during a lesson, and as they reviewed video footage of themselves. For this reason, their right to withdraw their participation was reiterated to the students at the beginning of each stage of the study. Throughout the data gathering stages I monitored the students' behaviours to detect signs of them being uncomfortable during filming and interviewing. It was also important that the students and their parents or carers knew that the video and audio recordings were only being used for the purposes of the case study. To fulfil this assurance, the safe storage of digital audio recordings and video footage that contained images of students was planned and carried out in compliance

with the policies of the Essex Local Authority. In practice this involved the following steps:

- I did not take or use video or audio recordings of students without the consent of their parents and the agreement of the students themselves.
- A specific storage area for video and audio recordings was created. I avoided storing the data in an area of a shared network and instead stored the data on my own laptop in an area that was password protected.
- All audio and visual recordings after they had been processed and analysed for the purposes of this research project were deleted.
- The audio-visual recordings were not used for any other purpose than this study.
- Images have not and will not be used in the reporting of the study.

These measures were taken to ensure that the data remained confidential, safeguarded the students' privacy and, thereby, contributed to the establishment of trust. Guarding the information shared by the students also raised issues of anonymity. The methods employed in the study demanded that the participants were identifiable to me as the researcher to enable selection of students for interview and because the interviews were conducted face to face. However, it was necessary to protect the anonymity of the student participants when reporting the outcomes of the research. Cohen, Manion and Morrison (2000) defined anonymity as the actions taken by the researcher to remove all identifying evidence from information. To fulfil this, the six students who proceeded to the interview stage of the study were assigned pseudonyms to protect their identities. Throughout the transcript of the interviews all references to the students used their pseudonym. Furthermore, the interview data were scrutinized to ensure that no identifying details were evident. This additional

level of analysis was important because of the personal nature of many of the students' responses and, in some instances, their use of examples drawn from their own experiences. Although this meant that some useful information might have to be omitted from the analyses, I judged that protection of the students' anonymity outweighed the purpose of the study. Indeed, maintaining the integrity of the study and the trust placed upon me as teacher-researcher depended on fulfilling my responsibility to protect the students' privacy.

Analysis of the interview data did not reveal information that could identify the student participants. This did not mean that protecting the students' anonymity was assured since it was possible that the participants could be identified through my written analyses. The chance of this happening was greatest in the short descriptions of each student's learning behaviours, presented in the first section of the Findings and Analysis chapter. Care was taken not to include information from my knowledge of each student's characteristic behaviours in the classroom, which could have been apparent to other students and teachers who knew them. Consequently, the pen portraits of each student focused only on their observed specific learning behaviours during the lessons when they were working on the challenging task. They included only those details necessary for the reader to associate the positive and helpless responses with each student's narrative.

The ethical issues identified as pertinent to the design of the research and to the contextual factors associated with the research setting were taken into account when I designed the study and during the stages of data gathering. Monitoring the effectiveness of the measures put in place to protect the safety and well-being of the student participants acknowledged the potential for issues to arise that were not anticipated. Punch (2009) endorsed a reflective approach to ethical issues before,

during and after conducting studies with children. To fulfil this principle of good practice, the ethical issues associated with the design of my research and the actions taken to ensure confidentiality and anonymity are critically evaluated in the final chapter of this thesis.

3.6 Chapter Summary

My research question asked how able students' ITI mind-sets impact on their engagement with a challenging problem-solving task in a classroom setting. To answer this question, I have adopted an interpretive methodology and case study design.

The study focused on six able Year Eleven Biology students from a single class in a boys' academy grammar school and involved three stages of data collection. During the first stage, twenty one students in the Biology class completed an online Likert-type questionnaire that had been used by other researchers in the field to assess the ITI mind-set of children over the age of ten (Dweck, 2000). The mean scores were used to assign each student as holding a growth, fixed or intermediate ITI mind-set. In the second stage, audio and visual data of the students working on a challenging problem-solving task were recorded during two consecutive Biology lessons. The questionnaire and lesson observation data were used as the basis for selecting six students for interview. Video clips were viewed during the semi-structured interviews to help each student recall and evaluate their response to the challenging task, and explain their ITI mind-set stance in relation to a real experience of facing difficulty.

A holistic approach to analysis of the interview transcript produced student narratives of their values, beliefs and conceptualisations of challenge, effort and the nature of intelligence. The interview data were further analysed to elucidate associations with the model of ITI mind-sets and theories of learning and motivation. To address issues of reliability and potential bias, the case study findings were reported alongside the student's responses to allow my interpretations to be scrutinized and criticised. Building the students' narratives around excerpts from the

transcript also gave precedence to the student voice and compelled me to focus on drawing meaning from the data, reducing the risk of prior knowledge of the student's learning behaviours influencing the analyses. Similarly, using video clips of the lesson observations during the interviews gave a focal point for the students to base their answers on and reduced the possibility of my own interpretations of their learning behaviours influencing their responses to my questions.

Ethical approval for the research design was gained from the ARU FREP, Head Teacher, Leader of Year Eleven and Leader of Science. Ethical issues of safety, confidentiality, consent and communication were addressed in the planning, data collection, analyses and reporting stages of the study. The BERA Ethical Guidelines for Educational Research (2011) provided a benchmark for ethical practice that I adapted to suit the particular needs of the students and contextual factors of the school setting. This included seeking both the consent of the students' parents or carers and the assent of the students themselves to participate in the study. My dual role as teacher and researcher meant that the design of the study met school and Local Authority policy and practice guidelines, particularly those pertaining to the safety and well-being of the students, ensuring student confidentiality and the secure storage of data. Full disclosure of the purpose and demands on the students who would participate in the study was communicated to parents and students at the time of seeking their consent and assent. The importance of establishing and maintaining the trust of the students and their parents or carers was also recognised by ensuring that the data were not used for any other purpose.

Chapter 4: Findings and Analysis

4.1 Introduction

This chapter is divided into sections that describe and interpret the data from the questionnaire, the students' responses to interview questions relating to their engagement with the challenging problem and their self-theories about intelligence. The order of these sections in the chapter mirror the order of the stages of the study because the questionnaire and video footage of students working on the challenging problem informed the purposive selection of students for interview and also provided the contextual background to the interview questions.

In sections 4.3 and 4.5, students' interview responses are analysed from the perspective of behaviours and beliefs predicted by the model of ITI and related frameworks, such as theories of motivation. The conclusions drawn from the data presented here are compared and contrasted with the outcomes of published studies that have relevance in terms of context and aims. Seven key findings that emerged from the data are presented in section 4.6.

4.2 Questionnaire Results and Analysis of Lesson Observations

All twenty one students in the Biology class completed the questionnaire during a lunchtime, which was done online through the school's VLE. The responses were processed to give each student a mean score. There were ten students with a mean score of three or less and they were assigned as fixed mind-set theorists. Eight students with a mean score of four or more were assigned as growth mind-set theorists. The remaining three students with a mean score between three and four were not assigned to either mind-set and, consequently, they were not eligible to be chosen for interview. This method of assignment of mind-sets has been described by Dweck (2000) and is discussed in more detail in chapter three of this thesis.

Between the questionnaire and student interview stages of the study, video-recordings were made of the class of students as they worked on a challenging problem-solving task during two consecutive Biology lessons. After reviewing my lesson observation field notes and the video footage, I identified and categorised students as showing behaviours associated with either positive engagement or a helpless response. Using students' assigned mind-sets and their observed behaviours as they worked on the challenging problem, I selected six students for interview (see Table 4.2). As described in chapter three, the selected students have been given pseudonyms to make it easier for the reader to follow the narratives in sections 4.3, 4.4 and 4.5 and to protect the identities of the students.

Table 4.2: Questionnaire mean scores, assigned mind-sets and observed behaviour type (positive engagement versus helpless responses) of the students selected for interview

Student	Mean Score	Assigned Mind-set	Behaviour type
Henry	2.0	Fixed	Positive
Chris	5.3	Growth	Helpless
William	1.0	Fixed	Positive
Isaac	2.7	Fixed	Helpless
Adam	6.0	Growth	Helpless
Nathan	4.7	Growth	Positive

To further assist the reader, a short descriptive characterisation follows for each of the selected students. These descriptions are based upon the observed behaviours of each student during the filmed lessons and do not include more general characteristics that would lead to the identification of individuals. Furthermore, these individual characterisations of the participants were drawn solely from my analyses of the video recordings of the observed lessons and did not influence subsequent analysis of their interview responses.

Henry, the ‘listening leader’. Henry sought the opinions and ideas of his fellow team members and co-ordinated the direction of the group. He kept the group focused on the task by verbalising what they had done, how successful this had been and what he thought they should do next. Henry took the role of team leader and was an active participant in the practical and data analysis stages of the task.

Chris, the ‘anxious assistant’. Chris was hesitant throughout the practical and data analysis stages of the task, waiting for others in his group to make decisions. Chris

spent most time during the practical lesson acting as the group's technician, gathering and setting up the equipment after confirming what to do with another member of the group. Chris offered few ideas during the data analysis stage and was reluctant to carry out calculations, construct graphs or evaluate the success of approaches through group discussion.

William, the 'determined director'. In his verbal interactions and behaviour, William projected an air of confidence in his abilities to solve the problem. From the beginning of the task, William assumed the role of group leader and made the final decisions about the strategies they would apply to solve the problem. Whilst William was clearly directing the group's activities, he was not dictating them because he did discuss the success of each strategy with his peers and subsequently modified the approach.

Isaac, the 'confused copier'. Isaac played an active part in the practical stage of the task, carefully following the protocol and demonstrating a deft touch in his use of the equipment. During the data analysis stage, however, Isaac's prior confidence was absent as he struggled to contribute ideas and looked to other groups for help. Isaac openly expressed his confusion about how to analyse the data in a meaningful way and attempted to apply other groups' approaches to the processing of his own group's data.

Adam, the 'team talker'. Adam made some contributions to the practical stage of the task, such as gathering equipment and labelling test tubes, but avoided becoming involved with the more challenging techniques. Throughout the practical and data analysis stages of the task, Adam was almost exclusively engaged in asking his fellow group members questions about what should be their next step. Questioning

was not Adam's means of offering or developing his own ideas, but rather a strategy of placing the responsibility of decision making onto others.

Nathan, the 'assertive advisor'. Nathan was an active participant in both the practical and data analysis stages of the task. Nathan did not lead his group, but rather took on an advisory role where he interpreted patterns in the data and contributed to the discussion about whether a particular approach would be successful. At key points during the data analysis, Nathan showed that he was able to both constructively criticise the team leader's decisions and concede that his own idea was not the best approach.

All the students were observed to experience some difficulties with the task, particularly at the beginning of the second lesson when the students were asked to use their experimental data to solve the problem. After the initial uncertainty of how to proceed, Henry, William and Nathan were observed using different strategies to solve the problem. This followed a pattern of trying to break down the problem into stages, applying a mathematical method they had used before and then evaluating the outcome of each step. Although not all methods tried were successful, these three students persevered to reach a solution in the time given. These learning behaviours are characteristic of students who are positively engaged with their task (Elliott and Dweck, 1988). Interestingly, Henry, William and Nathan also demonstrated high levels of co-operative learning behaviours, such as verbalising their thought processes and asking for the opinions of other members of their group. This may have contributed to their confidence to share their approaches and answers with the rest of the class.

The behaviours of Chris, Isaac and Adam contrasted markedly with those associated with a positive engagement with the task. Their approaches were not methodical, involving only a limited number of strategies, and with little evaluative discussion between group members. Consequently, group members tended to work individually rather than co-operatively towards a solution and did not share their thought processes through discussion. Adam did ask questions, although these did not prompt his group to select effective problem-solving strategies. By midway through the lesson, Chris, Isaac and Adam were seeking help from the students in other groups or from me. Taken together, the behaviours of these three students are characteristic of those described by Elliott and Dweck (1988) as the helpless response.

It is immediately apparent from the questionnaire and lesson observation data that four of the six selected students, Henry, Chris, William and Adam, displayed the opposite behaviours to those predicted by their assigned mind-set. Given the small number of students, statistical analyses to test the strength of a possible correlation between the variables cannot be carried out and would not contribute to answering the research question. Nevertheless, the mismatch between these students' assigned mind-sets and observed levels of engagement with the challenging problem raise questions about the questionnaire's fitness for purpose and applicability of the model of ITI as a predictor of engagement with challenging tasks, particularly in the context of this case study. For example, whether the higher abilities of the student participants meant that they held more complex conceptualisations of intelligence, which in turn led to different interpretations of each questionnaire item. A full discussion and evaluation of the questionnaire as a method of assessing students' ITI is in chapter six, section two.

In the following section, the students' interview responses relating to their engagement with the challenging problem are described and analysed. These findings are reported in the order in which the interviews took place to allow a detailed picture to emerge of each student's perceptions of their engagement in the lessons. Common themes and conceptualisations are noted throughout the section, and these are analysed from the perspective of the model of ITI mind-sets and other related motivation theories.

4.3 Students' interview responses about their engagement with the challenging problem-solving task.

Henry was observed using different strategies and looking at the problem from different perspectives. He confirmed this when I asked him about his engagement with the problem-solving task.

...I think at first we thought, 'oh, that's a good idea', and then we were looking for that in the other results and when we couldn't find it we started kind of broadening our minds...thinking about other things.

He expressed a degree of frustration as he worked through the problem, trying to reach the solution, but this was not a negative emotion for him. The frustration did not reduce his interest in the problem; the challenge prompted more diverse thinking and looking for links between ideas and combining ideas.

...it can be a bit frustrating, but I thought it was quite interesting.

Although it kind of got a bit complex...we had such different ideas...trying to draw them together.

Henry's comments and high level of engagement with the task are characteristic of the individual who is intrinsically motivated to learn (Schunk, Pintrich and Meece, 2008). Specifically, he demonstrated curiosity and a focus on the task rather than the outcomes of learning that would be expected of someone who was more extrinsically motivated. Furthermore, Henry's perseverance and resilience throughout the task embodies the deep state of involvement described in Csikszentmihalyi's (1991) theory of flow. In this model, the learner's absorption in the task is a product of their intrinsic motivation and a matching of the challenge level of the task to the learner's capabilities. It follows then that Henry valued the task and was confident that he could reach the solution.

When asked if he valued the task over reaching the solution, Henry clearly stated that the effort was more important.

...definitely more important to work through...

He went on to explain this in terms of his experiences in Mathematics lessons.

It's like in maths where you always have to write things down... the answer ...it doesn't prove that you know anything...I think I'd rather get something wrong and know where I've gone wrong than get something right and I don't know how I've done it right.

Here, Henry is expressing a value that is associated with the growth mind-set. As was the case with his positive engagement with the challenging problem, Henry's interview responses are at odds with the values associated with his assigned fixed mind-set. Specifically, Henry has described a learning goal-orientation that the model of ITI proposes as the basis for the challenge seeking behaviours and appreciation of effort characterised by growth mind-set theorists. It may also be the case that in referring to his experiences outside Biology lessons Henry's learning goal-orientation is for him a universal value that he applies across all areas of his studies.

In common with Henry, the challenging problem caused Chris to experience feelings of frustration. In contrast, however, these led to further negative emotions: confusion and annoyance. This was observed to hinder his progress in the lesson.

...the graph...we had a few little moments, 'cause it's minus...we got a bit confused half way through. So, when we got it wrong, it was quite annoying.

These negative emotions, alongside the observed helpless behaviours in the lesson, are evidence that Chris had a fixed mind-set rather than the growth mind-set he was

assigned to by the questionnaire. Chris's following comment suggested performance-goal orientation, another attribute of the fixed theorist.

It was quite frustrating, 'cause you just want to get the result.

It was important, therefore, to establish whether Chris valued the process of solving the problem over reaching the solution.

...probably working towards the answers... 'cause you can see if you work your way through it where you got it wrong.

This was similar to Henry's response to the same question. However, Chris's answer is less assured about the process being more important; Henry uses 'definitely' at the beginning of his response, whereas Chris starts with 'probably'. The inconsistency of Chris's responses relating to his goal orientation suggest a conflict between the values he professes to hold and the actual values that underpinned his actions in the context of the lesson. Schunk, Pintrich and Meece (2008) emphasised the impact that the learning environment has on determining the student's goal orientation. Given that goal orientation is an integral part of the framework of ITI mind-set, the potential for a student's goal orientation to be influenced by the contextual factors of the classroom suggests that ITI mind-set may be impacted upon in a similar way. It follows then that Chris may hold a more complex pattern of values and beliefs, and display the corresponding behaviours, as currently proposed by the model of ITI mind-sets. Specifically, that he is driven by the desire to find the correct answer, but also values the effort of working towards the solution.

When asked to comment on his engagement with the problem-solving task, William described relishing the challenge and applying positive learning behaviours, such as independence and perseverance. He also expressed positive feelings of enjoyment.

I liked it. It gave us a more free rein to do what we wanted. We had to...work through it a bit more.

...I quite enjoyed working like that. If I get a process, I get quite bored.

William's enthusiastic response is reminiscent of the reported reaction of a ten year-old participant in one of Dweck's studies who said, "I love a challenge" (Dweck, 2000). In common with Henry, William's comments resonate with theories of intrinsic motivation and flow. In particular, his comment about becoming bored when given the task procedure confirms that the level of challenge was appropriate to William's capabilities.

When asked if the process of solving the problem was more or less important than reaching the solution, William did not immediately answer the question, but instead explained that he valued the process as providing validation for his approach and leading to understanding.

I think if I'd just got the answer without doing it I think I wouldn't have been as certain why that was the answer. I think that by going through the whole thing you can quite clearly see what step leads to what. So, by doing the practical and then by working through with it afterwards it was quite easy to see why it happened that way.

William's interpretation agrees with my observations of his methodical approach to the problem. William was confident of his approach and final answer at the end of the second lesson, and the language he uses here conveys his sense of self-efficacy (Schunk, Pintrich and Meece, 2008). McCoach and Siegle (2003) reported that able students have high academic self-concept and self-efficacy in the domains in which they are identified as being gifted and talented. If William has been identified as gifted and talented in science, or he perceives himself as such, then this may explain his positive engagement with the task. Interestingly, the conclusions drawn by McCoach and Siegle in their study suggest that there is no difference between groups

of achieving and underachieving gifted students on measures of academic self-perception, although the underachieving group scored lower on measures of motivation. For this reason, it was important to find out what motivated William as he worked on the problem. I asked William whether he valued the problem-solving process over reaching the solution.

It was more important for me to get the answer.

William's answer is concordant with the performance –goal orientation that is associated with the fixed mind-set. Given that William had earlier expressed attitudes and shown behaviours associated with the growth mind-set and that the problem was set in a specific Biology context, I wanted to test the reliability of his performance-goal orientation by asking him if it applied across all his subjects.

I think I'd always prefer to get the right answer, but, I don't think there's a problem in getting the wrong answer... 'cause if you know you've got the wrong answer, afterwards you can look at why you got the wrong answer...and it might be more useful for you than getting the right answer.

William's answer has elements of both fixed and growth mind-set characteristics. He is driven to reach an answer, but, he also values the efforts getting to the answer. Furthermore, in the final part of his reply William implies that there are situations where the value of the process can outweigh that of reaching the correct solution. In this regard, students Henry, Chris and William are similar in their combined performance-goal and learning-goal characteristics. These findings can be also interpreted from the perspective of intrinsic and extrinsic motivation theory. In her review of motivation and gifted students, Clinkenbeard (2012) notes that most individuals are motivated by a combination of intrinsic and extrinsic factors and that these vary with the task.

Isaac was one of two students whose assigned ITI mind-set matched their observed response in the classroom. Isaac was also the only student interviewed who required my direct intervention during the data processing stage of the task because he had reached a point of helplessness where he could not have made further progress. This was borne out in Isaac's description of his experience.

...we were sort of, 'oh, we've got no correlation or anything, this makes no sense'. But then, it was you who mentioned something about the speed of the droplets and then it sort of clicked...I thought, 'oh, that's how we're meant to approach it'. Given that we got a bit of direction with it...but, that wasn't for a while. At first we were sort of 'whoa'.

Isaac then goes on to confirm his negative feelings that resulted in an inability to identify and apply different strategies to solve the problem.

[I felt] overwhelmed almost...I mean the first graph we did, we literally plotted the averages of each droplet, which doesn't really show much, but that's all we could do really.

The final comment implies a lack of ability as the reason Isaac felt unable to find the solution. From the perspective of attribution theory, Isaac's identification of a lack of ability as the explanation for his failure would be classified as a negative attribution. The opposing positive attribution for failure would be a lack of effort (Clinkenbeard, 2012). These causal attributions fit with the predicted differential values of effort associated with fixed and growth mind-sets. I went on to ask Isaac if he valued the process over reaching the solution.

I'd say the process, definitely. I think that's where you sort of understand it. You can be given an answer to something... but, the actual process of how you get there...I think that's definitely more important.

Students Henry, Chris and Isaac all expressed the belief that the effort in working through the problem was more valuable to them than getting the answer at the end.

Given that Isaac was assigned as a fixed mind-set theorist, his value of effort is at odds with his predicted performance-goal orientation. I asked Isaac to further explain this belief.

Like if you give someone the answer...and maybe they'll understand...but, whereas if you've worked through that middle gap getting every single sort of stage...understanding, or maybe not understanding, but then eventually understanding. Sort of that...the learning bit of it, which is more important.

Here Isaac gives an insight into his conceptualisation of learning as working through a series of stages that leads to the development of understanding. Isaac's response has confirmed the high importance he places on effort as a key component in the learning process. This conceptualisation of learning as a process resonates with Kolb's (1984) learning cycle. Furthermore, Isaac's description of stages of both understanding and not understanding relate to Vygotsky's (1978) zone of proximal development where the learner goes through stages of deconstruction of prior knowledge and reconstruction of new, deeper knowledge. The metacognitive perspective of Isaac's explanation is an affirmation of his higher cognitive abilities and reveals a complex, personal reasoning for valuing effort. This did not, however, result in Isaac engaging positively with the challenging task.

During the data processing and problem-solving lesson, Adam was observed asking questions, but at the same time, struggling to identify and apply strategies to answer his questions. When asked during the interview to comment on how he felt about working on the problem Adam acknowledged that he had difficulties with the task.

I was a little bit confused...I didn't know how we were supposed to answer it.

It was quite challenging because we didn't know how to process it...it became really challenging. We didn't know what we were looking for at all.

Like Isaac, Adam exhibited some helplessness when trying to solve the problem.

However, Adam had previously been assigned as holding a growth ITI mind-set and, so, his predicted and actual behaviours were at odds.

When asked if the process of working through the problem or reaching the solution was more important, Adam gave a similar answer to those given by students Henry, Chris and Isaac.

I think the process of doing something, of doing that in particular, was more important because I was able to see ways in which it was right and wasn't right.

We were reading off the graph the answers...we were like that's happened, but, why's that happened...you should question it all the time.

Adam's belief that the effort of working through the problem outweighs reaching the answer is in agreement with his associated growth ITI mind-set. However, Adam was not observed to be positively engaged with the problem as the growth mind-set model predicts. In his final comment, 'you should question it all the time', and combined with my observations of him asking questions throughout the lesson, it is possible that Adam perceived that he was engaged with the task. Like Isaac, Adam has emphasised understanding as having value, but, rather than explaining this in terms of cognitive processing Adam focuses on questioning as evidence of making progress. This interpretation of Adam's behaviours and interview responses calls into question a shared meaning of engagement with the task.

Researcher's reflections: At this stage of the data analysis my own understanding of engagement with the task became clearer. My judgements about engagement focused upon two aspects of the students' behaviours that were linked; specifically, that they used different strategies to solve the problem and were able to make progress by selecting the successful approaches. To link these actions required the students to verbalise their thought processes. In the cases of Chris and Isaac, they did not share their thinking with others in the group and this prevented effective evaluation of the strategies they tried. Adam was different in that he shared his thinking through asking questions. However, Adam's questions did not lead his group to select effective strategies to solve the problem. The possible reasons for this can be considered from the perspectives of the student's questioning and the group members' responses to the questions. Specifically, Adam's questions focused upon actions: for example, 'What do we need to do with these results?' and 'Should we plot the times on a graph?' He did not give details about each action, such as which variables to plot, or explain his reasoning. As such, it may be that the limited nature of Adam's verbalisation of his thinking lacked the necessary cognitive details to enable a collective understanding to be reached by the members of the group.

The central importance of communicating stages of thinking to effective problem-solving was recognised by Elliott and Dweck (1988) in their study that linked goal-orientation and learning behaviours. My findings support verbalisation of thinking as a key indicator of positive engagement, but also that expression of detailed cognitive processing is necessary to enable progression when given a challenging problem to solve. Where Whybra (2000) found that working with others of equal or greater intellectual ability was needed to develop argument and discussion, my findings suggest that skills of social interaction are also needed. Whilst Adam

expressed a learning goal-orientation that was in agreement with his assigned growth mind-set, his difficulty to make progress with the challenging task could be argued to be, at least in part, due to limited powers of expression.

Nathan was assigned as a growth theorist from his questionnaire responses. When shown the video clips of him working and then being asked to comment on his engagement with the problem, Nathan's comments were similar to those of Henry and William. Nathan was not put off by the higher level of challenge.

...obviously it was going to be more challenging...it wasn't something that couldn't be done.

In the last part of this comment and in common with William, Nathan expressed a high level of academic self-efficacy (Schunk, Pintrich and Meece, 2008). Nathan also rationalised increased challenge in the classroom as a means to achieving independence as a learner.

...this kind of made you think more than perhaps you would, which is kind of what we have to do in Year Eleven. Coming up to our GCSEs you have to learn to think for yourself. You're not going to have your teacher in your exams telling you what to do.

Clinkenbeard (1996) described student independence as one of the constructs associated with intrinsic motivation. That Nathan was more intrinsically motivated is concordant with my observations of his positive engagement with the task. He went on to describe another attribute that is associated with intrinsic motivation, perseverance.

It took time to think stuff through and just look over our results again. It took time, but, in the end we realised what we had to do.

In this comment, Nathan is also attributing his successful completion of the task to the efforts made by him and his group. Whilst this supports the growth ITI mind-set assigned to Nathan, it was important at this point to establish whether he held the associated learning goal-orientation.

I think it's more important going through the process, but the fact that you did get an answer is very important. You could have gone through the process and then not had an answer...it wouldn't be conclusive. You wouldn't know what you did wrong and, if you did do something wrong, you wouldn't really have known if you could've changed it.

In common with all the other student interviewees, Nathan recognised the value of working through the problem. He, like William, also mentioned the importance of reaching the answer. William and Nathan appeared to have beliefs associated with both performance and learning goal orientations even though they were assigned as holding opposing ITI mind-sets. They differed in the balance of importance each placed on effort over finding the solution: Nathan rates effort more highly, whereas William was more focused on reaching the answer.

4.4 Summary and key points: students' engagement with the challenging task

Students' descriptions of their experiences of working on the problem were in agreement with my interpretations of their positive or helpless responses. In particular, how the students responded to feelings of uncertainty and frustration as they tried to process their experimental data to find the solution matched their observed levels of engagement. Henry, William and Nathan who showed all the signs of positive engagement defined by Elliott and Dweck (1988) were motivated by their uncertainties to extend their problem-solving strategies, which accelerated their progress and led to successful completion of the task. The feelings of frustration experienced by Chris, Isaac and Adam were expressed as negative emotions, which resulted in restricted strategy choices and little progress towards a solution. That the students were confident to admit a lack of understanding and feelings of frustration indicates trust between participants and researcher. As such, the students' comments are reliable indicators of their thoughts, values and beliefs. Confidence to admit a lack of understanding was noted by Clinkenbeard (1996) as a characteristic of able students who hold learning goals and who are intrinsically motivated.

In this case study, all the students described a learning goal in the context of solving the problem, either in terms of developing understanding or as a means to become a more independent learner. At the same time, Chris, William and Nathan also stated the importance of getting to the answer. Given that goal-orientation underpins the framework of ITI, the potential to hold both learning and performance goals when working on a specific task could lead to a similar combining of fixed and growth mind-set characteristics. The following section of this chapter, 4.5, goes on to

analyse the students' responses to questions about their ITI mind-set in the specific context of their experiences solving the challenging problem.

As goal-orientation is an integral part of the theoretical framework of ITI mind-set, it is also related to intrinsic/ extrinsic motivation theory because both are concerned with valuing the task. Furthermore, the characteristics of intrinsically motivated learners overlap with those applied to positively engaged learners (Elliott and Dweck, 1988). Henry, William and Nathan were observed to be positively engaged with the task and they expressed curiosity, interest and a focus on the task during their interviews. It cannot be directly concluded, however, that Chris, Isaac and Adam were extrinsically motivated throughout the task as they did not mention exam grades, rewards, perceptions of being in competition with other students or other extrinsic interventions applied by teachers and parents as a motivating factor (Schunk, Pintrich and Meece, 2008). Only that Chris and Isaac sought the help of others after limited attempts to solve the problem offers indirect evidence of the influence of extrinsic motivating factors (Clinkenbeard, 1996).

Whilst goal orientation and intrinsic/ extrinsic motivation theories provided a framework within which the students' values for working on the problem could be interpreted, application of self-efficacy and attribution theories revealed some students' beliefs about their abilities to reach the solution. These aspects of a learner's self-confidence have been cited by Crozier (1997) as personality traits that affect behavioural responses to challenging tasks. Also, personality, along with challenge and motivation, is the third contributory factor in Montgomery's (2009) model of underachievement of able students. Examining the students' interview responses to elucidate what impact self-confidence may have had on engagement

addressed the personality perspective of the theoretical framework within which I have located the model of ITI mind-sets.

William and Nathan both expressed beliefs in their self-efficacy to complete the task. It can be inferred from the negative emotions that the task evoked in Chris, Isaac and Adam that they experienced some anxiety and, so, held lower self-efficacy beliefs. The observed positive engagement and successful outcomes of the efforts of William and Nathan in comparison with Chris, Isaac and Adam, are in agreement with predictions based upon the theory of self-efficacy (Bandura, 1986). These outcomes take into account comparable levels of ability and value placed upon the task. It is important to acknowledge, however, the tentative and limited nature of the links between the data and theoretical predictions with regard to aspects of the students' personalities.

To conclude, the questionnaire outcomes, lesson observations and video-stimulated interview data revealed complex relationships between the students' perceptions of and responses to the challenging task, and the students' motivations to solve the problem. These findings reflected the overlapping domains of Montgomery's (2009) model of underachievement of able students. When viewed through the lens of goal-orientation theory, the data revealed two key points: some students held both performance and learning goals, and an individual's goal-orientation can be at odds with their observed response to the challenging task. The diversity of relationships between these factors is further complicated by the mismatch seen between predicted responses to challenge based upon students' ITI mind-set questionnaire scores and their observed responses in lessons.

4.5 Students' responses to questions about their ITI mind-set in the context of their experiences solving the challenging problem

In this section of the chapter, each student's interview responses are reported as individual narratives. This structure was chosen in recognition of the personal nature of each student's conceptualisation of their intelligence and to accommodate the range of themes emerging from the data. Common features between the narratives are highlighted and discussed, alongside relevant links to the model of ITI and other theories.

4.5.1 Henry's Story

I gave Henry an opportunity to review his questionnaire responses and he confirmed that he still agreed with his chosen answers. I asked Henry if he thought that working through the problem would have changed his intelligence.

I'm not sure [if working through the problem]...it really kind of depends what we say intelligence is...you can have intelligence as an IQ test...then people can have a lot higher IQs, but, I wouldn't necessarily say they're more intelligent than say...someone else who's got more practical skills.

Here Henry is showing that he does not have a defined framework of what he understands as intelligence, although he appears to hold a belief related to the concept of multiple intelligences. Henry then went on to explain how he thought working on the problem impacted on his intelligence.

I don't know if I can actually change it...I don't know if the process kind of improves my intelligence as such. I think it helps to maybe use it in different ways. So, rather than actually growing or making it better, you actually just kind of learn how to use it in different ways.

Henry's conclusion that intelligence couldn't be increased is in line with the fixed mind-set. However, he does believe that working on the challenging task impacted

on his intelligence, specifically in terms of increasing his capacity to adapt his intelligence to, perhaps, solve different problems or problems set in different contexts. This brings another dimension to the theoretical fixed mind-set conceptualisation of intelligence, one which blends the fixed mind-set belief of an upper limit on the individual's intelligence with the growth mind-set value of effort improving intelligence. A case of quality over quantity.

To further understand the emerging picture of Henry's conceptualisation of his intelligence, I asked him how he thought his level of intelligence affected him as he worked on the problem.

I don't necessarily think my level of intelligence would have helped, but, maybe just the way I think about things.

This confirmed that Henry perceives intelligence as a quantifiable entity, but also, that his conceptualisation of intelligence is centred on his abilities to apply his intelligence in multiple ways. Henry then used examples to relate his ideas to his experiences.

Some people do well in different subjects. So, if somebody who does really bad [sic] at science might be really good in English just 'cause of the way they think and the way their mind works.

Henry's choice of Science versus English to explain why he values applicability of intelligence over amount of intelligence suggests that the concept of different thinking skills plays an important role in his understanding of intelligence. It may be that Henry assumes that different subjects demand mutually exclusive types of thinking. It is possible then that Henry assesses his own strengths and weaknesses in terms of how well he applies certain thinking skills rather than what his perceived level of intelligence will enable him to do.

This interpretation of Henry's conceptualisation of intelligence was supported by his answer to my question, 'How important is effort?'

I think it's probably more important than being clever.

Taken together, Henry's responses reveal his tacit acceptance of intelligence as being 'fixed', but, at the same time not being the principal factor affecting his ability to engage with challenging tasks. Given that Henry earlier demonstrated the positive learning behaviours and expressed some of the values and beliefs associated with the growth mind-set, his assertion that he can improve the way he uses his intelligence through effort makes sense.

4.5.2 Chris' Story

In common with Henry, Chris expressed some values and beliefs that were at odds with his assigned ITI mind-set. When asked to comment on the statement 'you have a certain amount of intelligence and you can't really do much to change it' Chris combined components of both growth and fixed mind-set models of intelligence.

Certain people might have a set bigger intelligence that they could work towards...you're sort of at a lower stage and you gradually build your intelligence...like a balloon...it's blowing up, but, there's only a certain amount of space it can fill.

Chris perceives a limit to each individual's intelligence and those limits are different for different people. However, the individual is not born with their maximum level of intelligence, but, must work towards achieving it. I asked Chris what he would have to do to achieve the higher intelligence.

Education obviously, but, there's learning and then there's intelligence that are kind of different...you can learn new things, but, it doesn't really change your intelligence. Intelligence is, I'd say, more learning how to solve things rather than learning facts about solving things.

Chris is struggling at first to define his understanding of intelligence, but, then goes on to assert his belief that intelligence is more about being able to apply your thinking than the extent of an individual's factual knowledge. In this respect, Chris shares with Henry a similar conceptualisation of intelligence. Nevertheless, there is a key difference between their personal frameworks of understanding that is revealed by Chris's analogy of increasing intelligence as blowing up a balloon. It could be interpreted that in his analogy Chris has focused on the capacity dimension of intelligence as a limiting factor, whereas Henry in his responses emphasised the adaptability dimension of intelligence. Also, by expressing the fixed mind-set belief that intelligence can't be changed Chris reinforces the concept of a limit of intelligence. It is in a subtly different balance of importance placed upon intelligence as a limited entity over intelligence as an adaptable entity that may underpin Chris's lower level of engagement with the challenging task.

I directly asked Chris if carrying out the problem solving task helped him to increase his intelligence.

...because it's a more difficult sort of experiment than we've done before, it's sort of enhancing your intelligence 'cause you've done something more difficult than you would do before and then work your way towards it.

Chris's choice of 'enhancing' rather than 'increasing' intelligence may be significant as it supports his understanding of intelligence as limited, but, also suggests an improvement of intelligence, which is in agreement with his previous assertion that intelligence is about being able to apply your thinking.

I completed the interview with Chris by asking him if his ideas about intelligence and how working on challenging tasks impacted on his intelligence were the same in other subjects.

I'd say yeah...everything in the school is quite similar ...it's all problems and you're gradually getting harder and harder problems...my ideas are quite similar across the different subjects.

Here Chris's response contrasts markedly with Henry's association of ways of thinking with different areas of the curriculum.

4.5.3 William's Story

When working through the problem-solving task William, like Henry, exhibited the opposite behaviours to those expected of a fixed mind-set theorist. Using his response to the first questionnaire item as a starting point, I asked William why he thought his intelligence won't change.

I know that the way I think is very logical; like maths I'm very good at, but, English literature I have to work really hard at to do well. I can learn English, I can get better, I can learn the technique, but, never ever be naturally good at it...I'll always have to work hard at it. Whereas with things like Maths, they just kind of come more naturally...the way in which your brain works is something you can't change...there's nothing you can do about that.

There are clear parallels between William's and Henry's conceptualisations of intelligence; both students focus upon thinking skills and attribute different thinking skills to different areas of the curriculum. William's response, however, reveals more about his conceptualisation of his own intelligence because he relates his beliefs to a self-evaluation of his strengths and weaknesses. William associates logical thinking with Mathematics and regards logical thinking skills as an innate cognitive ability. In this way William has redefined the original statement within the questionnaire item,

replacing 'intelligence' with 'the way in which your brain works'. Within this conceptualisation of intelligence, William expressed the fixed mind-set belief that his intelligence could not be changed.

Another similarity between William's and Henry's conceptualisations of intelligence was their choice of contrasting subjects (English versus Mathematics and Science).

In her report "Mindsets and Math/Science Achievement" (2008), Dweck extended the meaning of 'intelligence' within the model of ITI mind-sets to incorporate 'Math and Science ability'. This domain specific definition more closely resembles the students' own descriptions of their understandings of intelligence. Interestingly, Dweck also refined her description of the growth mind-set using the Mathematics and Science ability dimension of intelligence: students who believe their abilities can be developed. The interview responses of Henry, Chris and William reflect the subtle, but, significant substitution of terminology, using developed rather than increased intelligence that appears in the questionnaire items. Both Henry and William referred to ways of thinking and how the brain works, and Chris spoke of enhancing intelligence. As William had expressed a definite belief that the way a person's brain works cannot be changed, I wanted to test this idea within the specific context of the problem-solving task. I asked William if carrying out an open-ended problem impacts on the way he thinks.

The way you come up with ideas can improve...you can think of different ways of doing it. When I looked at the problem, I'm sure I looked at it in a different way other people would have looked at it.

As earlier in his interview, William expressed beliefs associated with both the fixed and growth mind-set theories. The concept of improving the adaptability of intelligence echoes the beliefs expressed by both Henry and Chris, and fits with the

refined growth mind-set concept of developing ability. Within his answer, however, William also refers to differences between people that could be interpreted as innate or, as he expressed in his previous response, thinking that comes ‘more naturally’. The concept of innate ability suggests an unchanging and quantifiable characteristic of intelligence that could be determined by genetic differences between individuals. Interestingly, Dweck refined the fixed mind-set description of intelligence within the Mathematics and Science domain as a fixed ‘trait’, the terminology used by biologists to describe characteristics determined by the genes. Taken together, the conceptualisations of intelligence described by Henry, Chris and William support the refined definitions employed by Dweck. Furthermore, William’s belief that his innate abilities in English (and by extension the thinking skills required to achieve highly in English) are at a lower level than his abilities in Science lead to the conclusion that he may hold different ITI mind-sets in different subjects. To further explore this possibility, I asked William if he were given a challenging text to interpret in English would he feel he might have reached the limit of his intelligence.

Yeah...there probably would [be a limit to what I could do]. I can work hard, but, there’s definitely a limit to what I’ll see in English.

I then asked William if he felt the same way about Mathematics and Science.

With Science and Maths, if I was taught something new I’d pick it up, then if I went further I’d just keep picking it up.

So in terms of his English studies, William’s assigned fixed mind-set correctly predicts his perception of a limit to his abilities that cannot be increased through effort. Conversely, William sees no limit to his learning in Science and Mathematics. What is not clear is if William attributes his progression in Science and Mathematics to his efforts, innate abilities or a combination of both. Nevertheless, in the final

comment William made during his interview he indirectly indicated that he did not make as great an effort in English as he does in Science or Mathematics.

I kind of know that I'm not as good at it [English], so it hinders me in a way because I know I'm not as good at it. I don't feel as motivated or as confident when I'm doing it.

This statement reinforces William's fixed mind-set as regards his English studies because of the negative impact it appears to have on his motivation and confidence. Since William is comparing his attitudes to learning English with those he holds towards Science and Mathematics, it can be inferred that his academic self-perception varies across curriculum areas and has a significant impact upon his engagement with challenge. According to the model of ITI, William's fixed mind-set approach to his English studies could lead to underachievement because the limits he perceives on his abilities prompt an avoidance of tasks that test those abilities. In a previous statement, however, William said 'I have to work really hard to do well' in English. This is a significant finding as it presents the possibility that fixed mind-set beliefs do not necessarily prompt students to low levels of effort. It may also be the case that William, as an academically able student, could still achieve his A*/A target GCSE grade in English because the limits he perceives on his abilities are beyond GCSE level. As such, William would recognise the benefits of making an effort.

4.5.4 Isaac's Story

Where William's fixed mind-set conceptualisation was at odds with his positive engagement with the challenging task, Isaac's helpless response was predicted by his assigned fixed mind-set. When I asked Isaac to explain why he agreed with the statement 'You have a certain amount of intelligence and you can't really do much to

change it', his comments resonated with Henry's and William's beliefs about individuals having natural abilities.

Yeah, I think people have their abilities to do things...some people won't necessarily be intelligent in the sense they know their times tables, but, also practicalities as well. My Dad, anything that needs fixing he fixes. You definitely have your own set of abilities.

Isaac's comments show that his understanding of intelligence incorporates ideas of capacity of knowing and being able to apply thinking to complete practical tasks.

Isaac's reference to his Father's practical skills could be an indicator of the relative value Isaac places on the knowing and applicability dimensions of his concept of intelligence. This is interesting because Isaac was the student whose engagement levels in the practical and cognitive stages of the problem-solving task were different; Isaac confidently carried out each practical skill as he gathered data for his group, but, lacked confidence and avoided engagement with the data processing stages. So, whilst Isaac's concept of intelligence focuses on abilities, it is possible that Isaac's definition of ability is narrower than those of Henry and William.

Even though Isaac asserted the fixed mind-set belief that abilities are predetermined and unchanging, he had earlier in his interview expressed the belief that effort in working through the problem was more valuable than getting the answer at the end. To resolve this apparent contradiction, I asked Isaac to explain if he agreed with the statement 'your intelligence is something about you that you can't change very much'.

I think not necessarily change your intelligence, but, how it's used. So, you'll have someone at this school who's pushed a lot to reach their potential...so, in that sense, you've got a fixed limit of intelligence and you can't change that.

Describing the impact of effort in terms of improving the applicability and adaptability of thinking is a common theme within the ITI mind-set frameworks of the four students interviewed up to this point. However in the second part of his answer, Isaac qualified effort in terms of being ‘pushed a lot’. This can be interpreted as an extrinsic motivation since it implies external expectations and interventions, from teachers and parents perhaps, as the driving force for students’ efforts. As none of the other students interviewed had explicitly mentioned extrinsic factors in relation to effort and attainment, Isaac’s comment may reveal an aspect of his personality that contributed to his fixed mind-set conceptualisation and his helpless behaviours observed during the data processing lesson. Since Isaac had also specified ‘at this school’, I asked him if he thought students were pushed more towards attainment or greater efforts.

Attainment. They encourage effort to a certain extent.

Isaac perceives a performance-goal culture within the school and this may influence his fixed mind-set stance and learning behaviours when given a challenging task.

The model of ITI predicts that if Isaac perceives that his teachers hold a performance-goal orientation, it follows that Isaac believes his teachers will value students’ abilities over their levels of effort. In her report “Mind-sets and Equitable Education” (2010b), Dweck described the negative impact that teachers’ fixed mind-sets can have on students’ learning and attainment. For example, praising students for their intelligence resulted in students losing confidence, motivation and not coping with learning they found challenging (Mueller and Dweck, 1998). This example is pertinent to Isaac’s following comments.

I don’t really think that awards should be given for attainment because some people are better at things than others and to reward someone for something they haven’t worked at, I don’t think that’s very fair.

Even though Isaac holds a belief that individuals have set abilities, he has confirmed the value he places on making an effort. Furthermore, the higher importance Isaac places on effort over attainment conflicts with his perception of the school's performance goal-orientation.

As the only student in the case study whose assigned fixed mind-set correctly predicted his helpless response to the problem-solving task, it was important to establish the reasoning that underpinned each of Isaac's questionnaire answers. Isaac explained why he agreed with the third item, 'you can learn new things, but, you can't really change your basic intelligence'.

Yeah, 'cause you've got your fixed abilities, but, learning is not necessarily related to intelligence. It's just you know how to do something. I think a lot of the time school isn't necessarily about how intelligent you are, but, how good you are at memorising stuff.

Where Henry, Chris and William discussed adaptability and enhancement of thinking skills as the benefits of effort, Isaac appeared here to be focusing on retention of information as the product of effort most valued in school. It is not clear if Isaac is referring to the expectations and values of his teachers or if he has a broader meaning of 'school' that encompasses his perception of the institutional ethos. Interestingly, Isaac did not say '*the* school' in his answer and, so, it may be the case that Isaac was also referring to his perception of educational outcomes that are valued at the national level. Whatever his precise intentions, Isaac's comments suggest a conflict between his own valuing of effort and the performance-goal orientation of his school setting. It may be the case that alongside Isaac's conceptualisation of intelligence as fixed abilities that defines what he can and can't

do, the imposition of school-based values that conflict with his own will compound feelings of helplessness.

Isaac's comments also showed that his conceptualisation of intelligence is less well defined than his understanding of how he learns. Earlier in his interview, Isaac had revealed his conceptualisation of learning as a process that resonated with Kolb's (1984) learning cycle and Vygotsky's (1978) zone of proximal development. Here, Isaac is separating learning from intelligence. Since Isaac had repeatedly expressed a strongly held fixed mind-set belief about intelligence, it was important to further explore his concept of intelligence in the context of the challenging task to ensure that his beliefs were reflected in his behaviours and actions rather than simply being abstract concepts. I asked Isaac if working on the open-ended problem had an impact on his intelligence.

I think it didn't really increase my intelligence. It was really beneficial, I think, in the sense that you are put out of your comfort zone...you have to think in different ways. But, maybe learning new ways to think, especially when you do get to that answer and you go through the process of getting it, 'cause that's where you sort of develop intelligence. You don't necessarily gain it or lose it doing things, but, you sort of...you use it. By going through the process in that experiment some people develop their intelligence...they learnt sort of how to approach it...but, not necessarily intelligence.

Isaac's explanation shares common themes with the conceptualisations of Henry, Chris and William in that they all saw the outcomes of working on the challenging task as improving their abilities to apply their thinking. Here Isaac talked about the development of intelligence, which resonates with Chris' description of enhancing intelligence. Of interest is Isaac's comment that the challenging task put him out of his 'comfort zone' as this is a phrase that relates to Vygotsky's theory of learning. Considering Isaac's previous comment where he separated learning and intelligence, it appears that by replacing intelligence with ways of thinking Isaac is able to unite

his beliefs and values about challenge, effort and learning. In his final comment above, Isaac confirms that his concept of intelligence is not well defined and, by referring to ‘some people’ rather than directly referring to himself, Isaac appears uncertain of the impact the task had on his own intelligence.

At the end of his interview, I gave Isaac an opportunity to make additional comments about the task or his questionnaire responses. Isaac chose to further discuss his concept of intelligence.

The whole of intelligence...what is it? A lot of the time someone might be incredible at something, but, because of the way your education is like...not necessarily the education system, but, like the opportunities, you're not taught to do these things, but, someone might have natural ability to do these things. Like a musician, some people are naturally amazing at music and that can't be taught...that could be intelligence, if you want to call it that, or it's natural talent. But, what intelligence is, I couldn't say.

Isaac was open about the difficulties he has defining his understanding of intelligence, although his concluding comments did give an insight into the nature of the attribute that he believes is fixed. In Isaac's mind-set, it is ‘natural ability’ that cannot be changed, a perception that resonates with William's self-evaluation of the subjects he is ‘naturally good at’. Isaac used a subject specific example, in his case music, to illustrate his belief that individuals have fixed abilities. Both of the other assigned fixed mind-set theorists, Henry and William, referred to specific subjects as they explained their conceptualisations of intelligence. For these students, this common characteristic can be interpreted as a consequence of holding a fixed mind-set; a manifestation of the limits of ability mapped onto the structure of the secondary curriculum. From another perspective, the organisation of the secondary curriculum as subject areas that are taught as discreet lessons in separate school

departments may reinforce existing beliefs that individuals have set abilities and limits to their intelligence.

4.5.5 Adam's Story

In his questionnaire responses, Adam was assigned as the growth mind-set theorist with the highest score. He strongly disagreed with the questionnaire statements and confirmed these responses again during his interview. When asked to explain why he disagreed with the statement that 'you have a certain amount of intelligence and you can't really do much about it' Adam expressed the growth mind-set belief that effort can increase intelligence.

When they [famous philosophers] asked a question that seems really intelligent that other people haven't thought of, they've worked towards that question, they haven't just had that from birth.

Like Henry, William and Isaac, Adam also made reference to innate abilities.

However, in Adam's construct there is a capacity for the individual to increase their intelligence that was not expressed by the fixed mind-set theorists. In this respect, Adam's explanation validates his assigned growth mind-set stance. However, Adam did not respond positively to the challenging task, so, I asked him if his belief that intelligence could be increased through effort applied to him also.

My concentration wasn't amazingly high, but, when I really try concentrating...I think that my intelligence increases in certain subjects. So, I consider myself smarter, but, then when I'm like not really paying attention to something I lose everything and my intelligence sort of decreases.

In the first part of his answer Adam revealed that he had not maintained his concentration during the task, which can be interpreted as an admission of having exerted lower effort levels. It appears here that Adam was attributing his failure to

answer the problem to a lack of effort. Ames, Ames and Felker (1977) found that children who cite a lack of effort as the reason for their failure also hold learning goals. This is in agreement with my interpretation that Adam's focus on working through the problem was an indicator of his having a learning goal orientation. Taken together, Adam's complete answer is an extension to the growth mind-set conceptualisation; intelligence can be increased through effort, but, can also decrease through lack of effort. Nevertheless, Adam does qualify this by saying 'in certain subjects' and I asked him in which subjects he thought he could increase his intelligence.

I think the Sciences to a low level. You can't really change much 'cause it's a set answer. Some things, like R.E. [Religious Education] or to an extent Economics, I think you can question things. You can ask different questions about and you can question the overall ideas.

Adam was the student who was observed to pose questions throughout the data processing task, although this was not an effective strategy for solving the problem. Also, Adam's earlier interview responses suggested that he valued questioning as a key indicator of his engagement with a task. By referring again to the importance he places on questioning in the comment above, Adam revealed a distinction between how he perceives the nature of knowledge in Science versus subjects that could be defined as humanities. Adam's narrow perspective of scientific inquiry can be interpreted within Perry's scheme of intellectual and ethical development (1970). Within this framework, Adam's acknowledgement that ambiguity exists in some areas of knowledge places his cognitive development in a transitional phase referred to as multiplicity. Perry highlighted subjects such as Sociology and Politics as areas where students begin to recognise contestable knowledge, which relates to Adam's identification of Religious Education and Economics as areas of the curriculum

where ‘you can question things’. At the same time, Adam sees only correct and incorrect answers to scientific problems. The potential impact of Adam’s more basic conceptualisation of scientific inquiry is that he will struggle to cope with open-ended problems that require a more diverse or creative approach to solve. Perry proposed nine stages of development in his framework and Adam’s comments place him between stages three and four, early to late multiplicity.

Perry (1970) proposed that learners in the multiplicity stage of intellectual development have not yet acquired the skills of metacognition. Furthermore, Perry described a stance of ‘playing the game’ where the learner struggles to independently apply critical cognitive skills and instead copies the behaviours and answers they believe their teachers will value. Both these descriptions resonate with Adam’s response to the challenging problem solving task. The questions that Adam put to his team members referred to individual functions that did not form a coherent cognitive strategy. Adam’s questions did not spring from critical evaluation of the approaches his team were trying as they attempted to solve the problem. Within Perry’s model, Adam’s questioning could be interpreted as the behaviour he associates with being actively engaged with the problem solving task.

To conclude the interview, I asked Adam if his intelligence had benefitted or grown because of working through the problem solving activity. He confirmed his earlier comments.

I think that my intelligence has definitely increased, especially in like the problem solving area.

Adam was the only one who referred to intelligence increasing; the other students referred to enhanced or improved abilities. However, by specifying ‘the problem

solving area' Adam was referring to the ability dimension rather than the knowledge dimension of intelligence. Overall, Adam's conceptualisation of intelligence and the impact of his efforts as he worked through the challenging problem closely resemble those of his fellow interviewees. This reinforces my earlier concern about the validity of the questionnaire as a means of assigning mind-sets to the students in this case. A critical factor was how each student interpreted the term intelligence and this is further discussed in section 5.2.2 of the Discussion and Conclusions chapter.

4.5.6 Nathan's Story

Nathan was the only student in the case study whose observed engagement with challenging problem matched the positive behaviours predicted by his assigned growth mind-set. Although Nathan didn't take the lead during the practical or data processing stages of the task, he was an active participant who contributed to his group's critical evaluation of the strategies they tried. After confirming that he still strongly disagreed with the first and second questionnaire items ('you have a certain amount of intelligence and you really can't do much to change it' and 'your intelligence is something about you that you can't change'), I asked Nathan if working on the problem had an impact on his intelligence.

Err...intelligence...it kind of depends on what you're doing. Personally, I'm not taking A-level Biology and I'm probably not going to see this stuff again unless it's in an exam. So, in the long run it might not really affect my intelligence that much whereas other people in the class who are thinking of taking A-level Biology, who are probably going to do Biology at Uni., will help them because they're probably going to do more experiments of this kind. So, it would probably help them to develop their intelligence.

In his response Nathan expressed a tacit acceptance that the efforts of working through the challenging problem solving task affected his intelligence. I have, however, quoted his full answer to my question as it revealed that Nathan held a

more complex belief about the impact of effort on intelligence. Specifically, that the improvements to intelligence are subject specific and, as such, will only be of benefit if he is required to apply the gained knowledge and skills in the same subject, probably at a higher level of study. These ideas resonate with those of Henry, William, Isaac and Adam who all qualified their conceptualisations of intelligence in terms of different subjects. In his following comments, Nathan further aligned his conceptualisation of intelligence with those of the other interviewees.

So, intelligence is how you adapt your knowledge and skills in different circumstances. So, for the circumstances I'm going to be in it's probably not going to help me as much as it's going to help another person.

Like the others interviewed before him, Nathan focused on adaptability as the effect on his intelligence. Nathan also described two strands, knowledge and skills, in his conceptualisation of intelligence. At the end of his answer Nathan confirmed his earlier assertion that the improvements to his intelligence were less valuable as he was unlikely to use the specific knowledge and skills gained. To further explore this belief I asked Nathan if his intelligence needs to be used many times over.

On occasions it can be used again and again, but, on some stuff it can be used just once and just imprinted on your brain. So singing...if I hear a tune once I just learn that and I don't have to do it again and again. Like in a couple of years I'll still know it, but, if it was something like a date in History I'm likely to forget that in about a week.

Nathan's description of his experiences of learning Music and History, and the examples he uses to illustrate his point revealed an interesting aspect of his self-perception. Specifically, Nathan has referred to examples of acquiring factual knowledge, albeit in the different forms of a piece of music versus numerical data. This is reminiscent of Isaac's comment about retention of facts ('I think a lot of the time school isn't necessarily about how intelligent you are, but, how good you are at

memorising stuff"). There is a practical skill aspect to Nathan's musical example, in that it is related to listening and singing, and it may be the case that Nathan considers this to be in the category of adapting skills. His comments may indicate a preference for skill-based activities, so I asked Nathan if an open-ended activity, like the problem-solving task, had a bigger impact on his intelligence.

I think so...the way we did the experiment, you have to be switched on one hundred per cent of the time. So, you can't just turn around and talk about something for five minutes and then turn back again and try to carry on because there's no set thing to do. You actually have to think about how you're doing it. So, you have to be talking about the actual topic and talking about why you're doing this and why you're doing a certain type of graph. So, yeah, I think it will affect your intelligence more.

Nathan's answer confirmed that the task was challenging as it demanded a greater focus of attention. Furthermore, he described the metacognition and group discussion I observed to be essential components of effective strategy choice. Taken together, Nathan's comments showed that he believed the efforts of working on the challenging problem-solving task had a positive effect on his intelligence. This is in agreement with Nathan's assigned growth mind-set and positive engagement with the task. To further test this significant finding, I asked Nathan if he were given the choice would he opt for an open-ended task or a one with some instruction.

At the time I probably would have gone for the set list, but, after actually doing the open [ended] one I reckon if I could go back I would do the open [ended] one. As I said, it would expand my intelligence more than a set list would have done. It was better for me.

Here, Nathan has confirmed his earlier assertion that the more challenging task has a greater impact on his intelligence. His final comment showed that his beliefs were not just based upon abstract concepts, but, were directly related to his experience of working through the problem.

Given that all the other students interviewed had blended fixed and growth mind-set associated beliefs and values, I wanted to find out if Nathan had a similar combined or wholly growth mind-set conceptualisation of intelligence. I asked Nathan if he thought he could keep increasing his intelligence.

You can increase your intelligence, but, there has to be a point where, personally, you can't exactly go higher at a certain point. You're further enhancing your abilities in a subject.

There are clear parallels between Nathan's conceptualisation of intelligence and those of Henry, Chris, William and Isaac; he perceives an upper limit or set potential to intelligence that the individual can work towards. Nathan, like Chris, uses the term 'enhancing' to describe the impact on intelligence, although he also specifies the ability dimension of intelligence in his comment. To tie together Nathan's combined growth and fixed mind-set conceptualisation of intelligence and his earlier assertion that challenging tasks have a greater impact on intelligence, I asked him if challenging work is more likely to increase his intelligence within its potential.

I think so, yeah. Being an open-ended experiment you can go all the way to the boundaries of your potential because otherwise with a set list you just read it, which is something you learn very early on. Whereas, with the open [ended] experiment you have to interpret stuff, you're having to think further. You have to think about how you're doing stuff and it will increase your intelligence because it shows you in what way you have to do different stuff.

In Nathan's answer he makes reference to reading, which he views as a lower level skill, and contrasts this with higher level thinking skills such as interpretation and evaluation. By associating higher level thinking skills with increasing intelligence to its limits, Nathan has constructed a coherent framework of intelligence that accommodates the value of effort within an entity perspective of intelligence.

4.6 Key findings: students' responses to questions about their ITI mind-set in the context of their experiences solving the challenging problem.

In this summary I have drawn together the themes, beliefs and influences emerging from the students' interview responses to questions about their conceptualisation of intelligence and how these relate to their classroom experiences. Seven key findings are identified and described. The first two key findings arose from data that directly relate to my research question: do able students' ITI mind-sets impact upon their levels of engagement with a challenging learning task? The other five key findings emerged from secondary data that are a consequence of the exploratory, open-ended nature of the student interviews. These key findings are relevant to the overall conclusions drawn from this case study because they contribute to the understanding of the factors that modulate the complex patterns of students' conceptualisations of intelligence and their behaviours. They also provide evidence for the critical evaluation of the research design, methodology and methods that were employed. Each of the key findings are developed and appraised within the Discussion and Conclusions chapter and referred to in the final chapter that critically evaluates my research approach.

A summary table (Table 4.6) on the following page has been constructed to help the reader to gain an overall view of the commonalities and diversities between the students' conceptualisations, and to relate these to the students' assigned mind-sets and observed responses to the challenging problem.

Table 4.6: Summary of students' assigned ITI mind-sets, classroom responses, goal-orientation and ITI associated concepts of intelligence

Student	Questionnaire assigned mind-set	Classroom response	ITI associated goal orientation	ITI associated concepts of intelligence
Henry	Fixed	Positive	Learning	Fixed and Growth
Chris	Growth	Helpless	Learning and Performance	Fixed and Growth
William	Fixed	Positive	Learning and Performance	Fixed and Growth
Isaac	Fixed	Helpless	Learning	Fixed and Growth
Adam	Growth	Helpless	Learning	Growth
Nathan	Growth	Positive	Learning and Performance	Fixed and Growth

Key finding one: All of the six student participants valued the efforts they made as they worked on the challenging problem. Chris, William and Nathan also expressed a performance goal in terms of the importance of finding a solution to the problem. According to the model of ITI mind-sets, the acknowledgement of effort as a worthwhile pursuit is restricted to growth mind-set theorists and a performance goal orientation is associated with fixed mind-set theorists.

Key finding two: Five out of six students combined fixed and growth mind-set associated beliefs in their conceptualisations of intelligence. In these cases, the students expressed a belief that intelligence has an upper limit or maximum potential that can be realised through effort. The students used a number of different terms to

describe the impact of working through the challenging problem on their intelligence: improving, enhancing, increasing and adapting.

Taking key findings one and two together, a more complex pattern of students' beliefs and motivations are presented by this case study than the model of ITI mind-sets proposes. Nevertheless, the students in this case study were able to describe their personal conceptualisations of intelligence and explain how the value they placed on effort fitted into their framework of understanding. The students managed this by selecting their own terminology that best described the precise nature of the impact their efforts had on their intelligence.

Key finding three: The students found it difficult to define intelligence. In some cases, students referred to abilities or thinking skills, and separated this practical dimension of intelligence from a knowledge dimension of intelligence.

Just as each student chose a particular term to describe the impact that working on the challenging problem had on their intelligence, they also tried to specify the nature of intelligence by selecting alternative descriptors. The diversity of meanings emerging from the students' interview responses raises a concern about the suitability of the questionnaire as a diagnostic tool to assign ITI mind-sets with the students in this case study and with students who share similarities with them.

Key finding four: Some of the students described varying limitations to their abilities in different areas of the curriculum. William and Henry, who were both assigned as fixed mind-set theorists and who were observed to positively engage with the challenging problem, perceived themselves to be more able in the Mathematics/ Sciences domain. Furthermore, William went on to describe himself as being less able in English Literature and stated that this led to lower levels of

motivation in the subject. This finding raises the possibility that for some students like William, the fixed mind-set concept of having certain innate abilities could have a significant effect on how he engages with challenging tasks in different areas of the curriculum. It should not be assumed, however, that this would lead a student to reduce their efforts or avoid challenging work in the subjects where they perceive themselves to be weaker.

Key finding five: The students' self-evaluations of their responses to the challenging problem were in agreement with my observations. This finding validates the use of the video clips as authentic representations of each student's learning behaviours.

Key finding six: A commonality between the three students who were observed to respond helplessly was their emotional response to the initial difficulties of how to process the data to reach a solution. Chris, Isaac and Adam reported feelings of frustration and confusion, and expressed these as negative emotions. The students who had a positive response to the challenging problem also reported feelings of frustration, but this acted as a motivating factor to pursue alternative strategies to solve the problem. The model of ITI mind-sets proposes that a fear of failure underpins the negative emotional response, however, none of the students described this during the interviews.

Key finding seven: The questionnaire assigned mind-sets did not predict the levels of engagement with the challenging problem for four of the six students. Also, assigned mind-sets as mutually exclusive categories were inadequate descriptors of five out of six students' goal orientations or conceptualisations of intelligence.

Alongside key point three, these findings reiterate concerns about the suitability of the Implicit Theories of Intelligence Scale for Children as a method of assigning ITI mind-sets in this case study.

Chapter 5: Discussion and Conclusions

5.1 Introduction

The model of ITI mind-sets has been the theoretical framework at the centre of this study. My research question asked how able students' ITI mind-sets impacted on their engagement with a challenging problem solving task in the classroom. The exploratory nature of the case study and the use of video-stimulated, semi-structured interview yielded rich, detailed data that revealed the values, beliefs, emotional responses and conceptualisations the six student participants held about motivation, challenge and intelligence. The key themes that emerged from the data have been used in section 5.2 of this chapter as signposts to guide deconstruction and critical evaluation of the model of ITI mind-sets as a framework for understanding the students' responses to challenge. The theories that underpin the model, its premises and predictions are compared to and contrasted with the case study findings.

At the end of section 5.2, I have proposed an alternative framework of understanding that has evolved from my investigation of the key concepts that underpin the model of ITI mind-sets. The new framework has been constructed to show the critical factors that affected the students' engagement with the challenging task and if they resulted in a helpless or positive (mastery) response. Being based upon the findings of this study, the proposed framework is tentative and has limited applicability beyond the context of the case. Taking this into account, the new framework is presented as a map of the key issues affecting students' responses to challenge that can be used to guide policy and practice in my school.

The contribution this study has made to new knowledge in the fields of ITI mind-sets and the education of more able and talented students, and its significance to policy and practice are discussed in section 5.3. With particular regard to the impact of my research on changing policy and practice in my own school setting, I have included an account of the development of a whole school strategy aimed at raising levels of students' engagement in the classroom. Following this account, I have reflected on and evaluated my own professional development as a teacher-researcher as I have moved through the two stages of my doctoral studies.

5.2 Critical evaluation of the model of ITI mind-sets in the context of the case study findings.

5.2.1 The role of goal orientation as an indicator of students' response to the challenging problem-solving task.

Key finding one: All of the six student participants valued the efforts they made as they worked on the challenging problem. Chris, William and Nathan also expressed a performance goal in terms of the importance of finding a solution to the problem.

The motivational processes that underpin students' responses to challenging tasks are a central tenet of the model of ITI mind-sets. As shown in the following diagram (Figure 5.2.1), goal orientation is categorised as two opposing stances: performance goal orientation where the student is driven to seek affirmation of their competency or avoid negative judgements of their competency, and learning (or mastery) goals where the student's aim is to improve their competency. In the model of ITI mind-sets goal orientation is a consequence of the individual's theory of intelligence. A performance goal orientation is the motivational outcome of holding a fixed mind-set, whereas the learning goal orientation is the outcome of holding a growth mind-set.

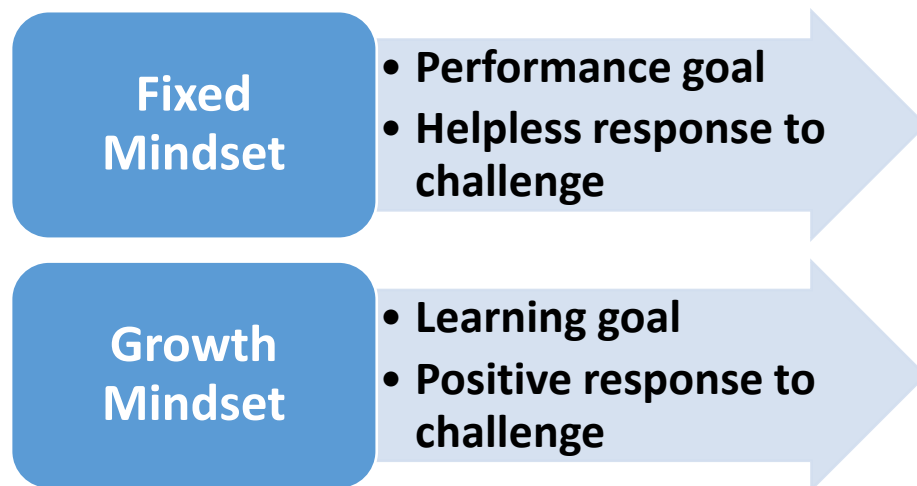


Figure 5.2.1: ITI Mind-set associated achievement goals and behaviour type in response to challenge (Dweck, 1986)

In the context of this case study, I interpreted a performance goal orientation as a student's expressed drive to find the solution to the problem. It followed then that a learning goal was evident where a student stated that working through the problem was of value. By applying these definitions to the analyses of students' responses to the question of whether it was more important to solve the problem or to work towards solving the problem, all the students expressed the learning goal and three students (Chris, William and Nathan) also expressed the performance goal. Where students held both goal orientations, they indicated that the learning goal was more important.

The model of ITI mind-sets does not accommodate the situation of an individual having both goal orientations; the theory presents performance and learning goals as mutually exclusive opposing stances. However, some studies have shown that students can hold both learning and performance goals simultaneously (Button, Mathieu and Zajac, 1996; Harackiewicz et al., 2002; Nicholls et al., 1989). The disparity between the separate goal orientations proposed by achievement motivation theory and the co-existent goal orientations interpreted from the interview data may

be due to differences in applying the definition of the performance goal orientation and, in a related way, the nature of the task given to the students. The definition of the performance goal orientation focuses on judgement of the student's competency. Earlier studies of children's performance goal orientation have manipulated the nature of the task, such as giving instructions under the headings of 'test', 'game' or as neutral instructions (Entin and Raynor, 1973; Lekarczyk and Hill, 1969; McCoy, 1965; Sarason, 1972). It could be argued that this experimental approach sets a strict definition for performance goal by integrating a judgemental factor that could be increased or decreased. This means that the type of assessment students expect at the end of the task is an important factor in determining the likelihood of a student having a performance goal orientation.

In this case study it was important to maintain an authentic context of learning to ensure that the students' behaviours and interview responses were valid representations of their beliefs, values and conceptualisations of intelligence. For this reason, the topic of the challenging task and the way it was presented and assessed were parts of the normal scheme of work for the class. In particular, the assessment strategy was formative in that students presented their solution to the class and were prompted through my questioning to evaluate the route they took to reach the solution. It could be argued that this type of assessment did not present a judgemental situation and, so, there was less likelihood of a student saying that reaching the solution was the most important motivating factor. Nevertheless, the students were aware from the start of the lesson that they would be required to share their solution with me and the other students in the class, and I assumed that this would present a clear performance goal for those students who tended to take that stance.

If I had directly applied the definition of performance goal orientation used in achievement motivation theory, rather than broadening the meaning to encompass being motivated to find the solution to the problem, then all six students would have been characterised as having a learning goal orientation. To validate this finding, however, would have required inclusion of a summative type assessment, for example using a grading system, and setting the investigation such that there was a single, correct answer. This would have compromised the authenticity of the context and task, by changing the purpose of the exercise from learning to testing. This is an important conclusion as it highlights the need to consider how the research design and method of analysis can affect the outcomes of the study. Also, to apply the same definition of performance goal orientation to a study aimed at uncovering students' implicit values as was derived from a study that purposely controlled the judgemental aspect of the task to test the value of performance goals would significantly affect the outcomes.

Three studies, which focused on the relation between goal orientation and the transferability of learning to solve problems, concluded that students who held learning (mastery) goals were most likely to transfer new learning. In the first of these studies, conducted in the United States of America, Farrell and Dweck (1985 cited in Dweck, 1986) tested children in eighth-grade on their ability to apply scientific principles they had previously learned through self-instructional booklets. Although their research shared with this case study a Science-based learning context, Farrell and Dweck's experimental approach yielded outcomes that wholly supported the relationship between goal orientation and positive learning behaviours predicted by the model of ITI mind-sets. Specifically, that mastery-oriented students attained higher transfer scores, compared with performance-oriented students, on tests where

they were required to apply their learned skills. The researchers also noted that the mastery-oriented students were more actively involved and made greater efforts as they worked on the transfer of learning task.

Following on from the study done by Farrell and Dweck (1985 cited in Dweck, 1986), Elliott and Dweck (1988) set out to test the hypothesis that different goals underpin the helpless and positive (mastery) behaviour patterns. This study had a broader scope as it tested children's task choice and performance during difficulty, and assessed the children's commentaries as they worked on the task. Elliott and Dweck (1988) also used an experimental research design where the student participants (fifth graders in schools in the United States of America) were randomly assigned to four different groups: learning goal and low perceived ability; learning goal and high perceived ability; performance goal and low perceived ability, and performance goal and high perceived ability. The students' achievement goals were manipulated using a priming method delivered through the task instructions. Where the performance goal condition was assigned to a student, their instructions gave the aim as looking competent, whereas the learning goal aim was increasing competence. Students' perceived levels of ability were also manipulated by the researchers through verbal feedback as the students completed a pattern recognition exercise. Following this, how effective the students were at problem-solving was measured using an exercise that involved discrimination between symbols on cards. After applying statistical analyses to their data, Elliott and Dweck (1988) concluded that the findings matched the predicted differences in task choice and effectiveness of problem-solving. Specifically, that students who held performance goal-orientation and low perceived ability beliefs were most likely to exhibit the helpless behaviour type. Furthermore, they reported that students under these conditions were

more likely to attribute their failures to a lack of ability, rather than a lack of effort.

From these correlational data, Elliott and Dweck suggested a causal relationship between achievement goal orientation and behaviours,

“Each goal, in a sense, creates and organises its own world – each evoking different thoughts and emotions and calling forth different behaviour.” Elliott and Dweck (1988)

These findings and the suggestion of causality (and, therefore, generalisability) presented by Elliott and Dweck (1988) aligned with the outcomes of the earlier study and formed the foundations of the model of ITI mind-sets that was proposed by Dweck and Leggett (1988). If this causal relationship is a fundamental connection between cognitive processes and the decisions students make to behave in a defined way towards challenging learning situations then it can be assumed that this would be a universal finding. However, a more complex pattern of achievement goals and behavioural responses to the problem-solving task were found during this case study, which challenges the causal relationship posited by Dweck and her colleagues.

In a more recent study, Bereby-Meyer and Kaplan (2005) also applied a method of manipulating the student participants’ goal orientations before assessing their transferability of learning, but in contrast, they used a more specific definition of performance goal. Bereby-Meyer and Kaplan (2005) divided the student participants into three groups, primed to hold the following goal orientations: mastery (learning), performance-approach and a neutral group (control). In their study the performance-approach goal orientation was defined as the drive to demonstrate high ability, treating this as a separate motivational goal from performance-avoidance where the student wants to prevent showing that they have low ability. Students were taught a problem-solving strategy that involved the use of a matrix before being assessed on

their use of the strategy to solve a similar type of problem. Irrespective of whether the goal orientation priming took place before or after the taught stage of the experiment, the researchers found that students who held the mastery goal were more likely to successfully transfer their learned skill to solve the problem than those holding the performance-approach goal. This appears to fully support the association between goal orientation and positive learning behaviours and outcomes as predicted by the model of ITI mind-sets. However, the researchers included a questionnaire that asked students to self-report their goal-orientations after they had completed the problem-solving task, thereby allowing for the possibility that they could hold both mastery and performance goals. With this additional data, the researchers further refined their conclusions and proposed that students who held high mastery and high performance-approach goals were less able to transfer the problem-solving skill than those who held high mastery and low performance-approach goals.

The conclusions drawn by Bereby-Meyer and Kaplan (2005) are applicable to the findings of this case study because, in both, students could hold joint mastery (learning) and performance goal orientations. In addition, the type of performance goal orientation expressed by the students in this case study were the performance-approach type; specifically, to find an answer to the osmosis problem.

Taken together, the studies carried out by Farrell and Dweck (1985 cited in Dweck, 1986), and Elliott and Dweck (1988) proposed a correlation between the mastery (learning) goal orientation and the ability to transfer and apply thinking skills to solve problems. The research of Bereby-Meyer and Kaplan (2005) went further to refine the categories of achievement goals and acknowledge situations where students hold both learning and performance goals. Nevertheless, they too concluded that the pre-eminent goal orientation was the learning type as this was associated

with more effective transfer of problem-solving skills and, so long as the learning goal was dominant, negated the less adaptive transfer of skills where the student also held a performance goal. Although it was not the purpose of this study to test the proposed correlation, the four different combinations of achievement goal orientations and behavioural responses presented by the students is a significant finding because it questions, in the context of the case, the validity of the correlation that is a central tenet of the model of ITI mind-sets.

The helpless responses of Chris, Isaac and Adam do not fit the correlation because they all expressed the learning goal, for example 'I think the process of doing something, of doing that in particular, was more important because I could see ways in which it was right and wasn't right' (Chris). Also, by stating that the effort exerted as they worked through the problem was more important than finding a solution, Chris, William and Nathan could be considered to have held high mastery and low performance goal orientations and, according to the conclusions drawn by Bereby-Meyer and Kaplan (2005) would be able to adapt and transfer their problem-solving skills. This was not the case with Chris, although it could be argued that Chris was less sure about the relative greater importance of the mastery goal versus the performance goal. It is important to note, however, that as this is a single instance that appears not to support the relation between high mastery/ low performance goal orientation and transferability of problem-solving skills, the finding is tentative and leads me to query rather than refute the conclusions of Bereby-Meyer and Kaplan (2005).

There are two possible reasons why the students participating in this case study presented a diversity of combinations of achievement goals and responses to the challenging problem-solving task, which were not predicted by the correlations

proposed in previous studies. In the first instance, there were significant differences between the cohorts of student participants in this case study and those of the three studies described above. The two earlier studies were conducted in the United States of America and focused on children younger than those who participated in this case study, aged thirteen to fourteen years old (Farrell and Dweck, 1985 cited in Dweck, 1986) and ten to eleven years old (Elliott and Dweck, 1988). For their study conducted in Israel, Bereby-Meyer and Kaplan (2005) also recruited younger children, but, included two age groups: seven years-old and eleven years-old groups of children. Interestingly, the researchers found that the older children had a slightly higher probability of transferring the problem-solving strategy. This supported the findings of others who had concluded that there was a greater positive effect of having combined mastery and performance-approach goals in late adolescents compared to younger children (Bouffard, Vezeau and Bordeleau, 1998). The confident application of effective problem-solving strategies shown by William and Nathan who held joint learning (mastery) and performance-approach goals may, at least in part, be because they were older than the participants in the other studies.

Bereby-Meyer and Kaplan (2005) suggested that more developed cognitive and metacognitive skills could be a reason for the effect of age on effective transferability of problem-solving strategies. The higher academic ability of the students who participated in this case study was an indicator of them having advanced cognitive and metacognitive skills and there was some evidence to support this in the data. For example, when Isaac responded to my question of why he valued the efforts made as he tried to solve the problem,

Like if you give someone the answer...and maybe they'll understand it...but, whereas if you've worked through that middle gap getting every single sort of

stage...understanding, or maybe not understanding, but then eventually understanding. Sort of that, the learning bit of it, which is more important.

Isaac expressed an awareness of the cognitive processes that he uses to explain how comprehension is achieved. However, Isaac did not demonstrate an ability to transfer and apply problem-solving skills. So, at least in Isaac's case, it did not appear that his metacognitive skills positively impacted on his response to the challenging task.

Dweck and Leggett (1988) also acknowledged that self-awareness and self-evaluation of competence may be necessary attributes of students who successfully pursue learning goals. Specifically, to be motivated to increase their competency, students need to be able to objectively assess their own strengths and weaknesses. As evidenced in their group discussions and methodical approach to solving the problem, Henry, William and Nathan demonstrated self-awareness of their competencies and used self-evaluation to guide their selection of successful strategies. William also expressed the importance he placed upon assessing his progress in the problem-solving task,

...I don't think there's a problem in getting the wrong answer... 'cause if you know you've got the wrong answer, afterwards you can look at why you got the wrong answer...and it might be more useful for you than getting the right answer.

Chris, who responded in a helpless way to the challenging task expressed the same idea when asked if the process of working on the problem or reaching a solution was more important,

...probably working towards the answers... 'cause you can see if you work your way through it where you got it wrong.

In the analysis of the interview responses in chapter four, I highlighted inconsistencies in Chris' responses about his goal orientation and I suggested a

conflict between the values he claimed to hold and those that he did hold as he worked on the challenging task. In a similar way, although Chris' statement indicated that self-evaluation was an important part of learning, he was not observed putting this belief into practice in the form of participation in group discussion. In conclusion, it appears that Chris was able to identify and articulate values and behaviours associated with the learning goal-orientation, but, another factor or factors were preventing him from translating these into actions.

As part of the framework of ITI mind-sets, Dweck and Leggett (1988) included self-perception of ability as a modulating factor on the association between achievement goal-orientation and response to challenging tasks. Nathan directly expressed his high level of confidence in his abilities to solve the problem,

...obviously it was going to be more challenging...it wasn't something that couldn't be done.

Also, the positive responses of Henry, William and Nathan to the frustration they felt as they experienced difficulties are indirect evidence of their high levels of confidence that they could solve the problem. It could be argued then that the high ability self-perceptions of William and Nathan outweighed the effects of holding a performance goal-orientation. It would follow then that Chris, who also held joint learning and performance goal-orientations, responded in a helpless way to the difficult problem because he had less confidence in his abilities. In support of this idea, Bandura and Dweck (1985 cited in Murphy and Dweck, 2010) and Elliott and Dweck (1988) have proposed that performance goals can work against the pursuit of challenge because they demand that the student perceives themselves as having consistently high levels of ability. However Chris did not explicitly report lacking

self-confidence, so self-perception of ability cannot be cited as a possible modulating factor between goal orientation and behaviour in this case.

In addition to different ages and cognitive abilities, the students participating in each of the studies experienced different learning environments. Curricula, teaching methods, assessments and the relative values of different educational outcomes are contextual factors that are characteristic of the educational systems and structures at national, regional and school level. Whilst I am proposing that these contextual factors could have an impact upon the responses of the student participants and, therefore, contribute to the contrasting outcomes, I do not intend to analyse the differences between the educational systems of the USA, Israel and the UK. There are two reasons for this. Firstly, the analysis would be a list of differences with little evidence from the studies to support the strength or weakness of each contextual factor, which would not contribute to answering my research question. Secondly, the studies carried out by Farrell and Dweck (1985 cited in Dweck, 1986), Elliott and Dweck (1988), and Bereby-Meyer and Kaplan (2005) were conducted outside the normal classroom environment, which contrasts with my deliberate efforts to maintain an authentic learning context for the participants in the design of my study.

Throughout my practice and professional development I have held a belief that the particular contextual factors of the learning environment have an influence on the behaviour of learners. These factors include the physical environment of the classroom, interactions between the teacher and student and interactions between students. Illeris (2009) referred to these collectively as external conditions and defined them as factors outside the learner that impact upon the learning situation and are involved in the learning process. In his model of the conditions for learning, Illeris (2009) proposed three categories of influences on learning: external conditions

and internal conditions, such as personal dispositions, and basis, which defines the biological and psychological processes of learning. This model is useful as a means of illustrating the disparity between the theoretical stance I have used to guide my research design and the theoretical stance underpinning the studies carried out by Farrell and Dweck (1985 cited in Dweck, 1986), Elliott and Dweck (1988), and Bereby-Meyer and Kaplan (2005).

Illeris (2009) criticised cognitive learning theories that focus only on internal psychological processes and exclude the internal processes and external conditions he proposed are integral to learning. The similar research designs adopted by Farrell and Dweck (1985 cited in Dweck, 1986), Elliott and Dweck (1988), and Bereby-Meyer and Kaplan (2005) involved treatment of the student participants as subjects in isolation from their normal learning environment. As such, the posited relationship between achievement goals and behaviours arose from a laboratory-based experiment. It follows that the epistemological assumptions associated with this objectivist research paradigm are that the students' minds are abstract machines, with thought being independent of human experience and, therefore, able to be deconstructed into individual components. Consequently, a universal model that consists of a sequence of cognitive and behavioural components that are unaffected by the contextual features of the learner's environment has been constructed. Using this model to explain learners' behaviours under the same, controlled conditions may be a valid exercise, but, to apply the same model to explain every learner's behaviour in any learning situation is at odds with contemporary theories of learning.

It could be argued that the study conducted by Bereby-Meyer and Kaplan (2005) acknowledged the individuality of the student participants by combining data about students' goal orientations gathered using different methods. The student participants

in their study were asked to self-report their goal orientations after they had completed the learning and problem-solving stages. Since they had been primed beforehand, that is their goal orientation had been manipulated, it is difficult to ascertain the reliability of their self-reported achievement goals. Specifically, were individuals who self-reported joint achievement goals simply combining their 'primed' goal with their actual goal orientation? Also, it might be expected that an effective priming method would have negated the possibility of the participants holding both mastery and performance-approach goals. In terms of methodology, the experimental design of their study was consistent with a positivist research paradigm. The self-reporting questionnaire, however, was not a controlled test or measurement and was designed to elicit the students' self-perceptions. As a consequence, the applicability of the outcomes of this study to real learning situations in the classroom are also contestable.

Given that the purpose of my study was to inform pedagogy and policy in my school by exploring the potential for students' ITI mind-sets to impact their responses to challenge, I employed methods associated with an interpretivist research paradigm. This approach was concordant with constructivist models of learning that are the framework for my understanding of how students learn. The studies carried out by Dweck and her colleagues from which the model of ITI mind-sets evolved are located within the positivist paradigm, which assumes that cognitive processes can be shown to lead to specific and predictable behaviours. The conflicting epistemological and ontological assumptions inherent in these different research paradigms may explain the more complex pattern of achievement goals and responses to the challenging task that were found in this case study.

In conclusion, the theoretical frameworks of learning underpinning the research approaches taken by Farrell and Dweck (1985 cited in Dweck, 1986), Elliott and Dweck (1988) and Bereby-Meyer and Kaplan (2005) contrasted markedly with those used to inform the design of this study. This was manifested in this case study as an adapted definition of performance goal to suit the nature of the challenging task and an interpretivist approach to ascertain the achievement goals held by the students when they worked on the task. Even taking these features of the case study and the older age and higher cognitive abilities of the participants into account, the relationship between achievement goals and behaviours would be shown to be consistent with previous studies if the model is a true representation of how the learner's mind affects their actions. According to the model of ITI mind-sets, students who have a learning goal orientation are growth mind-set theorists and will respond positively to challenging tasks. Since three of the students showed the opposite, helpless response to the challenging problem, either these students did hold a performance goal and this affected their responses or the relationship between learning goal orientation and positive behaviours, as proposed by the model, was not evident or was outweighed by other factors. The problematic application of theory that has evolved from research in the field of psychology to informing pedagogy, classroom practices and policies are further discussed in the next sub-section that examines the strength of the impact of students' ITI mind-sets on their responses to the challenging task.

5.2.2 Students' conceptualisations of intelligence and how these affected their responses to the challenging task.

Key finding two: Five out of six students combined fixed and growth mind-set associated beliefs in their conceptualisations of intelligence. In these cases, the students expressed a belief that intelligence has an upper limit or maximum potential that can be realised through effort. The students used different terms to describe the impact of working through the challenging problem on their intelligence: improving, enhancing, increasing and adjusting.

The model of ITI mind-sets proposes two, mutually exclusive and opposing conceptualisations of intelligence that determine the nature of an individual's achievement goal, which in turn prompts their response to challenging learning tasks. Students who hold the growth mind-set believe that their intelligence can be increased through their efforts, which leads to the pursuit of increasingly more challenging tasks. Conversely, students who hold the fixed mind-set perceive their intelligence as an unchanging entity that will determine limitations of their abilities. In the model of ITI mind-sets, fixed mind-set theorists avoid challenging tasks for fear of failure. Therefore, characteristics associated with the growth mind-set are promoted as desirable attributes in the learner whilst characteristics of the fixed mind-set are associated with disengaged and underachieving learners. Figure 5.2.2 below summarises the fixed and growth mind-set beliefs about intelligence that are the bases for the different rationales leading to engagement with or avoidance of challenging tasks.

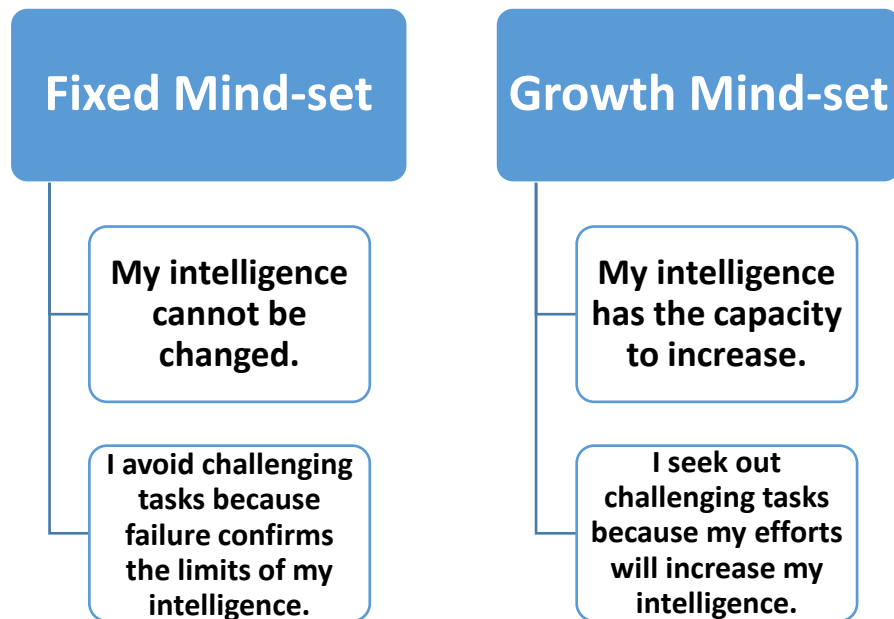


Figure 5.2.2: ITI mind-set conceptualisations and rationales relating to challenge (Dweck, 2000).

As noted in the Findings and Analysis chapter, the mutually exclusive and opposing conceptualisations of intelligence at the centre of the model of ITI mind-sets do not accommodate the blended features described by the students in this study. In a similar way to the combined performance and learning goals expressed by Chris, William and Nathan, the conceptualisations of intelligence described by five of the six students can be placed along a continuum, rather than occupying distinct categories. This suggests not only a move away from the polarity of the ITI mind-sets model, but also, reiterates the potential for mind-set to be influenced and modulated by other factors.

In a critique of the dichotomous structure of the model of ITI mind-sets, Bempechat and Boulay (2001) cited the positivist approach that employs questionnaire and experimental methods as pre-determining the characteristics of students' conceptualisations of intelligence as either fixed or growth. To test this, Quihuis et al. (2002) employed the Theories of Intelligence Questionnaire (developed by

Dweck and Henderson, 1988 cited in Hong et al., 1999) with fifty-seven first-generation Mexican American tenth to twelfth grade students (ages fifteen to seventeen years) and follow-up interviews with thirteen of the students to elucidate their questionnaire responses. The researchers reported a discontinuity between students' questionnaire and interview responses and demonstrated that the students held different mind-sets across English, Mathematics and Science areas of the curriculum. Therefore the outcomes of this case study support these earlier findings and, since the student cohorts differed (e.g. different nationalities, range of ages and cognitive abilities), the similar findings raise the possibility that combined fixed and growth mind-set beliefs are not limited to specific sub-groups of learners. Quihuis et al. (2002) went on to speculate that fixed mind-set theorists with low confidence are still capable of mastery-type responses when given a challenging task. However, they did not study the behaviours of the student participants and, therefore, could not test their hypothesis. By including observations of the students' responses to a difficult problem-solving task, this case study addressed the question of how mind-set impacts upon behaviour.

More recently, the possibility that students can hold both fixed and growth ITI mind-sets was investigated by Karwowski (2014) in his study of creative mind-sets. He defined creative mind-sets as beliefs about the stable versus malleable character of intelligence and the nature of creativity. Karwowski's findings lead him to conclude that it is possible for individuals to hold both fixed and growth mind-set beliefs about their intelligence and that motivation is a modulating factor in the likelihood of being able to solve creative problems. These conclusions are significant for two reasons. Firstly, the conclusions support the combined fixed and growth mind-set characteristics of the conceptualisations of intelligence described by Henry, Chris,

William, Isaac and Nathan. Secondly, highlighting the importance of contextual factors as potential contributory determinants of learning behaviours supports the location of my research in the normal classroom setting. In addition, Karwowski (2014) recommended further research to be conducted using interviews to gain better insight into the associations between fixed and growth mind-sets and their relationship to solving creative problems.

Key finding three: The students found it difficult to define intelligence. In some cases, students referred to abilities or thinking skills, and separated this practical dimension of intelligence from a knowledge dimension of intelligence.

In this case study, using semi-structured interviews allowed each student to describe his personal conceptualisation of intelligence, free from the terminology and meanings imposed by a questionnaire. Nevertheless, there were similarities in the descriptions given by five of the students. The constructs of two of these students, Chris and Henry, can be used to illustrate the similar combining of fixed and growth mind-set beliefs into a single, coherent conceptualisation of intelligence. Both students described intelligence as a fixed entity and went on to explain how intelligence could be changed within pre-determined limits. Chris used the analogy of a balloon blowing up where the individual is working towards their potential. Henry, on the other hand, defined changing intelligence in a more qualitative way by focusing on improving the adaptability of intelligence. Henry's conceptualisation is analogous to the skills of a potter; perseverance and practice can increase the range of objects the potter can mould from the same piece of clay.

The constructs of Chris and Henry differ in emphasis. Chris focused on the limitations of intelligence ...*it's blowing up, but, there's only a certain amount of space it can fill*. Whereas Henry's construct emphasised the adaptability and malleability dimension of intelligence...*rather than actually growing or making it better, you actually kind of learn how to use it in different ways*. If ITI mind-set beliefs formed the rationale for the ways the students engaged with the challenging task, then the difference of emphasis on limitation of intelligence versus malleability of intelligence could predict responses. However, even within the limitations of the small number of student participants in this case study the difference of emphasis within conceptualisations of intelligence did not align with the students' observed levels of engagement with the challenging task. Isaac, like Henry, William and Nathan, described intelligence in terms of fixed abilities that could be made to be more adaptable through effort. However, unlike Henry, William and Nathan, Isaac responded in a negative way to the challenging task. Despite the similarities between the conceptualisations of intelligence described by Henry, Chris, William, Isaac and Nathan, there was no consensus of achievement goal orientation or observed response to the challenging task. This suggests that in this case ITI mind-set was not the underlying rationale for the students' differing levels of engagement with the challenging task.

It was evident from the comments made by the students during their interviews that they struggled to define intelligence. All the students referred to skills or abilities when they described their conceptualisations of intelligence even though the questionnaire items and interview questions referred to intelligence. One student, Isaac, even posed the rhetorical question...*The whole of intelligence, what is it?* Also, at the end of his interview Isaac concludes...*but, what intelligence is, I*

couldn't say. Given that the central tenet of the model of ITI mind-sets is a causal relationship between the student's self-theory of intelligence, their rationale for the value of effort and response to challenge, it may be expected that students would have a more stable definition of intelligence. Interestingly, Dweck used this skills and ability dimension of intelligence when she reported the informal observation that students tend to have a more fixed view of Mathematics skills than of other skills. Although she also reported that the questionnaire items used in studies that focused on Mathematics and Science were adapted to these domains, the example she gave asked about Mathematics intelligence rather than Mathematics skills (Dweck, 2008). As Isaac so succinctly concluded, defining intelligence is problematic. For this reason, the alternative framework of understanding I have described at the end of this section (5.2.3) deliberately avoids using the term intelligence and instead refers to thinking skills and abilities. My rationale for this is that the purpose of the framework is to guide policy and classroom practice in my school setting, so the language and meanings used in its construction are the same as those used by the students themselves.

The open-ended questions asked during the interviews allowed the students to include personal experiences that they felt were relevant and gave depth to their mental constructs such that they were less abstract and related to their learning. These were examples that were memorable and, therefore, significant experiences to the students. As such, the personal constructs are self-theories that are rooted in meaning systems, the beliefs people hold that give meaning to their experiences and that are important in shaping their thinking. For William and Henry, they related their belief that intelligence is limited to their experiences of learning across the curriculum.

Key finding four: William and Henry, who were both assigned as fixed mind-set theorists and who were observed to positively engage with the challenging problem, perceived themselves to be more able in Mathematics and Science. William described himself as being less able in English Literature and explained that this led to lower levels of motivation in the subject.

Given that William expressed a performance goal, the variable perception of ability and consequential change in self-motivation when he compared his learning in Mathematics and Science lessons to his learning in English Literature lessons supports the association of these characteristics as proposed by Elliott and Dweck (1988) and Dweck and Leggett (1988). Dweck placed students' concerns about their ability levels at the centre of the performance goal orientation, as the factor that drives task choice and pursuit processes. As discussed earlier in the Findings and Analysis chapter, the ITI mind-sets model predicts that William's fixed mind-set characteristics would lead to lower levels of effort in his English Literature studies. However, William's lack of confidence in his abilities in English Literature had the opposite effect, *I have to work really hard to do well in English* (William). In this instance, the model of ITI mind-sets did not predict the student's behaviour. However, William's comments do support the suggestion put forward by Quihuis et al. (2002) that fixed mind-set theorists with low confidence are capable of mastery-type responses in the face of difficulties.

The reported subject dependent variation in academic self-confidence lends further support to the idea that fixed and growth mind-sets are two extremes of a continuum

of beliefs, values and behaviours rather than mutually exclusive categories. It would follow then that an individual can hold different ITI mind-set characteristics in different learning situations. A similar conclusion was reached by Mercer and Ryan (2009) following their exploratory study of learners' beliefs about the role of natural talent in the context of foreign language learning. They conducted semi-structured interviews with nine first-year university students in Austria and Japan, asking the participants open-ended questions about the role of natural talent in their learning. Using a grounded theory approach to their data analysis, Mercer and Ryan concluded that the participants' ITI mind-sets were more complex than the dichotomous model proposes. They also found evidence that the students have different mind-sets in different areas of their studies. Since their study focused on foreign language learning, the authors suggested the existence of skills-specific mind-sets, such that students can have different mind-sets related to their listening, reading, speaking and writing skills. The concept of skills-specific mind-sets is relevant to the findings of this case study for two reasons. Firstly, all six students used skills and abilities to explain their conceptualisation of intelligence and, secondly, when they were asked to evaluate the impact of their efforts working on the challenging problem the students described changes to their skills, abilities or ways of thinking.

These ideas are extensions of the model of ITI mind-sets and contribute to a deeper understanding of how students conceptualise their intelligence. Even though data in support of a continuum model of ITI mind-sets have been presented here and by other researchers, the evidence is from a limited number of small-scale studies.

Taking this into consideration, the proposed extension to the model of ITI mind-sets and any predictions extrapolated from this are tentative and restricted in application to the contextual boundaries of each study. Nevertheless, this knowledge is useful to

the policy makers and classroom practitioners in my school as it directs where intervention strategies could support students to develop growth mind-set associated attitudes and behaviours.

Key finding six: A commonality between the three students who were observed to respond helplessly was their emotional response to the initial difficulties of how to process the data to reach a solution. Chris, Isaac and Adam reported feelings of frustration and confusion, and expressed these as negative emotions. The students who had a positive response to the challenging problem also reported feelings of frustration, but this acted as a motivating factor to pursue alternative strategies to solve the problem. The model of ITI mind-sets proposes that a fear of failure underpins the negative emotional response. However, none of the students described this during their interviews.

The impetus to explore the impact of ITI mind-sets on students' engagement with challenging learning tasks came from the need to find ways to reduce underachievement amongst some of the able students I teach. For this reason, I searched for a defining characteristic or theme in the conceptualisations of intelligence described to me by the three students who responded in a helpless way to the challenging problem. However, there was no consensus of achievement goals, matching of beliefs about intelligence or relative values of effort that were common to them and different from those who responded positively. I had to go back to the video clips of Chris, Isaac and Adam as they worked on the data processing stage of the problem and re-examine their interview commentaries to identify their shared

characteristic of a negative emotional response to the difficulty they experienced as they worked on the challenging task.

According to the model of ITI mind-sets, students' negative emotional responses to challenging tasks are a consequence of their fixed mind-set beliefs. However, of the three helpless responders only Isaac was assigned as holding a fixed mind-set (based on his questionnaire responses) and none of the three students expressed purely fixed mind-set associated beliefs about intelligence during their interviews. So, neither the questionnaire nor the interview data would have accurately predicted the helpless responses of Chris, Isaac and Adam. Assuming that the data are reliable, these findings do not support the proposed causal relationship of fixed mind-set beliefs prompting negative emotional responses.

To explore potential reasons for the negative emotional responses of Chris, Isaac and Adam I analysed each of the students' commentaries to identify emerging themes. In Isaac's case, he described an underlying conflict between personal and school values of attainment versus effort. Might Isaac have seen the challenging problem solving exercise as mirroring school expectations where attaining the correct answer is valued more than the efforts made in trying to reach a solution? Without discussing this topic further with Isaac I could only surmise that this clash of personal and school values affected his emotional response to the challenging task.

Acknowledging that this link is conjecture, it is still valuable to consider the potential implications for a student who perceives a conflict of personal and institutional values that are based on the model of ITI mind-sets.

Dweck and her colleagues have proposed that students within learning environments that promote a fixed mind-set culture, such as those that value attainment over effort,

are more likely to feel that they must demonstrate their competency (Dweck and Leggett, 1988; Nussbaum and Dweck, 2008). According to the model of ITI mind-sets, this tension could lead students to express corresponding fixed mind-set behaviours, including avoidance of challenging tasks (Murphy and Dweck, 2010). These ideas were supported by the findings of a study that investigated the impact of perceived institutional mind-set on a sense of belonging and subsequent academic progression (Good, Rattan and Dweck, 2012). Focusing on female university students in the United States of America, the researchers found that those who perceived their academic environment as promoting a fixed mind-set view of Mathematics had a lower sense of belonging to Mathematics. This sense of belonging was defined as the student regarding themselves as a valued and accepted member of the Mathematics academic community. A lower sense of belonging was associated with a reduced intention to study Mathematics at a higher level and poorer Mathematics grades.

In Isaac's case, the performance goal culture he attributed to his school environment may indicate that he felt pressure to prove his competency in the skills needed to solve the problem and, if he lacked in self-confidence in these skills, this would lead to a helpless response to the challenging task. Isaac did not directly state that he lacked confidence in the skills needed to solve the problem. Nevertheless, his different levels of engagement with the practical and data processing stages of the problem-solving task together with the high value Isaac attributed to practical skills in his conceptualisation of intelligence could be interpreted as indirect evidence that Isaac was more confident of his practical skills. This contrasts with the high levels of self-confidence in the skills needed to solve the problem that were expressed by Henry, William and Nathan. Since Henry and William also assessed themselves as

more able in Science and Mathematics, it could be argued that they had a greater sense of belonging in these domains. Conversely, Isaac could then have a lower sense of belonging in Science, which would have compounded his helpless response when faced with a difficult problem set in a scientific context.

Neither Chris nor Adam reported a lack of self-confidence in the skills needed to solve the problem. Analysis of Chris's interview responses did not reveal any other intrinsic factors that could have explained his negative emotional response to the difficulty he experienced during the second lesson. Apart from the emphasis on the limited nature of intelligence in his balloon analogy, the only other defining feature of Chris's interview responses is his answer to the final question. When I asked him how his ideas about intelligence and how working on the challenging task impacted on his intelligence in different subjects, Chris was the only student in the case study who said that his beliefs were consistent across the curriculum, *my ideas are quite similar across the different subjects*. He did not elaborate on his answer and I did not ask follow-up questions to reveal what these similarities were and how they affected Chris's response to challenging tasks that demanded different skills sets.

Consequently, I cannot offer any specific explanations for Chris's helpless response to the challenging problem-solving exercise.

Adam's questionnaire assigned growth mind-set, his learning goal orientation and growth mind-set associated beliefs about intelligence recorded during his interview set him apart from the other students. Despite consistently being assessed as holding a growth mind-set, Adam's efforts to solve the problem were limited and he made little progress. However, as highlighted in the Findings and Analysis chapter, Adam did engage with the task through asking questions and he revealed in his interview the value he places on questioning as a means to increase intelligence. So, Adam was

not a typical helpless responder because he took some action that he believed would be of value, but, at the same time it was evident that he was not cognitively engaged with the task. Later in his interview commentary Adam revealed the possible reason for his lack of progress, *my concentration wasn't amazingly high, but, when I really try concentrating...I think that my intelligence increases in certain subjects*. On its own a low level of concentration is a plausible reason for Adam's cognitive disengagement with the problem and subsequent poor progress towards a solution.

Later in his interview, Adam revealed his narrow perspective of scientific inquiry, which could indicate he is yet to develop the skills of metacognition (Perry, 1970). Alongside a low level of concentration, difficulty in applying critical cognitive skills would also have had a negative impact on Adam's engagement with the challenging task. Taken together these factors can also be viewed from the perspective of different types of learning and their consequences for solving problems like the challenging task the students were asked to complete. Piaget (1952) described assimilative and accommodative types of learning. Students whose learning is accommodative would be better at applying prior learning in different, relevant contexts whereas students whose learning is assimilative would find it difficult to apply knowledge and skills outside the context in which they were learned. Since Adam perceived scientific knowledge as a set of facts, it follows that his learning could be typified as 'assimilative'; the learning of facts and skills within topics, but with little understanding of how these fit together and how they could be applied to other contexts. The problem-solving task required not only the application of theoretical knowledge in a practical context, but also, data processing skills that would have been learned in the context of Mathematics lessons and not practised in a biological context. Furthermore, poor powers of concentration would make

accommodative learning more difficult for Adam as this type of learning requires a higher level of mental energy (Illeris, 2009).

The narratives of Isaac, Chris and Adam presented three contrasting and individual profiles of able students who did not fully engage with the challenging problem-solving exercise. The narratives, like those of Henry, William and Nathan, were personalised and embodied complex patterns of values, beliefs and behaviours. No unifying self-theories emerged from these data. In the cases of Isaac, Chris and Adam, the fixed mind-set model does not adequately explain the mental processes that resulted in the helpless response. The findings do, however, support a multifactorial model of intrinsic and extrinsic mediators that have an inhibitory effect on students' engagement with challenging tasks.

Key finding seven: The questionnaire assigned mind-sets did not predict the levels of engagement with the challenging problem for four of the six students. Also, assigned mind-sets as mutually exclusive categories were inadequate descriptors of five out of the six students' goal orientations or conceptualisations of intelligence.

Seeking a correlation between students' ITI mind-sets, achievement goal orientations, conceptualisations of intelligence and levels of engagement with the challenging task was not the aim of this study. Nevertheless, comparing the case study outcomes to the patterns of association reported in the literature has highlighted discrepancies that raise questions about the strength of the relationships between the components of the model. However, there are no studies reporting correlational data between ITI mind-sets, goal orientations and learning behaviours

of able, male secondary school students in the Science domain. One study, a longitudinal investigation of ITI mind-sets and Mathematics achievement, focused on high school students of thirteen and fourteen years of age (Blackwell, Trzesniewski and Dweck, 2007). Although the students were younger and represented a wider range of cognitive abilities than the students who participated in my research, I judged the longitudinal study worthy as a comparison because in it the researchers assessed some of the variables that emerged from the interview data and the focus on Mathematics had resonance with the skills the students applied during the problem-solving task. Blackwell, Trzesniewski and Dweck's study is also important as it has been cited in a number of articles as key empirical evidence in support of the model of ITI mind-sets (Dweck, 2008; Murphy and Dweck, 2009; Good, Rattan and Dweck, 2012).

Using Likert-type scaled questionnaires, the researchers assessed the mind-set theories, learning goals, effort beliefs and strengths of helpless attributes and positive strategies of students in four successive classes across two years (during the seventh and eighth grades). Progression in Mathematics was shown to be higher for students who had been assigned at the start of seventh grade as growth mind-set theorists over those assigned as holding a fixed mind-set. The researchers then applied statistical methods to identify and test the strength of correlations between the variables described above. The resultant path model linked belief in a malleable quality of intelligence that could be developed, learning goals and belief that greater efforts lead to higher achievements to students who held the growth mind-set. These outcomes fully supported the model of ITI mind-sets and their predicted values and behaviours.

Although the assigned mind-sets of four of the six students in this case study did not align with their predicted responses to the challenging task, the variables identified in the longitudinal study as components in the strongest correlational relationships were also key themes emerging from the case study interview responses.

Specifically, the value placed on effort and its impact on developing a more malleable intelligence (described by the students in terms of adaptability of abilities, thinking skills and practical skills). The authors of the longitudinal study also found that growth mind-set students were less likely than fixed mind-set students to attribute potential failure to a lack of ability. This resonates with the confidence Henry, William and Nathan expressed in their abilities to solve the challenging problem, although only Nathan was assigned as holding a growth mind-set based upon his questionnaire responses. Even though these key values and beliefs correspond between the outcomes of the two studies, the mismatching assigned mind-sets and levels of engagement with the task observed in this study raise doubts about ITI mind-set as the cause of the patterns of values and behaviours proposed by the model.

The aim of my research was to explore how able students ITI mind-sets impacted on their engagement with a challenging problem-solving task. The conclusions I have reached question the proposed causal relationship between students' ITI mind-sets and their responses to the challenging task. For this reason, I cannot present an evidence-based argument in support of the link between implicit theories of intelligence and students' behaviours in the face of difficulty. Nevertheless, since the model of ITI mind-sets was first proposed numerous research papers and review articles have been published that present supportive data.

Throughout this discussion a pattern has emerged of agreement and disagreement between the outcomes of similar, related studies and my own research. Specifically, studies where the outcomes are supportive of and concordant with the findings of this research have in common an interpretivist methodological approach. It follows that the epistemological and ontological assumptions associated with this research paradigm are also shared features of these studies. As discussed earlier in this chapter, my reasons for adopting the interpretivist methodology stem from the social-constructivist theories of learning that shape my understanding of the factors that affect students' learning. My experience as a classroom practitioner has consolidated my belief that a complex interaction of intrinsic and extrinsic factors impact on the student and affect their learning. The values, beliefs and dispositions of each student, and the characteristics of their learning environment are particular to the individual, the point in time and the location. No single teaching strategy has delivered improved levels of engagement for all underachieving, able students and the same teaching approach that supported the learning of one group of students can fail to deliver the same outcomes with another, parallel class.

Students and their learning processes as subjects of study contrast markedly with the focus of my previous research experience in the field of virology. From the perspective of the scientific method, relationships between variables can be revealed by controlling confounding factors such that only a single, independent variable is deliberately changed. Calibrated instruments are then employed to measure the dependent variable. Through the use of statistical methods the data gathered can then be analysed to show any correlations that exist between the independent and dependent variables. However, the discovery of a statistically significant correlation between variables is not conclusive evidence of a causal relationship. To establish

this type of interaction requires more in depth investigations, which directly demonstrate cause and effect. To apply the scientific method (or positivist methodology) it must be possible to isolate, manipulate and measure the dependent and independent variables. However, I do not accept that learning and the values, beliefs and cognitive processes associated with learning can be reduced and examined like physical phenomena.

The studies that provided the initial data that lead to the development of the model of ITI mind-sets were conducted by researchers in the field of cognitive psychology. Subsequent research has been broader in scope, branching into different phases and settings of education to test the effectiveness of the model as a predictor of students' behaviour and achievement. Collectively, these studies share a positivist methodological approach. In practice this involves using scaled questionnaires that enable the application of inferential statistics to demonstrate links between variables and measuring students' responses to standardised and controlled tests. In these experiments, contextual factors have been excluded to elucidate the relationships between cognitive processes and behaviours (Astington, 1993). The epistemological and ontological assumptions that are associated with the positivist paradigm treat the minds of learners as isolated machines where the same stimulus can induce a reproducible response. Therefore, contextual factors are not relevant to this process and can be excluded from the investigation. In this respect, the location of my research in the classroom setting and the attention paid to maintaining the normal learning situation go against the philosophical premises of the positivist approaches that have produced data in support of the model of ITI mind-sets.

Costall and Leudar (2004) have criticised the application of scientific principles to the investigation of learning in real life settings. With a specific focus on the

approach adopted by researchers in the field of psychology, Costall and Leudar highlighted the discrepancies that exist between the outcomes of experimental studies with the outcomes of real-life studies that involve more observational data. They argued that the experiment has been used as a way to address the problem of Cartesian duality; that is, explaining how the consciousness and self-awareness we associate with the mind interacts with the intelligence we locate within the brain.

The issue of Cartesian duality is relevant to the model of ITI mind-sets for two reasons. Firstly, the body of empirical evidence that formed the foundations of the model was generated from experiments. Secondly, the proposed causal relationship between the fixed or growth ITI mind-set beliefs, achievement goals and response to challenge at the centre of the model relies upon the assumption that these components of the mind and brain interact. The concept of interactionism between self-awareness that is associated with the mind and the intelligence and decision-making processes in the brain is the central tenet of a philosophical stance termed Theory of Mind. In her description of Theory of Mind, Astington (1993) also referred to the proposal that children develop their own theories as a means to understanding their own and other people's minds. Taken together, the model of ITI mind-sets exemplifies the interactionism and self-theorising aspects of Theory of Mind.

A key criticism of Theory of Mind and its associated positivist approach to research is the over simplified view of cognition as the connection between a stimulus, such as a challenging problem-solving task, and a response, for example the level of engagement with a task (Costall and Leudar, 2004). The effect of this is to exclude the contextual factors of the learning situation from the investigation to reveal the student's cognitive processes. Subsequently, an artificial learning environment is

created where students are met with tasks they would not normally meet in their classrooms. This was exemplified in one particular study (Elliott and Dweck, 1988) that employed a priming method for mind-set during which some students' task choices were prompted by the following statement made by the researcher, 'In this box we have problems of different levels. If you pick this box, although you won't learn new things, it will really show me what kids can do'. To transfer this scenario to a real classroom situation, it would be surprising for the teacher to give their students any task that is not intended to support learning. Furthermore, the students may interpret a task that 'will really show me what you can do' to be a test, which resonates with an earlier point in this discussion about the nature of the task affecting the likelihood of assigning students as holding performance or learning achievement goal orientations. Costall and Leudar (2004) have described this type of experimental approach, common in the field of psychology research, as having a constricting effect on the meaning of cognition such that it has become an intermediary factor between the stimulus and response. This critical appraisal of the positivist approach associated with Theory of Mind supports my conclusion that conflicting research paradigms and their inherent epistemological and ontological assumptions are the reasons for the different patterns of achievement goals and responses to the challenging task, and the more complex conceptualisations of intelligence expressed by the students in this study.

A shared assumption between Theory of Mind and the model of ITI mind-sets is the required premise that it is valid to make indirect inferences about a student's mental processing from their observable responses. However, an individual's cognitive processes are not observable and, therefore, it is contestable that they are accessible to manipulation or measurement within the controlled framework of experimental

study. As such, it is impossible to directly demonstrate causal interactions between areas of students' self-awareness, such as beliefs about their own intelligence, and behaviours, for example the way they respond in the face of difficulty. The hidden and untestable nature of links between the mind and brain is problematic regardless of the methodological approach. For this reason, my research cannot directly demonstrate the validity or invalidity of the model of ITI mind-sets. Nevertheless, a direct and causal interaction between students' conceptualisations of their intelligence and their level of engagement with the challenging problem is not supported by the diverse patterns of the students' assigned mind-sets, achievement goals and behaviours.

Although a causal interaction between students' ITI mind-sets and their level of engagement with the challenging task could not be directly explored, the questionnaire, lesson observation and interview data allowed me to examine each component of the model separately. As such, my research question could be asked at different levels; for example, did the students believe that their greater efforts when working on the challenging problem increased their intelligence? This was a valid and useful exercise since it allowed any links between the attributes of the growth mind-set and positive learning behaviours to be revealed, thereby providing insight into key intrinsic factors that impacted on the students' rationale for and decisions made about their responses to the problem. These findings will directly affect teaching and learning policy and practice in my school.

My research question asked if students' ITI mind-sets impacted on their engagement with a challenging problem-solving task. Although I have concluded that it was an impossible question to directly answer in terms of the proposed causal interaction between ITI mind-set beliefs and behaviours, the more practically useful question of

whether students think that effort made when working on challenging tasks impacts on their intelligence could be answered. All six students confirmed not only the value they place on effort, but also, that effort improves their thinking skills and abilities to solve problems. I have used this shared value as the starting point for the development of my proposed framework of understanding, which maps the key themes that emerged from the data. In the following sub-section, 5.2.3, I have presented my framework for understanding the impact of ITI mind-sets on students' responses to challenging problem-solving. I have called it a framework as I am not claiming that it represents a universal model or theory and also to emphasise that it will be used to inform policy and practice in my school where the research was carried out.

5.2.3 Proposed framework for understanding the impact of students' ITI mind-sets on their responses to a challenging problem-solving task.

The following framework describes the relative impact (positive or negative) of the intrinsic and extrinsic factors that emerged from the observation and interview data. The framework is set out as a continuum rather than as discrete categories to reflect the diverse patterns of beliefs, values and behaviours expressed by the students, and the subject-dependent variation reported by Henry and William.

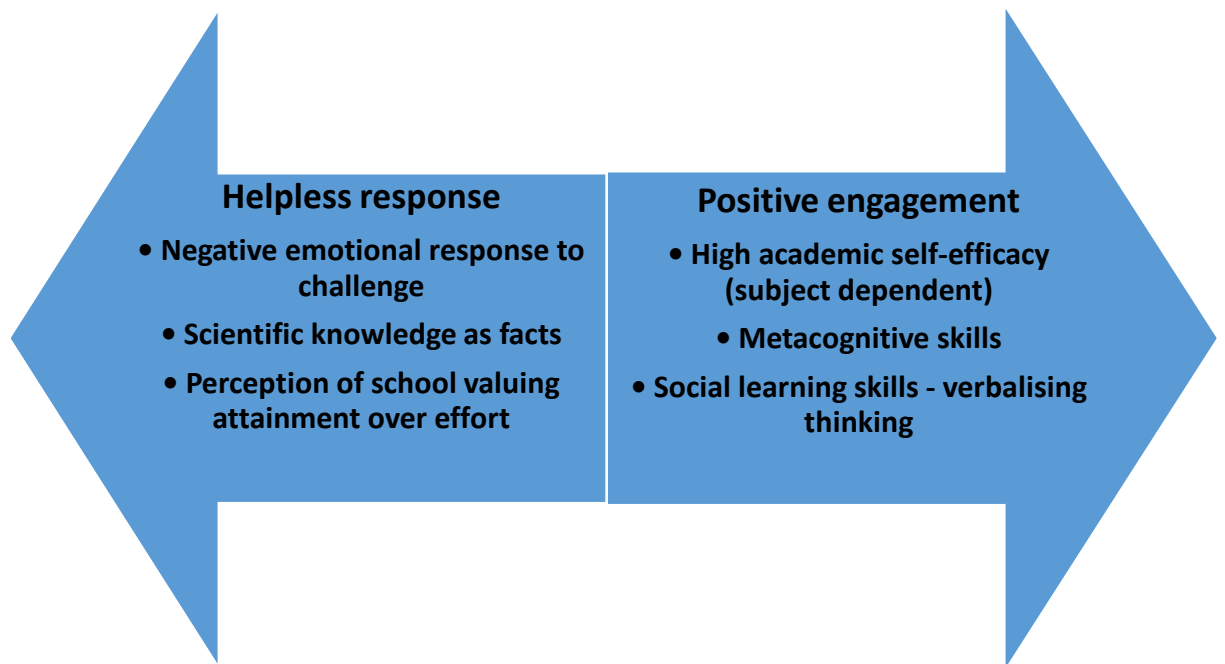


Figure 5.2.3 Framework for understanding the intrinsic and extrinsic factors that impacted on the students' engagement with the challenging osmosis problem.

Although the findings also revealed a more detailed picture of each student's conceptualisation of intelligence, for two reasons I have not incorporated these into the framework. In the first instance, the different emphases within the conceptualisations (the capacity dimension of intelligence versus the adaptability of skills) were subtle rather than distinct. Secondly, within the small cohort it was only one student, Chris, who differed from the others. So, to include this tentative finding within the framework would be impractical and potentially misleading. From a theoretical perspective it could also be argued that including differences between the students' conceptualisations of intelligence lends support to the causal interaction between students' ITI mind-sets and their responses to challenge that is proposed by the model.

The purpose of the framework is to signpost key learning attributes that would support students to respond positively to challenging tasks. It is not intended as a

diagnostic assessment, although the beliefs and negative emotions associated with the helpless response could indicate foci for intervention strategies. Since the framework has evolved from case study data, it must be interpreted within the contextual boundaries of the case. All except one of the components of the framework can be transferred to other areas of the curriculum within my school, namely the immature perception of the nature of scientific knowledge. However, the application of these ideas must be considered alongside the particular contextual factors associated with each specific learning situation. This reiterates my assertion that the framework should not be viewed as a universal model and echoes comments made by John Dewey (1920)

“What is needed instead of general theory is more specific inquiries into a multitude of specific structures and interactions in education.”

The risks of directly applying a theory such as the model of ITI mind-sets to policy and classroom practice are discussed in the next section of this chapter. Section 5.3 sets out the impact of my findings on teaching and learning in my school and the contribution made by the outcomes to the debate about the validity of the model of ITI mind-sets as a basis for educational policies and practice.

5.3 Impact of the findings

5.3.1 Introduction

In this section of the Conclusions and Discussion chapter, the realised and potential impacts of the findings of the case study are discussed and evaluated. The significance of the findings can be considered on two levels: the impact on the students at my school through changes to policy and classroom practice, and the contribution of new knowledge to debates about the model of ITI mind-sets, levels of engagement with challenge in the classroom and listening to the voices of able students.

In sub-section 5.3.2, the significance of the outcomes of this research at school level is presented in relation to the aims of the school improvement plan. One of the aims of the plan directly relates to using the growth mind-set model to support students to become more resilient in the face of difficulty. Consequently, promoting growth mind-set has formed the basis for many of the Continuing Professional Development (CPD) activities at staff and departmental meetings. My findings have contributed to the planning of activities and I have used my expertise to support colleagues as they develop their classroom practice. This part of the discussion concludes with a reflection on the importance of evidence-based practice on guiding and informing improvement to teaching practices.

Linking the school level and wider issues impact of my research is the current debate about the value of the model of ITI mind-sets in educational settings. Sub-section 5.3.3 sets out the conflicting opinions that have been expressed in professional journals and explains how my research contributes to this debate.

As a consequence of the exploratory nature of my research, the findings contribute new knowledge and lead to further questions about a number of areas of professional practice and the relationship between theory and practice in schools. In addition, adopting an interpretive research paradigm provided a forum for the students to express their beliefs and values. The rich data yielded by listening to the students' voices has increased the impact of the findings, in particular when sharing the case study findings with teaching colleagues. To conclude this section of chapter five, I have reflected upon the student voice to inform our understanding of learning and to act as a powerful agent of change to educational policy and practice.

5.3.2 Impact of the case study findings on policy and classroom practice in my school

As I have described in chapter one, a particular feature of the school where I work is the importance afforded to evidence-based practice. The emphasis on evidence-based practice is stated within one of the four strands of the school's current improvement plan (see Table 5.3.2.1). Small-scale research set in the classroom is actively encouraged and supported through CPD programmes, the performance management system and collaboration with other schools. My case study findings have been shared with colleagues through a number of different forums: meetings with senior leaders, whole staff CPD sessions and focus groups of teaching colleagues across the curriculum, such as More Able and Talented Co-ordinators and the Teaching and Learning Group. By sharing my research outcomes and receiving feedback from colleagues, I have gained valuable insight into the potential impact of my research to directly influence policy and classroom practice in my school.

To understand the impact of my research on school policy and classroom practices, it is necessary to outline the recent historical development of school-wide improvement plans (SIP). Prior to the current SIP, the focus had been on increasing challenge in the classroom to raise standards of work and the expectations of students. As I have described earlier, this provided the situation for the development of my research question. Following on from this, the current SIP (2015/16) includes four key objectives: leading change for the better; shaping the path towards young adulthood; optimising our practices and securing financial health. Each of these main objectives are sub-divided into specific foci, which are shown in Table 5.3.2.1. Within the optimising our practices objective, the growth mind-set model was identified as the focus for improving classroom practice; specifically, creating learning situations in which our students can develop resilience and perseverance when faced with challenges. These same characteristics are included in the attributes promoted through the 2020 Vision framework.


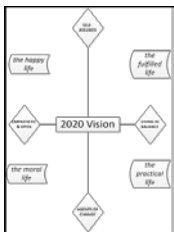
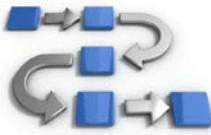

	<ul style="list-style-type: none"> - leading change for the better: maintaining a culture of high challenge and high expectations <u>with</u> high levels of support for all pupils
	<ul style="list-style-type: none"> - shaping the path towards young adulthood: implementing our 2020 Vision focusing on mental health awareness, promoting care and kindness, addressing prejudiced attitudes, developing 'well-being', encouraging self-reliance (incl. before/after pupil absence)
	<ul style="list-style-type: none"> - optimising our practices: revising homework approaches, reviewing grading and assessment, supporting colleagues (sharing best practice, balancing workload, embracing curriculum change), advancing evidence-based teaching, promoting resilience ('growth mind-sets'), exploiting new technology
	<ul style="list-style-type: none"> - securing financial health: addressing the challenges of viability and the demands for greater efficiency, incorporating the transformation of the premises and site, maximising the benefits of new facilities

Table 5.3.2.1 School Improvement Plan Objectives

Given the central importance afforded to the growth mind-set model in the SIP, my research has provided evidence to inform teaching colleagues and leaders at senior and middle levels about the most effective means by which to nurture students' positive engagement with challenge. Furthermore, the outcomes have indicated

potential strategies and interventions that could be employed that may negatively affect some students who are struggling to achieve their target grades. Whilst I do not claim that the case study findings offer a definitive solution to the problem of how to support able underachieving students to become high achieving students, the findings do offer signposts based upon the beliefs, values and attitudes expressed by the students themselves.

An important outcome of my research was the finding that all the students valued the efforts they made as they worked on the challenging problem. This provided a link back to the increased levels of challenge in the curriculum driven by the aims of the previous SIP and indicated that effort is a core value shared by the students and the staff. Value of effort is a central tenet of the growth mind-set model, so finding this to be common among the student participants suggested that the aim of promoting the attributes of growth mind-set is achievable.

The initial work that has been done with students and teaching colleagues has been the promotion of the values, attitudes and behaviours associated with the growth mind-set model. These have been presented as effective lifelong learning strategies that lead to academic progress and achievement (Yeager and Dweck, 2012). Students in Key Stage Three (Years Seven, Eight and Nine) have been introduced to the characteristics of the growth mind-set learner through Year group assemblies. My role in the assemblies was to describe and explain to the students how neurones in the brain communicate, and how engaging with more difficult tasks can improve their skills for learning. Following their assembly, the students were given challenging tasks, such as number puzzles and logical thinking problems, during their form periods. This was designed to give students the opportunity to use the growth mind-set characteristics as a point of reference to reflect upon their own

response to challenge and to practise using different strategies and team working skills. The Key Stage Three Year Leaders have co-ordinated these form period activities and the Form Tutors have supported the students' understanding of the characteristics and how they relate to their experiences in lessons.

With Key Stage Three Form Tutors supporting their tutees to develop generic skills and all teaching colleagues responsible for helping students apply these skills in their learning, there was a need to provide staff training to ensure a consistent and effective teaching approach across the curriculum. Whilst this training will be ongoing throughout the year, it was started with a specific focus on promoting and supporting students to develop growth mind-set attributes through use of language in the classroom. During a staff meeting in the Autumn Term, teaching colleagues worked in cross-curricular groups to reflect upon the common features of the language we used in our lessons and to decide if our lexicon and discourse promoted the attributes of the growth mind-set learner. I contributed to the planning, resourcing and delivery of the training session. The outcomes of this workshop were collated and given to colleagues for them to refer to when planning lessons. The structure of the workshop was purposely designed as group-based, cross-curricular and open-ended to allow teachers to explore their own, subject-specific language use and, at the same time, to appreciate how other colleagues in different departments used language in their lessons. Also, because the language identified by colleagues as being most effective in supporting students to demonstrate resilience and perseverance emerged from our professional expertise, it was more likely to be viewed as useful to our practice.

The importance of teachers' use of language and its impact on students' responses to challenging tasks was the subject of a study conducted by Mueller and Dweck in

1998. They reported that students who were given praise for their levels of effort were afterward more likely to choose challenging tasks than those students who had been praised for being clever. The performance in completion of tasks of the latter group of students was shown to be poorer when they experienced failure. Mueller and Dweck (1998) attributed these outcomes to a shift of mind-set prompted by the different emphases of the feedback the students received. Whilst involvement of ITI mind-set associated beliefs could not be directly demonstrated in this study, the correlation between promotion of effort through praise and positive engagement with challenging tasks supports the initial focus on language in the school's CPD training.

A focus on teachers' talk and the way it can support students to be resilient and persevere in the face of difficulty was recommended by Dockterman and Blackwell (2014) as an important step towards embedding growth mind-set attitudes in the classroom. Stein (2014) incorporated use of language as part of creating a community of learners in her proposed five ways to promote growth mind-set in schools. The workshop structure adopted during the CPD training exemplified Stein's description of teachers developing pedagogy by working together in professional learning communities. The student assemblies and form period activities included the students as members of the learning community by giving them an opportunity to reflect, collaborate and share their ideas with each other and their Form Tutor.

The conclusions drawn from my research findings played a significant part in the planning and delivery of staff training, and my contributions to the Year group assemblies. Sharing my research findings with teaching colleagues as part of the introduction to the staff training session allowed me to raise the concern that the model of ITI mind-sets could be seen as a diagnostic tool to assign each student as

being a fixed or a growth mind-set learner in every learning situation. The diversity of the patterns of assigned mind-set, mind-set associated beliefs and levels of engagement with the challenging problem shown by the students who took part in the case study and the change of attitudes and behaviours between subjects that were described by William and Henry do not support fixed and growth mind-sets as static, mutually exclusive categories. This was an important conclusion to share with colleagues from the beginning because it established the purpose of using the attributes of growth mind-set as a model that all students can work towards achieving. It also prompted me to advise colleagues against using questionnaires to assign students as holding either a fixed or a growth mind-set. The potential risk here would be to entrench the fixed mind-set associated behaviours in students who perceived themselves to be lacking the necessary skills to learn in a particular subject ('I can't do Mathematics' or 'I can't draw'), which could also be used as a defence when faced with difficulty.

Promoting the growth mind-set model as a set of effective learning attitudes and behaviours that all students can attain was the central message of my contributions to the Year group assemblies. To avoid the possibility that students were given the idea that ITI mind-set is an innate and unchangeable aspect of each individual's character, the fixed mind-set model was deliberately not mentioned during the assemblies. These concerns and the potential to exacerbate students' negative attitudes and behaviours towards engaging with challenging tasks were also raised by Tim O'Brien (2015) in his critique of the model of ITI mind-sets. A more detailed appraisal of Tim O'Brien's article, Carol Dweck's (Wiggins, 2015) response and how the findings of my research contribute to this debate is given in the following section 5.3.3.

As discussed earlier in this chapter, the application of theory that is based upon psychology experiments to teaching and learning in real classroom situations represents a clash between the principles underpinning Theory of Mind and Social-Constructivist theories of learning. Furthermore, I concluded that the causal relationship between conceptualisation of intelligence, achievement goal orientation and engagement with challenge proposed by the model of ITI mind-sets could not be directly demonstrated. It was clear then that I had to deconstruct and separate the theoretical aspects of the model of ITI mind-sets from the attributes of growth mind-set that could be applied to optimise teaching and learning practices. This meant that the premise of the growth mind-set behaviours being driven by a belief that intelligence can be increased was not included in the presentations to either staff or students.

The decision to focus only on growth mind-set characteristics is at odds with other educators' approaches to promoting the growth mind-set model in the classroom. In one example, Stewart (2015) advocates teaching children about both the fixed and growth mind-sets and she includes this as part of a scientific rationale used to aid children's understanding. This approach is taken from an intervention programme developed by Dweck and her colleagues, called Brainology®, which is based upon the theory of brain plasticity. The programme teaches students about the brain's capacity to make new physical connections between cells and relates this process to learning. The link between effort, challenge and increasing intelligence is made explicit and explained through basic neurobiology. What is interesting is that Dweck (2008) intended this approach to disavow students of the belief that ability is an innate and unchangeable quality. Dweck used the analogy of the brain as a muscle, which when it is exercised (learning effort) will grow (increase intelligence).

However, it could be argued that the structure of the model as opposing categories of mind-sets and the use of questionnaires to assign mind-set reinforces a concept of mind-set as a static characteristic of each individual.

Whilst delineating the theoretical and descriptive aspects of the model of ITI mind-sets was congruent with my argument that a causal relationship could not be established, it also shifted the emphasis towards exploring practical interventions aimed at developing positive learning attributes such as resilience and perseverance. The proposed framework for understanding the intrinsic and extrinsic factors that impacted on the students' engagement with the challenging osmosis problem (Figure 5.2.3) signposted specific foci for practical intervention. The foci for intervention within the framework can be mapped to Stein's (2014) five ways to promote growth mind-set in schools. Where Stein's recommendations are more open-ended, for example, using strategies aimed at developing students who know how to learn, the framework offers a definitive plan for intervention.

Within the proposed framework, the factors that promote the growth mind-set attributes refer to the skills aspect of intelligence that was a major theme in the students' interview responses. Metacognition and group-work skills are cross-curricular and valued by universities and employers. Adapting teaching practices and introducing strategies specifically aimed at developing students' abilities to co-operate and collaborate during group work through effective communication of their thought processes could raise levels of students' engagement with challenging tasks and support the 2020 Vision project that is aimed at nurturing lifelong learning.

The framework for understanding the factors that influenced the students' engagement with the challenging task evolved from the interpretivist research

paradigm that was concordant with the principles of Social-Constructivist theories of learning. This meant that my research acknowledged the impact of the contextual factors associated with the classroom on the students' learning. As discussed earlier in this chapter, the research evidence upon which the model of ITI mind-sets is based was gathered from experimental studies that followed the principles of the positivist research paradigm. Consequently, contextual factors were purposely excluded in the methods employed by the researchers. Nevertheless, data from experimental studies have been cited by authors as direct evidence of the effectiveness of the model of ITI mind-sets to explain and predict students' learning behaviours in the classroom (Dockterman and Blackwell, 2014; Briceño, 2015). It follows then that the model would be applicable to all students, in all learning situations, and would require no further refinement before being applied in the classroom.

Amongst many recently published newspaper, magazine and internet-based articles offering guidelines and advice about how to implement growth mind-set in the classroom, the paper written by Dockterman and Blackwell (2014) stands out. Although the authors presented evidence from experimental studies to advocate application of the growth mind-set model in the classroom, they also acknowledged that contextual factors affect how well students develop positive learning behaviours. As such, this paper represents a paradigm shift away from direct application of a psychology-based theory in the classroom and towards growth mind-set as one of the components that are necessary for successful learning. The authors described requisite intrinsic and extrinsic factors that create a supportive learning culture for students to apply growth mind-set behaviours, such as perseverance and resilience, when challenged. Three factors described by the authors were also themes that

emerged from this case study: self-efficacy, having a sense of belonging, and team work skills.

Although it was described previously by Dweck as a modulating factor that affects the proposed driving force of the growth mind-set and a learning goal orientation, self-efficacy has largely been ignored in the proposed intervention programmes in the literature. Dockterman and Blackwell (2014) have stated that growth mind-set theorists need also to feel confident in their abilities to be able to act positively when they encounter failure. The high levels of confidence in their abilities in Science and Mathematics expressed by William and Henry support self-efficacy as an important intrinsic factor that affects students' response to challenge. Dockterman and Blackwell also linked self-efficacy to students' sense of belonging, which echoes my hypothesis that Isaac had less of a sense of belonging to the scientific academic domain than William and Henry. However, modulating intrinsic factors is problematic. Self-efficacy and a sense of belonging are influenced by each individual student's classroom experiences and their interactions with teachers, peers and parents, so to devise a single intervention that raises all students' levels of confidence in their abilities and their sense of belonging is unrealistic. What would be required, therefore, is consistent and embedded culture change across a school that involves a programme of strategies aimed at supporting students to become more confident to persevere with challenging tasks.

Dockterman and Blackwell proposed a focus for intervention aimed at promoting growth mind-set attitudes and raising students' level of confidence that relates to components of my proposed framework for understanding (Figure 5.2.3); specifically, shared reasoning for following different strategies (fostering metacognition and team-working skills). Whilst this provides support for the specific

foci for intervention I have identified from my research findings, the classroom-based strategies used in the next stage of the SIP need to be planned in such a way as to acknowledge the different skill sets required across the curriculum. Although my school is in the early stages of introducing a culture of growth mind-set attitudes and behaviours, the findings of my research have helped to bridge the gap between the growth mind-set characteristics described in theory and the teaching practices most appropriate to the needs of the students.

In addition to the impact of the research outcomes on changing classroom practice to achieve the aims of the current SIP, my research has also highlighted areas of school policy and procedures that need to be amended to align with the growth mind-set model. Specifically, the school assessment guidelines relating to the monitoring and reporting of students' efforts. One of the aims of the school's assessment policy is to recognise effort and perseverance as well as attainment. The guidelines for practice set out five levels of effort, which are applied when reporting to parents via termly interim assessment reports and annual full reports:

Level	Description of effort
1	Excellent
2	Good
3	Satisfactory
4	Poor
5	Unacceptable

Table 5.3.2.2 School Guidelines for Assessing and Reporting Students' Efforts

Effort levels are reported along with current attainment grades, for example, A1 or B3, in each of the subjects a student studies. The same system is employed when grading students' written class work and homework.

A high level of effort, such as being fully engaged with solving a challenging problem, is one of the key characteristics of the growth mind-set learner.

Furthermore, to ensure that all students are supported to apply a consistently high level of effort in their learning it is necessary to emphasise the value of effort over attainment. This is not to say that academic attainment is not important, rather it is an acknowledgement that without perseverance and resilience of effort a student's attainment will be limited. In this respect, effort leads to achievement, such as solving increasingly more difficult problems, which in turn results in higher attainment in assessments. It follows that in a school where effort is the most important indicator of success, all students regardless of their prior attainment or other factors such as SEN, are encouraged to work to their potential and achieve their personal goals. This approach is consistent with the principles of equal opportunities for students.

The rationale for promoting effort through the school's assessment and reporting policy and procedures is supported by my research findings. All the student participants valued the efforts they made when working on the challenging task and five out of the six students recognised that their academic potential could be achieved through working hard on challenging tasks. Raising the importance of effort within school policy and procedure would be compatible with the beliefs expressed by the students and the attributes associated with growth mind-set that are central to delivering the SIP objectives. Further support for change to policy and practice regarding assessment of students' efforts comes from Isaac's commentary.

Isaac described an underlying conflict between his personal valuing of effort and his perception of the school focus on attainment. Although none of the other students described a similar belief, Isaac's comments are evidence of the negative emotional effects that a clash of values can elicit. Isaac explained how he felt about the school's emphasis on attainment.

I don't think that awards should be given for attainment because some people are better at things than others and to reward someone for something they haven't worked at, I don't think that's very fair.

It could be argued that Isaac's sense of injustice is based upon his perception of what is most valued by his teachers. Indeed, the school assessment policy does not state that attainment is more important than effort and the reporting procedure could be considered as giving equal weighting to attainment and effort. Nevertheless, to disregard Isaac's comments would risk ignoring the negative impact on students like him.

Changing assessment policy and practice has been proposed as an important part of creating a growth mind-set culture in schools (Dweck, 2010b; Masters, 2013). In his essay, Masters argued the case for a revision of current assessment objectives that move away from testing students against standardised levels of progress and towards using methods that help students and teachers understand what each individual student has learned at that point. This is congruent with the growth mind-set approach because it shifts the focus of assessment onto progress, which raises the importance of effort over attainment. Furthermore, this approach demands the setting of personalised learning goals for students such that all students can make good progress. There are, however, difficulties associated with establishing an assessment system where effort is the pre-eminent criterion. Firstly, any school-based

assessment system must work alongside external assessment demands, such as attainment grades reported to Government for national statistics, for Ofsted evaluations and to bodies such as Fischer Family Trust who provide baseline data for monitoring purposes. Also, reporting current and predicted examination grades to students and their parents is an important function of secondary schools as these data are used in applications for college and university places. It is not possible, therefore, to move completely to an assessment system that only monitors individual student's progress without some comparison against standardised levels of attainment.

I have presented my research findings, including my conclusions about promoting the value of effort through changing policy and procedures, to colleagues during a Senior Leadership Team meeting and later in a meeting with the Assistant Head Teacher who is responsible for Teaching and Learning across the school. At this early stage in development, I have recommended using student focus groups to gauge the views of students across year groups about the current assessment system and to ask the students to share their ideas about promoting and valuing their efforts. This approach has the additional benefit of including the students as agents of change who have an active role in shaping their learning environment and is also advocated by Dockterman and Blackwell (2014) and Stein (2014) as an important feature of creating a growth mind-set culture in schools. The theme of listening to the student voice is developed further in the next section as a characteristic of my research approach that has enhanced the impact of my findings in my own school setting and with colleagues in other schools and areas of education provision.

In conclusion, my research findings have made a significant contribution to the development of policy and practice in my school. Specifically, the conclusions I have drawn from the lesson observation and interview data have enabled me to tailor

the application of the growth mind-set model to the needs of the students. Analysis of the ontological and epistemological assumptions that underpin the psychology experiments from which the model of ITI mind-sets evolved led me to question the validity of applying the model directly in the classroom. For this reason, the proposed causal relationship between theories of intelligence and learning behaviours has not been presented to staff or students as part of the growth mind-set development training sessions. The framework of understanding of the extrinsic and intrinsic factors affecting the students as they worked on the challenging problem has signposted areas for intervention and optimisation of teaching practice during the rest of the SIP period. Taken together, the use of research data that have been gathered directly from the students in their normal learning environment imparts an authenticity and reliability to the findings as a basis for making decisions about policy and practice.

5.3.3 The impact of the case study findings on wider educational issues, debates and national policy

The advantage of being able to directly apply my case study findings to improving policy and classroom practice becomes a disadvantage from the perspective of impact outside the specific context of the case. Nevertheless, my research outcomes contribute new knowledge about the model of ITI mind-sets that support an emerging revision of its original binary structure. In relation to this, the conclusions I have drawn from the case study outcomes answer some of the questions that have been raised about the validity of applying psychology-based theories to teaching and learning in real classroom settings. As mentioned earlier, I have also identified

listening to the student voice as an area of educational inquiry to which my research approach and outcomes make a significant contribution.

Dweck (2000) has presented the model of ITI mind-sets as two opposing theoretical stances, fixed versus growth, which drive an individual's achievement goal orientation and learning behaviour. The fixed and growth mind-set models were never intended to represent immutable beliefs and characteristics; that is, a person is not a fixed or a growth mind-set theorist across all aspects of their learning. If mind-set was only determined by our genes then intervention strategies to develop growth mind-set attitudes and behaviours in students could not achieve their aims.

Nevertheless, the items in the scaled questionnaires used to assign students as holding a fixed or a growth mind-set are written as generalised statements that exclude any differences between learning experiences in across the curriculum. For example,

“You can learn new things, but, you can't really change your basic intelligence” (Dweck, 2000).

The questionnaires were developed as research tools and not as diagnostic or predictive assessments of students' performance in a school-setting. However, studies have applied the questionnaires in school or college contexts and found correlations between ITI mind-set and learning behaviours (Wang and Ng, 2012). The risk of applying the questionnaires in schools to assign individual students as either a fixed or a growth mind-set theorist is to send the message to students, teachers and parents that mind-set is an unchangeable characteristic.

Within the boundaries of the case, my research supports the proposal that individual students can exhibit different learning behaviours in different subjects. These behaviours can be classified as being associated with the fixed or growth mind-set

models. However, a direct causal relationship between different learning behaviours and fixed or growth mind-set associated beliefs about intelligence could not be shown from the case study data. The comments made by William and Henry indicated that their perceptions of variable self-efficacy and levels of motivation influenced their learning behaviours in Science, Mathematics and English Literature. In William's case, his greater efforts in English Literature lessons were the opposite of that which the model predicts. Furthermore, the causal relationship at the centre of the model of ITI mind-sets was not supported by finding complex patterns of assigned mind-set, achievement goal orientation and response to challenge among the student participants. Consequently, my research contributes to the body of knowledge about ITI mind-set because the findings do not support the theoretical premise at the centre of the model.

As well as questioning the proposed interaction between ITI mind-set, achievement goal orientation and response to challenge, the personal constructs described to me by five of the students combined beliefs associated with both the fixed and growth mind-set models. This led me to conclude that the dichotomous structure of the model was too simplistic to accommodate the conceptualisations of the able students who participated in the case study and to propose an alternative continuum of beliefs. A similar conclusion was reached by Quihuis et al. (2002) and later on by Karwowski (2014). These new ideas could have a significant impact on the theoretical premises of the model and its application as a social-psychological intervention in schools. Although my research contributes to only a small number of studies that propose a revision of the structure of the model of ITI mind-sets, the evidence I have presented is unique. No other studies have focused on male, academically able students in a selective secondary school.

From a theoretical perspective, a continuum of beliefs about intelligence supports the claims of Dweck and her colleagues that individuals can hold different mind-sets in different learning domains. This refutes the potentially harmful misunderstanding that mind-set is an innate characteristic that dictates an individual's response to challenge. The continuum structure goes further in that it accommodates students who are undergoing a change of mind-set, in particular, a gradual change over time. This has significance in terms of application of the model in educational settings because researchers and educators have proposed long-term school intervention programmes aimed at developing and embedding growth mind-set attitude and behaviour. For example, Yeager and Walton (2011), Dockterman and Blackwell (2014) and Briceño (2015) have promoted classroom-based and school-wide strategies that focus on policy, curricula, pedagogy and assessment as part of their recommendations for creating a growth mind-set culture. In their rationale for this approach, the authors acknowledged the many factors that influence students' beliefs and values, and explained that changing mind-sets would require inclusion of growth mind-set principles in every aspect of students' learning environment. This could not be achieved over a short period of time.

Previously I have argued against the use of questionnaires to assign students as fixed or growth mind-set theorists. If the model were a continuum where students could hold both fixed and growth mind-set associated beliefs simultaneously, the questionnaires would not be fit for purpose. This could lead to either further revision of the questionnaires currently used to assign mind-set or prompt more researchers to adopt an interpretivist approach to investigate students' beliefs about intelligence and their impact on learning behaviour. For example, using observation and interview methods as proposed by Karwowski (2014).

My adoption of the interpretivist research paradigm was a deliberate attempt to explore the impact of students' ITI mind-sets on their response to a challenging task in an authentic classroom-based context. Underlying the design of my research was an assumption that both intrinsic and extrinsic contextual factors affect students' learning. For this reason, my research outcomes contribute to the current debate about the validity of applying social-psychological theory in schools. This debate has gathered momentum because the growth mind-set model has been incorporated into a number of schools' strategies for improvement and has been the subject of articles and letters published in professional teaching journals.

In June 2015, the Times Educational Supplement published a critique of the model of ITI mind-sets that brought together many of the concerns voiced by education researchers and practitioners about the applicability of psychological theories in classrooms. At the centre of Tim O'Brien's (2015) argument was a criticism of the reductive nature of psychology-based theories. Conclusions I have drawn from the case study findings support the author's concerns about excluding all other intrinsic and extrinsic factors that affect students' learning in real classrooms. The diversity of combinations of assigned mind-set, achievement goal orientation and response to challenge presented by the small cohort in my case study were at odds with the reported patterns from studies that employed scientific methods of investigation.

A single theory that simplifies students' beliefs, goal-orientations and responses to challenge into two categories is attractive to school leaders and teachers because it appears to offer solutions to a range of teaching and learning problems. Furthermore, evidence from experimental and correlational studies are presented as evidence that the model is a true representation of students' mental processes. Combining these two characteristics of the model of ITI mind-sets bestows a persuasive quality to the

ideas it proposes, which was noted by Yeager and Walton (2011) as a common feature of social-psychological theories applied in educational settings. The conclusions I have reached challenge claims made about the model of ITI mind-sets; specifically, that it is not possible to directly demonstrate a causal relationship between students' beliefs about their intelligence and their learning behaviours in the face of difficulty. Indeed, analysis of the case study interview and observation data identified self-efficacy related to subject, metacognition, level of concentration and ability to verbalise thinking processes as the intrinsic factors that impacted upon the students' response to the challenging task. These findings suggest that the students' responses to challenge involved complex inter-relationships between many factors rather than the defined stimulus and response that is proposed by the model of ITI mind-sets. From a theoretical perspective, my research findings support the argument forwarded by O'Brien (2015) that the scientific method used to generate the data upon which the model of ITI mind-sets is based is incompatible with the multifactorial context of real classrooms.

O'Brien (2015) cautioned educators against accepting and applying the model of ITI mind-sets because it could lead to categorising all students as either fixed or growth mind-set theorists. He described two possible damaging outcomes of applying the theory of ITI mind-sets in schools. Firstly, assigning mind-sets to individual students could create groups of fixed mind-set theorists who would be the focus for intervention strategies and this, he argued, would stereotype and marginalise them. The conclusions I have drawn from my analyses of the case study data have led me to share some of the same concerns.

I have asserted that using a questionnaire to assign students as holding a fixed or a growth mind-set risks promoting the misconception that mind-set and, therefore, the

goals and behaviours associated with them are innate and unchangeable features of a student's personality. Dweck (Wiggins, 2015) and Briceño (2015) have acknowledged and discussed the potential dangers of misinterpreting the intended impact of the model of ITI mind-sets as an exercise in labelling students. Both reiterated the potential for students to develop growth mind-set attitudes and learning behaviours, and emphasised the facilitating role of teachers in this process. As my research has fulfilled its purpose of exploring the impact of ITI mind-set on able students' response to a challenging task, the case study findings have helped to define the facilitating role of teachers in my school setting.

The response of school leaders and classroom practitioners to assigning individual students as fixed or growth mind-set theorists was the second concern raised by O'Brien (2015). He predicted that teachers would narrow their perceptions of students because the pre-eminent characteristic that would inform practice would be ITI mind-set. Consequently, teaching practice would be restricted to focus on changing the mind-set and behaviours of students assessed as having a fixed mind-set. This conclusion is supported by Thomas (2007) who argued against the application of theories based on mental construction because they have led to unhelpful and even damaging teaching practices and Carr (2006) who said that constructing theory outside our practice was a pointless exercise. O'Brien's (2015) predicted erosion of teacher professionalism resonates with my own understanding of professionalism and the role of the professional practitioner described in the first chapter of my thesis. However, within his argument O'Brien (2015) has made an assumption that school leaders and teachers would translate mind-set theory into teacher-led classroom strategies that focused on telling some (fixed mind-set) students to work harder.

In contrast with the classroom scenario presented in O'Brien's (2015) critique, application of the model of ITI mind-sets has followed a different course in my school due to the impact of the case study findings. As described earlier in this chapter, using semi-structured interviews in my research did not restrict the students to using the definitions and ideas determined by the model of ITI mind-sets. Consequently, the scope of my exploration around the topic of the students' responses to the challenging task was extended and encompassed the key themes raised by the students themselves. The framework for understanding the intrinsic and extrinsic factors that impacted on the students' responses to the challenging task (Figure 5.2.3), therefore, is the product of my analyses in the light of my professional knowledge of the students and their learning environment. Furthermore, through sharing my research findings with senior and middle leaders and with teaching colleagues, the conclusions I have drawn are open to scrutiny and criticism as part of a professional dialogue about how to create a growth mind-set culture across the school.

Using my research outcomes to inform and guide changes to school policy and practice has also made a significant contribution to the wider debate about the value of applying the model of ITI mind-sets in schools. This is because the case study exemplifies the 'practice-based evidence' that O'Brien (2015) advanced as the essential step between theory and practice that should be carried out in schools by teachers. My research also aligns with recently published clarifications and recommendations about using the growth mind-set model in education (Yeager and Dweck, 2012; Dockterman and Blackwell, 2014; Stein, 2014; Briceño, 2015). Specifically, to recognise the specific contextual factors affecting students' learning and incorporate growth mind-set ideas as part of a wider programme of interventions

aimed at optimising teaching practice and improving learning. Overall, the design of my project and the way the outcomes have been used to inform application of the growth mind-set model in the classroom offer a prototype approach that could be useful to other teacher-researchers who are exploring the impact of theory on practice.

Researching a problem that affects the achievement of students in my own school fulfils a key intention of the Educational Excellence Everywhere policy paper (DfE, 2016): fostering an evidence-informed teaching profession. Although the emphasis of how to deliver this aim is on teachers using research evidence from other sources, the policy does promote a greater level of decision-making about interventions such as those aimed at reversing underachievement. Supporting the development of evidence-based practice also aligns with the greater control academies have to decide how best to deliver the curriculum (DfE, 2015). The Educational Excellence Everywhere policy document (DfE, 2016) states that teachers and leaders “should be equipped to make these choices...” (p38) and cites Brain Gym as an example of an intervention that gained popularity in schools, but, which lacked a reliable evidence-base to validate its effectiveness (Goldacre, 2011). Different patterns of beliefs, values and behaviours than those predicted by the model of ITI mind-sets were revealed by my case study and this supports the use of evidence in decision-making. Nevertheless, the outcomes of my research also raised questions about the nature of the research evidence that is used in support of introducing new teaching methods and interventions. Specifically, that the positivist methodology applied in the majority of studies that found supporting evidence for the model of ITI mind-sets does not align with the social constructivist theories of learning that underpin current

pedagogy. As such, my research highlights a need for clarification of national policy regarding the fitness for purpose of research evidence applied in schools.

The use of Brain Gym in the Educational Excellence Everywhere policy (DfE, 2016) as an illustrative example of an intervention lacking research evidence about its efficacy is pertinent to the application of the model of ITI mind-sets to classroom practice. In his criticism of Brain Gym, Goldacre (2011) described the reasoning for its use in schools as “...silly pseudoscientific justifications”. It could be inferred from his choice of language that Goldacre considers evidence from scientific research to be most reliable. Quoting Goldacre’s (2011) critique in support of equipping teachers to “make these choices based on the best evidence” (p38; DfE, 2016) alongside an intention to model the use of evidence to develop teaching practice along the lines of medical colleges, suggests that the authors of the policy have an implicit acceptance that scientific research takes precedence over other methodologies. Given that the body of supporting literature for the premises and predictions of the model of ITI mind-sets has emerged mostly from positivist studies, there is a risk that the reliability and rigour afforded to scientific research outweighs consideration of whether it is appropriate to apply this evidence to school settings. Therefore, my research outcomes support a refining of what is meant by “best evidence” (Section 2.55, p38) in the Educational Excellence Everywhere policy (DfE, 2016) and further development of the support that will be given to teachers and school leaders to select and apply research evidence in the classroom (Section 2.60, p39).

Although there appears to be concordance between the purpose of my study and the professional development areas of the Educational Excellence Everywhere policy (DfE, 2016), potential conflicts can be identified within the Teachers’ Standards

(DfE, 2011). Whilst specific reference is made to teachers using research evidence to inform decision-making about their practice in the Educational Excellence Everywhere policy (DfE, 2016), this aspect of teacher professionalism is not explicitly described in the Teachers' Standards (DfE, 2011). This discontinuity between policies leads to questions about the likelihood of teachers engaging with research evidence and conducting their own school-based research as part of an evidence-based practice approach. The opportunity for teacher-researchers to contribute to decision-making in their schools becomes dependent upon time and resources available for conducting classroom-based research, and the value afforded to the outcomes of the research by school leaders. The findings of the report on the workload challenge consultation (DfE, 2015) highlighted the extent of teachers' day-to-day activities, with specific reference made to the lack of time to complete the volume of work. Alongside limitations on time, the opportunity to conduct classroom-based research will be affected by current issues surrounding school funding (NAHT, 2017). In the context of my own research, these negative pressures were outweighed by the value of being able to directly apply the findings to inform development of policy and practice in my school.

At this point in the chapter I have described and explained the impact my research has had in my own school and the contributions made to the wider educational debate about applying theory to practice. One particular aspect of my research approach has had a significant impact in both of these spheres of education: using student voice. To conclude the discussion about the impact of my research, the following sub-section explores the importance of listening to the students' voice in relation to changing policy and teaching practice. These ideas are explored further in the critical evaluation of my research methodology and methods.

5.3.4 The impact of using student voice on changing school policy and practice and on sharing my research outcomes with others.

The aim of my research was to explore the impact of ITI mind-set on able students' responses to a challenging task. The exploratory nature and case study design of my research were purposely chosen to elicit rich, detailed data about the student participants' beliefs, values and conceptualisations of intelligence. By using semi-structured interviews to gather the data that would answer my research question, student voice was given precedence over the students' responses to the questionnaire items and their learning behaviours during the observed lessons. The following section describes and evaluates the impact of using student voice from two perspectives: the response of colleagues in my workplace to outcomes of the case study and contribution of student voice to changing school policy and practice.

It is pertinent at the start of this discussion to establish what I mean by the term student voice. The definition proposed by Fletcher (2005) accurately describes my own understanding of listening to student voice: "validating and authorising them (students) to represent their own ideas, opinions, knowledge and experiences throughout education in order to improve our schools". This concept of student voice agrees with the purpose of the interviews because it accommodates a breadth of themes expressed by students, which in turn satisfies the exploratory character of my study. Also, using the themes that emerged from the students' interview responses to construct the framework of understanding (Figure 5.2.3) to guide changes to policy and teaching practice fulfils the criterion of using student voice to improve the school. From a wider policy perspective, listening to and acting upon the students'

views aligns with the intentions of empowering pupils (chapter four) and building character and resilience in every child (chapter six) that are contained in the Education Excellence Everywhere paper (2016). These intentions are also enshrined in the United Nations Convention on the Rights of the Child (UNICEF UK, 2010). Specifically, the right to be heard (Article twelve) and the right to freedom of expression (Article thirteen), which promote respect for children's views, feelings and wishes in matters that affect them. Associated with the requirement of student voice having an impact on teaching and learning, are the interlinked issues of power, school structures and culture (Robinson and Taylor, 2013). As part of the discussion that follows, I have analysed the school-specific factors related to listening to student voice that have the potential to promote or hinder the impact of my research.

Two qualities that can be attributed to the student interview data are authenticity of context and richness of detail. By reviewing video footage of themselves working on the challenging task, the students had a focus for their answers. Since the video footage was recorded during two consecutive timetabled biology lessons, the times, location, fellow students and teacher were not different from their usual experience. Emphasising the students' personal experiences within a semi-structured interview approach was purposely done to help the students to articulate thoughts, values and beliefs that they may not have voiced before. At the same time, the students were not restricted in their choices of topic or theme that were of importance to their personal knowledge, understanding and concepts of challenge, motivation and intelligence. Perhaps because of the higher cognitive and metacognitive abilities of the student participants, the opportunity to freely express their ideas during the interviews resulted in detailed answers that they illustrated through use of example and analogy. At certain points, the interviews evolved into discussions because the follow-up

questions asked were dependent upon the topic chosen by the student. In this way, the students were driving the direction of the conversations. Consequently, the students' involvement with the research had become participatory (Smith, 2011).

When shared with teaching colleagues, the clarity and detail of the students' interview responses provoked discussion and further questions. Colleagues were surprised and impressed by the students' complexity of thinking, insightful and open comments about their own and others' behaviours in the face of difficulty, and their developing personal conceptualisations of intelligence and learning. This reflected my own responses as I listened to the students during the interviews and again during analysis of the data. By presenting the students' comments directly to colleagues, the case study findings had a greater impact as evidence in support of changing policy and practice; the student voice was more convincing than my conclusions alone. In this respect, the students' interview data epitomises the claim of Toshalis and Nakkula (2012) that student voice has the potential to be a powerful tool for transformation in schools.

Whilst the student voice expressed in my research had the power to provoke positive reactions from teachers, it would be naïve to assume that this automatically meant that the findings would change policy and practice. Translating the framework for understanding into action is dependent upon issues of power relations, school structure and culture. Cox et al. (2010) described the unease felt by educators when students are given the opportunity to make decisions in areas such as curriculum change and teaching practice that are usually controlled by school leaders and teachers. Such a change in the decision-making dynamics represents a shift in power relations, which may be reinforced by hierarchical structures of organisation in schools (Lynch and Lodge, 2002). Resistance against giving students a say in the

policies and practice that affect their learning is compounded by the pressures on teachers to ensure students attain their target grades (Richards, 2010). As an academy grammar school, the students at my school are expected to attain the top grades in examinations across their subjects. Therefore, the school could be seen as having a performance goal-orientated culture where the democratic ideals of listening to student voice and empowering students to be involved in decision-making about teaching and learning issues are not promoted. Cox et al. (2010) explained the rationale for this as a lower value placed upon the learning outcomes of student participation in decision-making because they are qualitative and based upon perception (e.g. increased confidence and greater sense of belonging) as opposed to measureable knowledge or skills.

I have set out reasons why the areas for improvement arising from the student voice in my research may be hindered in directing change to school policy and teaching practice. However, it would be unfair to judge the potential for student voice to have impact in a specific case based solely upon conclusions drawn from studies in the literature. A more detailed analysis of the actual power-relations, organisation and culture of my school is needed to be able to evaluate the potential for the student voice in my research to translate into changes in the classroom.

Having a School Council is an indicator of student voice being recognised and valued in a school. Harber (2010) described the increasing number of student-led School Councils in the UK, but, questioned the reality of students having power to make decisions about issues that affect their learning. Similarly, Cox et al. (2006) and Davies et al. (2006) reported that students in their studies were allowed to participate in decision-making on issues that affected other areas of their school life, such as the canteen and fund-raising, but, were not involved in decisions that directly

affected their learning. In my workplace, the School Council is an established student representative body with its membership comprised of student Councillors from each Form, across all Year groups. Student Councillors are elected by the students in their Form. Whilst many of the issues the School Council make decisions about could be classified as those ‘playground’ types described by Cox and her colleagues, there are also examples of involvement of the School Council in issues that directly affect teaching and learning. In one example, Student Councillors participated in focus group discussions with teachers about the effectiveness of written feedback. The dialogue between students and teachers resulted in improved practice and, most importantly, showed that the students were trustworthy and capable of collaborating with their teachers to make decisions that directly affect their learning. Furthermore, other forums for student voice have been established in my workplace, such as the Charity Committee and Sixth Form Council. Although based on anecdotal and limited evidence, the value and trust afforded to student voice at my school is greater than in other schools described in case studies and reviews of the literature (Cox et al., 2006; Davies et al., 2006; Harber, 2010).

Consideration of the organisational structures within my workplace is necessary because it reveals the balance of power regarding decision-making. This in turn helps to put into perspective the level of influence that data derived from student voice can have on changing policy and practice. The school has a hierarchical organisational structure: Governing Body, Head Teacher, Senior Leadership Team, Core Leaders and Middle Leaders, teaching and support staff. There are also distributed leadership roles that are fostered through professional learning communities, such as teaching and learning group, more able and talented co-ordinators and ICT champions. In terms of decision-making processes, the

collaborative groups cross the boundaries between the levels defined by the hierarchical structure thereby enabling the consultation component of the decision-making process to be more inclusive. Newton and Tarrant (1992) described this type of collaborative approach as part of a process-led, participative school development model. However, the group that exerts the major influence within an organisation's structure will hold the balance of power when it comes to making decisions (Morgan, 1986). It follows then that the Governing Body and Head Teacher with the Senior Leadership Team will make the final decision about changing policy and practice.

The collective activities of various student and staff forums represent a diversity of voice that contribute to the collaborative phase of decision-making processes at my school. It is reasonable, therefore, to predict that by using student voice in my research approach and in presentations to colleagues during staff and professional learning group meetings, my research would have greater impact. At this early stage in developing a growth mind-set culture at the school, my informal analysis of the impact of using student voice confirms this prediction. In particular, the value colleagues placed on the students' interview data as evidence-base practice aligns with the school's culture of classroom-based inquiry. Furthermore, using student voice in this case avoids importing and imposing growth mind-set based strategies from elsewhere that would be at odds with a participative model of school development (Newton and Tarrant, 1992).

Whilst I have presented an argument in support of an enhanced impact of my research through listening to student voice, the predicted effects on changing policy and practice at my workplace are tentative. This is because student voice is only one source of information about the areas of policy and practice that could be optimised

to nurture growth mind-set attitudes and behaviours in students. Also, the decisions pertaining to changes to policy and practice will be taken by others who will be constrained by issues of time, cost and competing concerns. Even if policy and practice guidelines are changed to reflect the case study findings, how these might translate into real differences in the learning experiences of students is unknown. Although this question is outside the scope of this case study, it could form the basis of an extension to my research.

In their review of relevant research, Yamashita, Davies and Williams (2010) reported a consensus of beneficial outcomes attributed to listening to student voice. The benefits to the students included improved perception of themselves and school, such as self-confidence and a sense of belonging. The authors also cited studies where it was claimed that students had learned skills associated with communication and leadership. What is interesting and pertinent to my workplace, is that many of these posited benefits of listening to student voice are also aims of the 2020 Vision project. The overarching intention of this school policy is to promote lifelong learning, which is a core outcome of the fourth global Sustainable Development Goal, Quality Education (UN, 2015). Nevertheless, it is not valid to claim that through listening to the student voice in this case study would also result in any of these informal learning outcomes. Yamashita, Davies and Williams (2010) cautioned against claiming a variety of improved learning as a direct result of developing student voice forums, partly because it is difficult to measure these sorts of skills. Even if these learning outcomes could be measured and a positive correlation demonstrated with listening to student voice, this is not evidence of a causal relationship. For these reasons, I have not included any additional learning or development of skills as a potential impact of listening to student voice in the case

study. Consequently, the only impact of student voice would be contributing to the decision-making process about changing the assessment policy and development of teaching practices to promote growth mind-set attitudes and behaviours in students.

5.3.5 Reflection on the impact of the case study on my professional development.

Stretching able students has been promoted as an essential feature of effective lessons. This has driven the development of pedagogy and curricula aimed at increasing the level of challenge in my school, a grammar academy. My experience of employing stretch and challenge strategies in the classroom has shown that most able students respond positively to the greater demand, but, those who do not are at risk of underachievement. My research question arose from a need to understand why some able students do not engage with challenging tasks and use this knowledge to implement supportive interventions. Taking action to address an issue that has a direct effect on the learning and educational outcomes of some of the students I teach is concordant with my conceptualisation of the professional teacher, which is discussed in chapter one. Furthermore, given that the underachievement of able students is a widespread issue, my research question has relevance beyond my own practice and, therefore, the outcomes of my research contribute to the body of professional knowledge.

Completing the data gathering stages of the case study and sharing findings with colleagues have had a significant impact on my professional development. During the gathering of data, my dual role as teacher-researcher was an advantage because I was able to follow the students' narratives as they were being told to me. Familiarity

with each student's particular use of verbal and non-verbal communication helped me to understand and process the meanings of the student's responses, and immediately form follow up questions that maintained the momentum of the discussion. This is a strength of being both teacher and researcher. At the same time, my perception of the students changed as I reflected on the coherent and detailed personal frameworks of understanding the students were revealing during their interviews. Rarely in my professional life do I have the time or opportunity to discuss wider issues about learning with students, so the case study was also part of my learning about listening to young people and valuing their ideas and perceptions from their perspective. It was a privilege engage in discussion with articulate students who, through their participation in the research, demonstrated a shared value of learning.

Whilst my role as teacher and researcher made some aspects of access and data analysis easier, I was also aware of risks to the accuracy and reliability of the data that accompany this dual role. In such a close working relationship as that between student and teacher, it was difficult to disregard prior knowledge of an individual's learning behaviours and not allow this to influence the outcomes. The risk of introducing researcher bias was higher given that the interview data were analysed through me using a qualitative approach. In the following chapter, the impact of these risks have been evaluated from the perspective of validity and reliability of the data. From the perspective of my professional development, the benefits and drawbacks of being a teacher and researcher emphasised the integral part I played in the case study. Adopting an interpretive research paradigm demanded a much closer connection with the data where layers of analyses were used to draw meaning from the students' interview responses. This meant coding the data line by line in the first

instance, identifying details of each student's beliefs and values to build their personal narratives. After mapping the key themes emerging from each student's narratives as a mind-map, I then applied a holistic approach to cross reference the narratives with the lesson observation data and the model of ITI mind-sets. Although I did not purposely apply a defined method of data analysis, my approach most closely resembled the holistic method of coding described by Saldaña (2013). The approach I took to analysing the case study data contrasted with the quantitative methods I am more familiar with using, for example analysing examination data against target grades. Consequently, the interpretive design of my research required me to operate outside the positivist paradigm I am more familiar with in my role as Leader of Biology. Stepping out of my normal teacher and middle leader roles as I worked on the case study has allowed me to evaluate the role of educational researcher as one I would want to repeat in the future and develop as part of my longer-term career progression.

Undertaking the case study fulfilled a critical step towards becoming a researcher in the field of education. This required that I successfully completed an extended research project that met the standards of planning, execution, analysis and presentation of findings expected of a professional educational researcher. The structure of the professional doctorate course not only provided support and guidance to help me gain the necessary knowledge and skills, but, also provided regular opportunities to receive constructive criticism of my early plans and writing. In addition to developing practical research skills, receiving validation that I was working at doctoral level was also a means to achieving a sense of belonging, a concept I referred to in the Discussion and Conclusions chapter. In my case, this meant being an accepted member of the academic research community. The process

of applying for ethical approval from the ARU FREP (Health, Social Care and Education) for my study illustrates the progression I was required to demonstrate to gain validation of my design as worthy of doctoral level research. The attention to detail and critical self-evaluation required was beyond the requirements of any other piece of work I had undertaken before (including an ethical approval application for a research project involving the use of human blood samples as part of my work on the immune response to HIV infection – Brown et al., 1999). Gaining ethical approval to conduct my case study gave me confidence to defend the purpose, methodology and methods of my design and present the findings of my research to a wider audience.

I have shared the findings of my research with a wide range of practitioners: colleagues at work, in other partner schools, with fellow doctoral students at university workshops and conference, with my supervisors and with educators in the field of more able and talented education. Developing my presentation skills and being able to defend my work were actively encouraged throughout Stage 1 of the professional doctoral programme. From my early tentative presentations given to fellow doctoral students during workshops, I have grown in confidence and even started to enjoy the unexpected questions and debates that my research approach, findings and conclusions have provoked. I also found helping my fellow doctoral students to find solutions to problems arising in their planning, ethical approval applications and writing helpful to the development of my own research skills. The mutual support given created a safe environment in which to become more self-critical and resilient when problems arose. At first I found it difficult to present my work in such a way as to ensure that an audience comprised of colleagues from across fields of education would be able to understand the theoretical background,

aims, approach, findings and potential applications of my work. I was most aware of the diverse interests and perspectives of the members of audiences when I presented at conference.

To date, I have presented my work at two Anglia Ruskin University Student Conferences and been awarded a commendation. I have also presented at the Early Career Researcher BERA Conference in London (June 2014) and at the NACE Challenge Award Assessors Training Day in Birmingham (June 2015). At the BERA Conference I had the opportunity to get feedback from professional educational researchers, which also acted as a test of my research design and skills of analysis. Listening to other researchers' work and contributing to discussions that followed gave me an insight into the breadth and diversity of educational research and I learned about current educational debates. The NACE Assessors Training Day was an opportunity to test how valuable my research would be to educators and researchers who work with more able and talented children. In the audience that day were school senior leaders, Ofsted Inspectors and researchers who were also assessors for the NACE Challenge Award. This is a tiered award that recognises excellence of school provision and practice for more able and talented students. My research was well received and prompted questions and discussion about growth mind-set applications with more able and talented students, and the factors that affect response to challenge emerging from the students' interviews. Consequently, my work has reached a much wider audience than I initially anticipated and I have received feedback from a broad spectrum of educators and researchers. This has given me additional perspectives to explore in my analysis of the data and evaluation of the impact of my findings.

Whilst my experience of planning, gathering data, writing my thesis and sharing my work with a diverse range of colleagues has been an overwhelmingly positive experience for my professional development, there have been some unexpected difficulties that I have had to manage alongside my day to day professional role. Changes to systems and structures at school have significantly affected the time I am able to allocate to writing. These increased demands upon mine and my school colleagues' workload have been prompted by changes to the funding arrangements for schools that were imposed by Government. The impact of reduced funding on the school is reflected in one of the current SIP objectives, securing financial health (Figure 5.3.2).

The inclusion of growth mind-set in the SIP as a focus for optimising practices has raised the profile of my research and, as a consequence, colleagues have associated me with promotion of the growth mind-set model. For the most part this has led to being asked for my advice about the model of ITI mind-sets and its application in the classroom. I have been referred to as an expert on the growth mind-set model.

However, the conclusions I reached at the end of the case study are not supportive of the theoretical basis of the model and, as such, I do not accept the proposed causal relationship between beliefs about intelligence and response to challenge.

Nevertheless, some colleagues have assumed that I am an advocate of the growth mind-set model as a universal solution to many problems affecting students' learning. However, there is rarely time or opportunity to explain my rationale for rejecting the theoretical premise of the model. In an effort to redress this situation, I have presented my work at a joint schools training day (colleagues from three schools in the authority area) with the aim of explaining the advantages and disadvantages of using the growth mind-set model as a framework for optimising

practice, and the consequences for classroom strategies. I used my research findings to promote practice-based evidence as the bridge between theory and application in practice that accommodates the particular contextual factors and needs of students in each school.

To conclude, completing the case study has had impact on all aspects of my professional practice. As a classroom teacher, I have a new respect for and a better understanding of my students through listening to and analysing their personal frameworks of understanding. The diversity of the topics they identified as important to their motivation and response to challenge, and the level of self-awareness and rational thought embodied in their conceptualisations of intelligence and learning has changed my perception of students' understanding and capabilities. As a consequence, I am a more active listener and now plan lesson activities for students aimed at exploring novel ideas and routes to solutions. I am more comfortable with students making mistakes, which I hope will also be adopted by the students themselves. In my role as leader of biology I have worked with my colleagues to introduce and develop more student-led team work activities for the new A Level and GCSE schemes of work. As a middle leader I have taken an active role in whole school improvement, working with an Assistant Head Teacher to offer advice on CPD staff training and assisting KS3 pastoral leaders to promote growth mind-set attributes through student form time activities. Taken together, the impact of my research has been to change my own perceptions and practice, and support colleagues by sharing my expertise.

5.4 Chapter Summary

My research question asked how able students' ITI mind-sets impacted on their engagement with a challenging problem-solving task during biology lessons. By using a case study design, the boundaries of the case represented a unique educational context that had not previously been explored. In particular, the higher cognitive abilities of the student participants and location of the study in a boys' grammar academy secondary school in the United Kingdom. For this reason, the outcomes of the study are new knowledge that contribute to the understanding of the theoretical basis and practical applications of the model of ITI mind-sets.

Five of the six student participants in the case study combined fixed and growth mind-set associated beliefs in their conceptualisations of intelligence. This led me to conclude that a continuum of beliefs about intelligence accommodated the more complex personal constructs expressed by the students. Although moving from the mutually exclusive fixed and growth mind-set categories to a continuum of beliefs about intelligence has also been proposed by others, the evidence presented by my study is unique in terms of the boundaries of the case.

The diverse combinations of questionnaire assigned mind-set, achievement goal orientations and responses to the challenging task presented by the six student participants of the case study are at odds with the categories of beliefs, goals and behaviours described previously in published studies. I concluded that my research findings did not support the causal relationship between ITI mind-set, achievement goal orientation and response to challenge that is the theoretical premise of the model.

The factors affecting the students' responses to challenge could be associated with positive learning behaviours (high self-efficacy, metacognition and social learning skills such as ability to verbalise thought processes) and helpless learning behaviours (negative emotional responses to challenge, perception of school valuing attainment over effort and a concept of scientific knowledge as fact). To facilitate the application of the case study outcomes to changing policy and practice in my school, the factors affecting the students' responses to the challenging task were presented as a framework (Figure 5.2.3). The framework was purposely written to emphasise skills and abilities to reflect the language used by the students in their narratives.

From a wider perspective, my research contributes to the current debate about applying the mind-set model in schools. The findings lend support to the argument that assigning students as fixed or growth mind-set theorists could entrench helpless behaviours. However, the framework that I developed from the themes in the data could be used as a map for guiding changes to policy and practice in my workplace. As such, the framework is an example of practice-based evidence that can bridge the differences between theory and its application in schools. The potential impact of the framework to change policy and practice is enhanced because it was derived from listening to the student voice.

To conclude, the case study is an original piece of research because there are no other studies that have explored the impact of ITI mind-set on response to challenge with able, male students in an academically selective school. Furthermore, the scope and design of the study are novel because the students' conceptualisation of intelligence were investigated following an interpretivist research approach as opposed to the positivist methodology adopted by the majority of researchers in the field. In the small number of studies that have also employed interpretivist methods,

none have assessed students' responses to a challenging task and compared these with their assigned mind-set, achievement goal orientation and conceptualisation of intelligence.

Chapter 6: Critical Evaluation

6.1 Introduction

The aim of my research was to explore the impact of able students' ITI mind-sets on their engagement with a challenging problem-solving task. By choosing a case study design within the interpretivist methodology, the outcomes of my research present new knowledge that contribute to understanding the theoretical premises and issues surrounding the application of the model of ITI mind-sets. The purpose of this chapter is to reflect upon and critically evaluate my research approach. The methodology and methods employed during the study, and my roles as teacher and researcher are appraised using the case study data as evidence to support my argument. The benefits and drawbacks of each aspect of my research design are considered in terms of how they affected the validity and reliability of the case study outcomes.

Section 6.2 focuses on the design of the case study. This section begins with a review of my argument for adopting an interpretivist methodological stance and considers whether this approach was appropriate to answering the research question. Following this discussion, selected data are presented as evidence that support and raise concerns about the fitness for purpose of the methods employed. The concluding part of section 6.2 identifies areas of my research design that could be improved.

My dual role as teacher and researcher is critically evaluated in section 6.3. The ethical issues surrounding the case study are revisited, with a particular focus on the potential for the dual role of teacher-researcher to place pressure on student

participants. The potential effects my teacher-researcher role may have had on the students and their responses to the questionnaire items and during the lesson observations and interviews are explored and evaluated. Improvements to the way each stage of the case study was conducted are recommended at the end of section 6.3.

To complete the chapter and the thesis, section 6.4 describes further research and development that is prompted by the outcomes of the case study.

6.2 Critical evaluation of the case study research design: methodology and methods.

In chapter three, I set out my argument for adopting the interpretivist methodology to answer my research question. From a theoretical perspective, the application of a positivist approach to studying the impact of the model of ITI mind-set on students' learning behaviours was contested because the model evolved from a social-constructivist perspective of goal-orientation theory. This creates a conflict of ontological and epistemological assumptions between the theoretical premises of the model of ITI mind-set and the principles underpinning the positivist research paradigm. Specifically, interactions between multiple contextual factors that determine a student's goal-orientation must also shape the beliefs that form their ITI mind-set (Pintrich and Schunk, 2002). Accepting that cognitive and contextual factors are integral to and contiguous with each student's goal-orientation and ITI mind-set, then the design of an investigation of the impact of ITI mind-set on students' response to a challenging task must be set in an authentic learning situation. To impose the criteria of an experiment to study the impact of ITI mind-set on students' learning would necessitate the exclusion of contextual factors. This would result in a reduction of students' personal constructs and behaviours to simplified cause and effect relationships.

Adding weight to this theoretical argument in favour of adopting the interpretivist methodology in my research was the exploratory aim of my research question. This set an open-ended objective that demanded inclusion of all the contextual factors normally present in the student participants' Biology lessons. This aligns with the ontological assumption that students' ITI mind-set are products of their individual consciousness and the epistemological assumption that students' personal

experiences shape their ITI mind-set. Other researchers have recommended an interpretivist research approach when investigating the complex values and beliefs that form individuals' personal constructs (Burrell and Morgan, 1979; Cohen, Manion and Morrison, 2000; Punch, 2009).

Tying together my argument that the model of ITI mind-set should be viewed from a social-constructivist perspective and, therefore, should be investigated in the normal classroom setting, are the theories of learning that shape my understanding of how students learn. The stages of Kolb's (1984) learning cycle and the steps leading to construction of new knowledge by students as they face increasing difficulty that was proposed by Vygotsky (Daniels, 2001) both emphasise the individuality of the student's mental processes and experiences in shaping their knowledge and understanding of the world. When applying the model of ITI mind-set to students' learning behaviours in school then it follows that the research approach should incorporate all the normal contextual factors associated with the classroom and allow the students themselves to identify the issues that affect their learning.

If I had adopted a positivist approach to answering my research question, it may have entailed using scaled questionnaires. The questionnaire items would have asked students to rate the level of impact each of their assigned ITI mind-set associated beliefs had on their response to the challenging task. In effect, this tool would have been a more detailed form of the questionnaire given to the students at the start of the study, with items referring directly to their experiences in their Biology lessons rather than asking for more generalised responses. However, developing a questionnaire of this kind would have meant imposing my own ideas and those of other researchers about how challenge, motivation and conceptualisation of intelligence affect students' learning behaviours rather than empowering the students

to freely choose the issues that were of importance to them. For this reason, I would not have been able to call my study an exploration of the impact of ITI mind-set on students' response to challenge.

Another problem associated with adopting a positivist approach is the assumption that the language used, for example in questionnaire items, have a shared meaning between the researcher and the participants. As shown by the difficulties that the student participants of this case study experienced when trying to define intelligence and their use of alternative words and phrases instead of 'increasing intelligence', a shared meaning of key words cannot be guaranteed. This problem reduces the reliability and validity of the data. Since the concept of intelligence is central to the model of ITI mind-set, setting questionnaire items that ask students to rate the strength of their beliefs about their intelligence must assume that all respondents are applying the same definition. However, intelligence is not a tangible variable that can be measured using a calibrated instrument. From the positivist research perspective, objectivity of the data collection methods allows fair comparisons to be made between control and test groups. For this reason, the subjective judgements made by students when rating the strength of their beliefs also reduces the reliability and validity of the data.

Taken together, adopting the positivist methodology would have demanded treating the student participants' values, beliefs and personal frameworks of understanding related to challenge, motivation and intelligence as isolable variables. In turn, design of the data gathering tools would have involved pre-determination of the themes and the language associated with them. This would negate the exploratory objective of my research question. By conducting my study within the interpretivist research paradigm, I allowed for multiple factors impacting on the students' responses to the

challenging task and avoided imposing my own definitions of challenge, motivation and intelligence. For example, during each interview I asked the student to explain their responses to the questionnaire items that were used to assign their ITI mind-set. The semi-structured design of the interviews allowed me to ask follow-up questions to clarify each student's responses thereby reaching a more detailed understanding of what the student really understood about intelligence and how these ideas formed their whole conceptualisations. Since gaining a better understanding of how and why the students reacted to the challenging task in the way they did, and if their concepts of intelligence impacted on their responses were the objectives of the study, creating scaled questionnaires could only have revealed a limited amount within scope of the issues I had pre-determined in the items.

Although I have argued against a positivist approach to answering my research question, there were some drawbacks associated with adopting an interpretivist methodology. Restricting the number of student participants to six during the interview stage could be seen as a weakness in the design of my study because the cohort was not a representative sample. However, the objective of my research was not to characterise the population of able, male Year Eleven students in the school or compare these generalisations with other student populations. The exploratory objective of my research question meant that a small number of students were chosen to accommodate the time needed to analyse the data from different perspectives to reveal rich detail. Furthermore, designing my research as a case study had established the boundaries within which the outcomes could be applied. The conclusions I have drawn from the data are not claimed to be generalisable or applicable beyond the specific contextual factors of the case.

An advantage of the positivist approach is being able to include a larger number of student participants, in this instance because scaled questionnaires can be administered simultaneously to a large cohort using ICT systems that can subsequently process and score responses automatically. Indeed, I used this method of analysing the students' ITI mind-set questionnaire responses to assign them as fixed or growth mind-set theorists prior to the lesson observation and interview stages of the study. The processed data can then be compared and tested for statistically significant differences between experimental and control groups or to reveal correlations between variables. Including statistical analyses of data increases reliability of the findings and avoids researcher bias by setting parameters of acceptability. Consequently, outcomes are more trustworthy and comparable with other studies that have used the same measuring tools. The ITI mind-set questionnaires that have been developed by Dweck and her colleagues have been widely used to generate correlational data that are comparable with each other and tested for statistical significance. Nevertheless, these studies cannot reveal students' beliefs about intelligence beyond the parameters of the questionnaire items.

The aim of elucidating richly detailed student narratives was the reason I opted not to use software programmes that scan data to identify common phrases and key words. The personal frameworks of understanding expressed by the students could be highly individual, so, it was important to reveal the key differences that would have been omitted by an automatic system designed to identify commonalities. Also, the implicit and abstract nature of the students' concepts, beliefs and values related to intelligence were difficult topics for conversation. Using myself as the processor of the data at all stages of analysis meant that I could call on my experience of teaching the students because I was familiar with the nuances of their verbal expression. A

clearer understanding was gained from identifying a student's use of a particular word or where the student had changed a word in their answer that would have not been picked up as significant by an automatic scanning programme. For example, when Chris preceded his comment about effort being more important than reaching the answer with 'probably' this indicated to me that he was less convinced of this than Henry who had expressed the same belief using similar words. Also, the alternative adjectives used by the students to describe the effect of effort (improving, enhancing and adjusting) rather than increased, which was used in the questionnaire items and in the interview questions, reinforced the abilities and skills dimension of the students' conceptualisations of intelligence. From this perspective, the time and effort required to analyse the data in depth was not a disadvantage since it fulfilled the exploratory objective of the research question. Furthermore, the potential criticism that the data are unreliable because of the small cohort of students included in the study is negated because the case study findings are acknowledged to be limited to telling us about the students in the study and are not claimed to be generalisable. The exploratory nature of the study was primarily to enable diversity of beliefs, values and concepts to be revealed, therefore, even subtle differences could be significant as a means to comprehend the students' personal frameworks of understanding.

The exploratory aim of my research question determined that I adopted an interpretivist methodology, which in turn influenced using a case study design. The connection between the demands of my research question and methodology also extended to the methods I employed to gather data. Continuity between the theoretical and practical aspects of my research design made it more likely that the conclusions drawn from the data gathered would answer my research question.

Nevertheless, the methods employed at each stage of the case study must be scrutinised to ensure that valid data were collected.

The first stage of data collection used the Implicit Theories of Intelligence Scale for Children – Self Form questionnaire (Dweck, Chiu, Hong, 1995; Levy, Stroessner and Dweck, 1998; Dweck, 2000). This was used to assign each of the students in the Biology class as holding either a fixed or a growth ITI mind-set. As reported in the findings and analysis chapter, the assigned mind-sets of the students were inadequate descriptors of the actual conceptualisations of intelligence the students described during their interviews. Consequently, I have questioned the fitness for purpose of the questionnaire in this case. Using the questionnaire as a method in the study could, therefore, be criticised. However, the questionnaire was used only to assign students' ITI mind-set as baseline data to contribute to the purposive selection of the six students for interview. The assigned mind-set data was not intended to answer the research question and, therefore, did not impact on the validity of the research outcomes.

The students were observed working on a challenging problem-solving task during two consecutive Biology lessons in the second stage of the study. The level of challenge that the practical and data processing stages of the problem presented to the students needed to be high enough to stretch the abilities of the students. Specifically, the route to a solution was not immediately obvious and required several steps to be linked together by applying scientific knowledge, mathematical skills and logical thinking. At the same time, the problem could not demand knowledge or skills beyond those the students possessed. The decision about which particular task to set the students came down to my professional judgement and involved choosing a Biology topic that the students had recently learned, practical

equipment they were familiar with using and mathematical skills they had acquired at that point in their GCSE studies.

The increased challenge of the practical stage was achieved by selecting an osmosis practical that had been used as an investigative skills assessment at AS level.

Although a year in advance of the stage the students were at in their Biology studies, the necessary practical skills and understanding of the biological basis of the investigation were accessible to all the students. A high level of challenge was achieved in two ways during the second observed lesson when the students were processing the data to reach a solution to the problem. Firstly, none of the data processing steps were given to the students. Secondly, the students had used two different methods in the previous lesson so they had two sets of data each of which were measurements of different variables (difference in mass of potato tissue and time taken for drop to rise or fall) and required different processing to lead to a solution. The students were told that they could analyse both sets of data to reach a solution and then compare the answers to see if they agreed.

During both observed lessons, I monitored the progress of the students to ensure that the level of challenge was appropriate. As mentioned in the findings and analysis chapter, I was required to intervene once during the second lesson with Isaac's team as they had reached a point of helplessness when they were not attempting to use any other strategies to process the data. It could be argued that the level of challenge was too high for Isaac and his team members. Isaac's comment during the interview, *"...it was you who mentioned the speed of the droplets and then it sort of clicked..."* could be interpreted from different perspectives; either he and his colleagues stopped making progress because they lacked the skills and understanding and my intervention bridged a gap in their knowledge or they were inhibited from making

progress because the high level of challenge was outside their perceptions of their own abilities. Since I did not ask Isaac to explain why he didn't make progress at that point in the lesson, I could not offer further evidence and it remains a possibility that Isaac and others in his team had gaps in their knowledge and skills that prevented them from independently progressing towards a solution to the problem. Nevertheless, Isaac did not express doubts about his ability to complete the task, although he may have felt that expressing this would have prompted an unfavourable assessment of his competence. This issue is also discussed in the following section of this chapter. Evidence that supports the task being at an appropriate level of challenge for the students was the expression of confusion and frustration stated by both positive and helpless responders, although these emotions were presented as motivating by the positive responders and as inhibitory by the helpless responders. That all the student participants later achieved an A* or an A grade in their GCSE Biology examination provides indirect evidence that they possessed the necessary knowledge and skills to solve the problem.

To improve this aspect of the study design an additional task of comparable difficulty, but, requiring the application of a different skill set could also be given to the students to complete. This would account for some students responding helplessly because they lacked the particular knowledge or skills to solve one or other of the problems. Furthermore, I could directly ask students who responded helplessly to the challenging task why they thought they had not made progress. The implications of reconciling the need ask additional questions that the students may find uncomfortable with my duty of care to ensure no harm or distress is caused through participation is discussed in the following section of the chapter.

In a similar way to the design of the challenging task, assessment of the students' observed behaviours during the two consecutive lessons relied upon my own professional judgement. To check that my judgements were accurate, I reviewed the video data from both lessons and asked the students to describe their responses to the task as they watched the clips at the beginning of their interview. Apart from Adam, all the students confirmed my own assessment of their level of engagement with the challenging task. In his interview, Adam focused on his approach of asking questions and I interpreted this as his perception of being engaged with the task. Since Adam had been unable to make progress towards the solution because his questioning was not linked to a logical train of steps or led to evaluation of what had been already tried, I did not change my assessment of Adam having responded helplessly to the challenging task.

Bridging the lesson observation and interview stages of the study was the use of recorded video data during the student interviews. The efforts made to maintain the authentic context of the students' normal classroom environment allowed for real experiences to be used as prompts and as a scaffold to which the students could relate abstract and implicit concepts. This was done to aid translation of the students' thought processes, values and beliefs into verbal narratives. There was evidence from the lesson observations that the three positive responders, Henry, William and Nathan possessed the ability to articulate their thoughts clearly to their team members as they worked out a route to a solution to the problem. The video clips also served to focus the students' interview responses on their actual learning experience in an attempt to minimise the chance that they would refer to instances that they thought I might approve of and, therefore, tell me what they thought I wanted to hear. If the students had referred to learning experiences that did not

involve a suitable level of challenge this would have made the interview data unreliable and invalid.

The interview data were analysed as the primary source of information for answering the research question. However, a weakness in the interview design was the limited time available to discuss some of the students' comments that merited further explanation or clarification. Nevertheless, an upper limit on the duration of each interview was unavoidable because the interviews took place during lunchtime when the students had one hour to eat, take a break from their lessons and be interviewed. Particularly as each student was giving up their time to participate in the study, to have extended their interview beyond the allotted time would have taken advantage of their good will and affected their well-being if they had not sufficient time to eat and relax. The ethical implications of conducting extended student interviews are discussed in the section 6.3.

Even though the time available for each interview was limited, there were examples of responses made by the students that could have been discussed in more depth during the interview. For example, I could have asked Isaac to explain from his perspective why he took a more active role in the practical stage of the task compared with the data processing stage. His response may have given clarity to the reasons behind his helplessness and need for my help so that he could make progress toward a solution. Also, there were other questions that could have been put to the other two helpless responders, Adam and Chris. Chris was not as sure about the greater importance of effort over finding a solution to the problem and I could only surmise the reasons behind his helpless response. Additional follow up questions could have revealed if Chris was anxious about getting an incorrect answer or using the wrong method to try to reach the answer. Since I described Adam as being an

atypical helpless responder, further questions could have been put to him regarding his beliefs about the value of questioning and how he judged effort. Also, I could have asked Adam if he had lost concentration during the data processing lesson because he alluded to this rather than linked the two directly. This additional information would have been of value during construction of the framework, particularly for identification of the factors that were associated with the helpless response.

An improvement to the research design that would reduce the chance of missing key data is inclusion of follow up interviews or written questions given to students alongside extracts of the interview transcript. There are benefits and drawbacks to giving the students follow-up questions after the initial interviews. As well as revealing further detail and explanation, follow-up questions also have the benefit of giving the students time to reflect and consider their responses. The initial interviews were limited to thirty minutes in length, which could be criticised as not allowing the students enough time to think about and compose their answers. Also the follow-up questions would be put together after analysis of the initial interview data, which would afford me more time to identify and frame the most useful questions. The drawbacks include the additional time required by a second round of interviews or written questions, which could be viewed as imposing on the students and carries the related risk of the students feeling pressure to participate. Furthermore, this would have required their parents' consent and their assent to participate in a third stage of data gathering.

From the perspective of the research design, a second interview or issuing of written questions would happen after the first interview and the observed lessons. The length of time between these phases could have an impact on the reliability of data because

of the importance of relating the students' responses to their actual experience of carrying out the challenging task in the classroom. The students may have answered follow up questions more generally and without reference to the challenging task. This could be more pronounced if written follow-up questions are used because I would not be able to refer to the lessons or phrase the questions differently if the student needed clarification. Analysis of written answers would also lack the additional communication of meaning that comes through listening to verbal responses, such as pauses, corrections and contradictions, and observing non-verbal cues such as smiling, frowning, shifting position and making eye contact. It is possible that the students would choose a more formal, possibly academic, style of writing in their answers, perhaps using the style of writing I have encouraged and helped them to develop in lessons. This would have an impact on the communication of meaning. For example, verbal responses are more immediate than written responses and the students could censor their answers through a process of mental filtering to remove any ideas or expressions that could elicit a negative judgement of them. Written responses would allow the students more time to consider what they think I want to hear. Therefore, the data gained through follow-up questions, particularly if they are written, would need to be analysed for any signs of inconsistency or overtly edited responses.

The methodology and methods I employed to answer my research question were an effective approach to explore able students' ITI mind-sets and their engagement with a challenging problem-solving task. The students' conceptualisations of intelligence were revealed in greater detail than questionnaire responses allowed and all the students stated that the efforts they made as they worked on the problem had a positive effect on how they applied their abilities and thinking skills. Furthermore,

the other factors that the students described as contributing to their motivation and learning behaviours suggested a more complex effect involving many aspects of the students' personalities, attitudes and perceptions. However, these last two findings alongside my argument against the assumption at the heart of Theory of Mind, namely that mind and brain interact directly, led me to conclude that a causal relationship between ITI mind-set and response to challenge could not be demonstrated. Furthermore, I have argued that the problematic issue of showing cause and effect between ITI mind-set and learning behaviour cannot be overcome by adopting alternative methodological approaches. Consequently, the aspect of my research question that asked how able students' mind-set impacts on their response to a challenging task was not and could not be answered. Nevertheless, this conclusion has a significant impact on the application of the model of ITI mind-sets and other psychology-based theories that are underpinned by the same epistemological and ontological assumptions.

6.3 Critical evaluation of my role as teacher-researcher.

My dual role as teacher-researcher and the age of the student participants meant there was a risk that an unequal power relationship could affect the reliability and validity of the case study data. In this section of the chapter I have reflected on my classroom and school wide personae, and appraised these in terms of their potential to affect the students' behaviours and responses at each stage of data collection.

Using this approach to critique my role in the study mirrors Reinharz's (1997) concept of the researcher as the "key fieldwork tool" and a "created self".

Specifically, I have evaluated the extent to which the 'selves' that collectively form the role I have taken in the case study (personal, teacher and research selves) overlap to influence the validity and reliability of the data. Evidence from the interview data and from literature are presented to support my argument.

In chapter three I described the ethical issues surrounding the design of research which involved children. The process of gaining ethical approval through the Faculty Research Ethics Panel at ARU demanded a thorough examination of each proposed stage of my case study to identify procedures that could cause harm, distress or place psychological pressure on the students through participation. Gaining ethical approval for my research confirmed that my design included appropriate safeguarding measures and effective mechanisms for communicating with students, parents and other stakeholders. A successful application for ethical approval also confirmed that my research approach met the standards required by the professional body of educational researchers. This was important as it gave credibility to my work, which increased my confidence to present my research at conference.

Although each stage of my study had been scrutinised to ensure the student participants would not be harmed or disadvantaged by participating in the research,

my dual role as teacher and researcher presented an unavoidable risk of influencing the students' behaviours and responses. This would have resulted in unreliable data and, of greater concern, undue pressure on the students to conform to my expectations. For these reasons, the data collected at each stage of the study have been re-evaluated to identify student responses that could be interpreted as evidence of the effect of the power relationship between teacher and student.

The degree of power I have to influence the decisions made by the students I teach is affected by aspects of my teacher persona. For example, whether my lessons tend to be teacher-led or student-centred, the relationships formed with individual students and if these are based on mutual trust and respect. It is difficult to assess my own classroom persona because this would require making assumptions about the students' perceptions of the power balance within the teacher-student relationship. Aspects of the research design and findings from the study offer insight into this relationship. The inclusion of student assent, alongside parental consent, as a prerequisite for participation in the case study was an acknowledgement of the rights of the students to make their own decisions, thereby placing the power of decision-making with the student. Evidence drawn from the lesson observation and interview data revealed an atmosphere of openness in the classroom that allowed the students to express feelings of frustration and confusion in the face of difficulty. I have interpreted the willingness of the students to express these emotions as an indicator of their ease that their behaviour and response to the problem I set them would not elicit a negative judgement on my part. Also, the personalised examples used by Isaac and Nathan to illustrate their values and experiences were unlikely to have been shared with someone they perceived to be judgemental or someone they did not trust.

Examination of the potential for the students' responses to be influenced by a perception of authority associated with being their teacher should be extended to my wider role in the school as leader of Biology (Lynch and Lodge, 2002). Being strongly identified with the subject may have influenced the students' interview responses, which could have been compounded by the overtly biological basis of the problem-solving task and laboratory setting of the observed lessons. There was indirect evidence supporting this idea within the combined fixed and growth mind-set conceptualisations of Henry, Chris, William, Isaac and Nathan. Specifically, their belief that intelligence has an upper limit that can be reached through effort can be related to characteristics that are under the control of genes and environment. This is analogous to examples the students would be familiar with, such as, each individual having specific genes that determine their maximum potential height, but at the same time, environmental factors such as nutrition affect the actual height to which a person grows. Given that I had taught these principles of inheritance to the students previously and the potential for higher ability students to be able to apply their learning to other contexts, it was possible that the five students were influenced to give answers that were concordant with their understanding of Biology.

The argument that the subject specific context of the problem and my role as leader of Biology affected the students' conceptualisations of intelligence can be counteracted in two ways. Firstly, the students did not make direct reference to intelligence being under the control of genetic and environmental factors. If the students had applied their knowledge of inheritance of characteristics within their conceptualisation of intelligence, they might have been expected to make this explicit by using another example as illustration or using biological terminology related to genetics. Secondly, the students found defining intelligence problematic.

This could be interpreted as an indicator that their concept of intelligence was dynamic, not fully formed and, therefore, more likely to be influenced by new knowledge. Just as I have reported the subject-dependent modulation of ITI mind-set associated beliefs and behaviours expressed by Henry and William, the students' conceptualisations of intelligence could also be affected by other factors. Being influenced by the biological principles they have learned may be normal if we accept that understanding of what constitutes intelligence is not fixed, but rather, develops over time. This is concordant with Kolb's (1984) learning cycle as it acknowledges the impact of experience and prior learning to the construction of personal frameworks of understanding. Consequently, it could be considered that the students were responding to my questions through the lens of their learning in Biology because they, even subconsciously, were giving 'correct' answers.

Analysis of the interview data for instances where the students responded to questions with answers they thought would be concordant with the attributes of a good student highlighted Adam's narrative. He was the only student whose questionnaire and interview responses were consistent with the achievement goal-orientation, beliefs and values associated with the growth mind-set model. It is possible that Adam interpreted the emphasis on effort inherent in the growth mind-set characteristics as an attribute I valued. As such, this represents an overlap of my teacher and researcher selves, but, one which emanates from Adam's perspective rather than from a particular aspect of the research design. This conclusion is tentative because it is also possible that Adam's responses simply reflected a less complex conceptualisation of intelligence. In support of this alternative interpretation is the observation that Adam's questions during the problem-solving task did not form a coherent series of logical steps and his understanding of the nature of

scientific knowledge was at an early developmental stage. Together, these observations suggested that Adam was not engaged in metacognition. In contrast, Henry, William and Nathan who all responded positively toward the problem-solving task and demonstrated an ability to verbalise and evaluate their thinking described more complex conceptualisations of intelligence that combined both growth and fixed mind-set characteristics. Adam's conceptualisation of intelligence could be simpler because he engaged less in metacognition.

The evidence I have presented to support arguments for and against the influence of my teacher persona on the students' responses is indirect. For this reason, I cannot confirm the extent to which my teaching role directly affected what the students said. Similarly, it is important to acknowledge the potential for bias by using myself as the "key fieldwork tool" and relying upon my own interpretation of the data. To counteract this risk, I sustained a reflexive approach throughout the data gathering and analysis stages of the study, and shared my findings with other researchers and practitioners (see Chapter 5, sections 5.3.4 and 5.3.5). This revealed alternative interpretations that reduced the chance of presenting one-sided arguments and contributed to maintaining a separation between my personal, teacher and researcher selves. Nevertheless, an overlap of the teacher and researcher roles was an essential part of the case study design to enable rich, detailed data to be gathered.

Another critical point in the study where overlap of my teacher and researcher roles could have introduced bias was selection of the six students for interview (Flutter, 2007). It was possible that my knowledge of how the students responded to challenging tasks during previous lessons influenced my decisions, which in turn could have reduced the reliability and validity of the data. I used the questionnaire outcomes as a criterion for selection to reduce the chance that prior judgements

about the students' learning behaviours would affect the decisions I made. Although I have argued that the questionnaire was inadequate as a tool for assigning students' ITI mind-set in this case, it did provide an objective method of providing baseline data. The second criterion for selection of the students for interview was whether they responded positively or helplessly to the challenging task. To ensure that I had classified each students' response accurately, I confirmed my observational assessments with the students during their interviews using the video footage.

Asking the students to evaluate their own response to the challenging task had the additional benefit of reinforcing the importance of student voice in the study. From the perspective of the relationship between teacher-researcher and student participant, valuing student voice contributed to redressing any real or perceived power imbalance (Harber, 2010). Furthermore, in the information sheet given to the students they were told that the outcomes of the study would inform teaching practice. Taken together, the clear communication of purpose and the video-stimulated semi-structured interview method empowered the students to express their ideas and influence their future learning experiences (Toshalis and Nakkula, 2012).

Alongside making clear to students and their parents the purpose of my research, it was important to establish that participation in the study would not affect the students' school studies. This reduced the possibility of students being coerced into participation and helped to separate my teacher and researcher personae. One of my teaching roles is assessing students' attainment, which includes marking coursework that contribute directly to students' GCSE grades. This responsibility confers power on the teacher to influence a student's future opportunities. The high expectations of the able students who took part in the case study to achieve A*/A grades in their

GCSE examinations had the potential to exacerbate this imbalance of power. For these reasons, clearly delineating my teacher and researcher roles at the outset, when the students were asked to consider their participation in the research, was critical to upholding ethical standards of research and to maintaining the reliability and validity of the data gathered.

Statements relating to confidentiality and the right to withdraw from the study were included in the information sheet, parent consent and student assent forms (see Appendix III). Ensuring that these standards of research were evident throughout each stage of the study had the effect of situating decision-making powers primarily with the students. The required student assent for participation reinforced the autonomy of the students in reaching a decision. The information given to the students and their parents at the outset set out my responsibilities to treat the students' data with respect and ensure security of students' personal details. Together, the information sheet and participation forms could be considered as contractual in nature because they established the expectations and standards of procedure between researcher and participant. The clarity of communication and reiteration of my responsibilities and actions during the case study contributed to the division of my teacher and researcher roles.

An important aspect of the research design that related to my duty of care to the student participants was ensuring that the duration of each interview did not exceed thirty minutes. Although this may seem at first to be a relatively trivial concern, extending the interviews beyond the allotted time would have had a significant impact upon the power balance between myself and the students. This is because the decision to ask further questions would have been taken by me and for my own purposes, and represents exerting the power I have as the teacher to make decisions

that affect the student. The potential outcome of this overlap of my teacher and researcher roles would be erosion of the trust between myself and the students because it breached the agreed standards of behaviour upon which the students had given their assent to participate. For this reason, none of the student interviews exceeded thirty minutes even in the circumstances where additional questions could have provided useful information.

As discussed earlier in section 6.2, a potential criticism of the interview method was the lack of time the students were afforded to consider and compose their answers. From the perspective of maintaining the students' decision-making power, the recommended follow-up questions could be an option rather than a requirement. This would give students the opportunity to reflect upon and amend their answers in their own time. The potential to gather richer, more detailed data whilst protecting the rights of the students to make their own decisions outweighs the drawbacks of including this additional step. For this reason, I have proposed a stage of optional follow-up questions in future research projects (see section 6.4).

A second recommendation for improvement relates not to the case study design, but, to the actions that result from the case study findings. In chapter five I described the potential impact of the case study findings on changing policy and teaching practice in my school. Part of the proposal to develop a school-wide focus on growth mindset attributes was to establish student-teacher focus groups that would collaborate to identify ways to support students to become more resilient and persevere when challenged, and emphasise the value of effort in the school's assessment, recording and reporting systems. Inviting the students who participated in the case study to join the focus groups would fulfil the stated purpose of the study by providing an active role in shaping their learning experiences. Student participation in decision-making

about issues that directly affect their learning was described by Dimmock (1995) as a feature of effective schools, however, such power to affect change in areas normally controlled by adult educators is rare (Cox et al., 2010).

Including the case study participants in the student-teacher focus groups would confirm the value of student voice as an important source of information to drive change in the school. This aligns with the 2020 Vision school improvement strategy that aims to support students to develop dispositions of participatory democracy, independence of mind and service to the community. Furthermore, collaboration between students and teachers to create a culture that promotes the characteristics of growth mind-set learners is the antithesis of the prescribed interventions imposed on students who are assigned as fixed mind-set theorists that has been predicted by O'Brien (2015).

To conclude, designing the data gathering methods and data storage to meet BERA ethical research guidelines (2011), and by clearly communicating the purpose and procedures of the research to students and their parents, defined my role as researcher. Separating my teacher and researcher selves reduced the possibility that students' responses were influenced by the power imbalance within the teacher-student relationship. Shifting decision-making powers to the students gave prominence to the student voice data gathered through semi-structured interview. The rich, detailed narratives that resulted were concordant with the interpretivist methodology I adopted in the case study and met the demands of the exploratory research question. The recommended improvements to the methods used in the case study focus on digging deeper into the issues of importance to the students whilst maintaining ethical standards of research. In the final section of this chapter, the

recommended improvements have been included as part of proposed further research.

6.4 Further Research and Development

The exploratory objective of my research question revealed the issues of importance to the student participants that affected their response to the challenging problem-solving task. At the same time, uncertainties were revealed within the data and further questions arose from the conclusions. In this final section of the chapter I have described potential lines of enquiry and appraised the value of extending the research. The first sub-section collates and summarises proposed future work related to the development of a growth mind-set culture in my school and links to the discussion of the impact of the case study findings in chapter five, section 5.3.2. The second sub-section focuses on further research that could contribute new knowledge about able students' ITI mind-sets and their responses to challenging tasks. Here, the additional research questions have arisen directly from the case study findings and have been influenced by the queries and comments made by teaching colleagues, fellow doctoral students and conference delegates with whom I have shared my conclusions.

6.4.1 Development of a growth mind-set culture at my school

In section 5.3.2 I discussed the potential impact of my research outcomes to change teaching practices and school policy. Given that the growth mind-set model has been integrated into the SIP as the focus for optimising teaching practices, the case study findings are relevant and applicable. I have argued that my research represents a bridge between theory and practice because it took into account the contextual factors that affect learning and accommodated the personal frameworks of the students by listening to the student voice. The varied patterns of goal-orientations,

responses to the challenging problem-solving task and beliefs about intelligence presented by the student participants were not predicted by the model of ITI mind-sets. For this reason, I concluded that the items of the scaled questionnaire were inadequate descriptors of the students' conceptualisations of intelligence in this case. I have cautioned that assigning students as fixed or growth mind-set theorists risks labelling some students, with the effect of entrenching their helpless behaviours, and may reinforce the misconception that mind-set is an innate and permanent characteristic.

The conclusions drawn from the case study findings confirmed that developing growth mind-set associated learning behaviours, such as resilience and perseverance when working on challenging tasks, rather than identifying and targeting intervention for fixed mind-set theorists was more likely to affect improved learning. The proposed activities for developing school policy and teaching practices, therefore, focus on promoting growth mind-set associated attributes for all students and avoid explicit reference to the fixed mind-set model. It is important to note that the changes to policy and practice are currently underway and will be the products of collaboration between staff, students and other stakeholders in the school. For this reason, the following descriptions and evaluations of further work are tentative and focus on the activities in which I have been directly involved.

Initial CPD activities with teaching colleagues were designed to introduce the growth mind-set model and prompt reflection on classroom discourse that promoted resilience and perseverance. Feedback received from colleagues showed that knowledge and understanding of the growth mind-set model ranged from early stage through to those who were already purposely planning lesson activities to support students to develop resilience and perseverance. It is important that colleagues have

a shared vision of the purpose of the strategy and see the value in changing policy and practice to realise the intended outcomes. Consequently, I have proposed that part of the programme of activities to develop a growth mind-set classroom culture across the school should include repeated opportunities for colleagues to share and discuss examples of classroom strategies they have used. This would provide a forum for professional dialogue and debate, and contribute to a growing body of knowledge about effective teaching practices. This approach to CPD exemplifies Eraut's (1994) proposed framework for work-based learning that includes time for reflection, collaboration with fellow professionals and critical debate to allow reshaping of theories of practice. Furthermore, the openness and evaluative aspects of sharing practice with colleagues fulfil my own expectations of professionalism, which have also been described as characteristics of the 'activist professional' (Sachs, 2000; Whitty, 2008).

An important step in embedding growth mind-set culture in the school is changing policy and practice to reflect the high value of effort associated with resilience and perseverance. Whilst all the students interviewed in the case study stated that they valued effort, one student, Isaac, perceived that the school merited attainment over effort. The case study findings alongside recent changes to national assessment structures have necessitated revision of our school assessment policy and procedures. In section 5.3.2 I described the current arrangements for assessing and reporting students' level of effort and explained how the case study findings supported changes being made to school policy and practice regarding assessment of effort. I have proposed that the next step in development of school policy and practice involves collaboration between staff and students, in the form of focus groups, to gain knowledge about how teachers can promote increased levels of effort from the

students' perspective. Extending the process of collaboration and decision-making to include students was described by Dimmock (1995) as an effective strategy for school improvement. A potential model for this stage of development is the participatory research design adopted by Fowler (2010) in his case study. Fowler demonstrated the benefits of involving students as volunteer co-researchers to creating a collegiate teaching and learning environment in the classroom. In this way, the role of the students in the case study would evolve from participants to co-researchers, fulfilling the criteria for listening and affording real power to the student voice (Mitra and Gross, 2009; Cox et al., 2010; Toshalis and Nakkula, 2012; Simmons, Graham and Thomas, 2015).

The framework for understanding the factors that affected the students' response to challenge (Figure 5.2.3) will provide the foci for the professional learning forums and teacher-student focus groups. For developing teaching practices, the professional learning forums will share and evaluate classroom strategies aimed at fostering students' metacognitive and social learning skills. Also, discussion of the ways in which teachers can create a classroom ethos that defuses the fear of making mistakes and encourages students to persevere to find new routes to solving problems. The objective for the teacher-student focus groups that emerges from the framework is to identify classroom strategies that promote effort and propose changes to school policy and guidelines for practice that reflect the importance of students' effort.

The conclusions and critical evaluation of this case study have directed the approaches and foci for developing a growth mind-set culture at my school. In this respect, the exploratory aim of my research question has been fulfilled. Locating my research in the school and maintaining the authentic classroom contextual factors in the design of the study meant that the outcomes could be directly applied to inform

changes to school policy and teaching practices. Rather than presenting a prescriptive plan for development, the case study findings in the form of the framework for understanding will guide the stages of collaboration and decision-making. This approach has the advantage of giving teachers and students the opportunity to be agents of change who are contributing to improving teaching and learning in their own classrooms.

6.4.2 Further Research

The critical evaluation of the case study revealed areas where further questions could have been put to students during their interview. These questions could have resulted in more detailed answers that helped to explain the students' response to the challenging task or to reveal their conceptualisations of intelligence. I have divided this part of the chapter into tentative further research questions; for each question I have described the rationale for investigating this question, outlined a possible approach to answering the question and explained how the outcomes could impact development of policy and practice in schools, and contribute to the body of knowledge about able students' ITI mind-set and response to challenge.

<p>1. Are able male students' responses to challenge, goal orientation and mind-set associated beliefs consistent when completing different Biology-related tasks?</p>

The first research question addresses the uncertainty that arose from the observed helpless responses of Chris, Isaac and Adam. One possible reason for their helpless response was a gap in knowledge or skills needed to solve the problem. To answer this question, I will use a similar case study design and interpretive methodology to

gather rich, detailed data from a small cohort of able male students. As a consequence of the conclusions I reached through evaluation of my research approach, the questionnaire and observed lesson stages will be amended. Although the data derived from the questionnaire would only be used as the basis for discussion during later interviews, the terminology used in the items will be altered to reflect the skills and abilities dimension of intelligence preferred by the students in the original case study. To address the research question, two equally challenging problems will be given to the students to complete. The tasks will relate to Biology-based learning, but, differ in the knowledge and skill set required for their completion. Specifically, one task will demand processing of quantitative data using mathematical skills and the second will involve the application of creative and logical thinking to design a practical investigation. This second case study will still be set in the Biology classroom and follow the same stages as the original case study, thereby providing an opportunity to test the consistency of types of response and mind-set associated beliefs within the same learning environment and its associated contextual factors.

The research question addresses a gap in the findings of the first case study and, as such, is an extension of the original research rather than following a different line of enquiry. The outcomes may lend support to or question the reliability of the original case study findings. However, it would be invalid to directly compare the outcomes of the two case studies. Although the student participants would be the same age and attend the same school, their learning experiences would be different. Also, given the small cohort size in each case, neither are representative of their student population. Following the same strategy of analysis of the data in the first case study would

highlight individual differences as much as commonalities, so to then cross reference the cohorts for common features would be an inconsistency of approach.

<p>2. Are able male students' responses to challenge, goal orientation and mind-set associated beliefs different in Science and English lessons?</p>

Comparing and contrasting students' responses to challenge in different subjects would extend and complement the outcomes of the original case study. The rationale for investigating this research question is based on the comments of Henry and William who described their differing motivations and levels of self-efficacy in English versus Science and Mathematics. To investigate this question I will follow a similar case study approach where the authentic classroom context is maintained. In this study, however, the balance of my roles would be weighted more towards researcher than teacher, as I would be observing a colleague's lessons. It follows then that I will need to collaborate and plan the task stage with a teacher of English who is willing to have their lessons observed and recorded as video clips to be used later during student interviews. The roles and responsibilities of teacher and researcher will need to be negotiated and established beforehand, particularly concerning issues surrounding use of data and confidentiality.

Taken together, the outcomes of the extended Biology-based case study and the English-based case study would contribute knowledge of able male students' beliefs about intelligence, their motivations, achievement goals and the factors that affect how they respond to challenge. This is important for three reasons. Firstly, by contributing to a deeper understanding of the factors that affect the learning attitudes and dispositions of students at my school effective policies and teaching practice can be developed that support resilience and perseverance in the face of challenge.

Secondly, to share this new knowledge with colleagues in other schools where they are also implementing or considering implementing growth mind-set or other Psychology-based theories in the classroom. Thirdly, these questions follow on from the research carried out by Quihuis et al. (2002) and Karwowski (2014) by connecting modulation of ITI mind-set beliefs across the curriculum in relation to skills, with observed responses in the classroom. These studies would combine to present the interpretivist perspective on ITI mind-set theory and its application in educational settings.

<p>3. An exploratory case study of able female students' goal orientation, ITI mind-set and their response to challenging tasks.</p>

The third further research question is an extension of my original case study. The previous two questions represent additional research that evolved from uncertainties in the findings of the original case study. Exploring the achievement goals, ITI mind-set beliefs and response to challenge of able female students is an important endeavour because I have been asked by colleagues in school and at conference whether I intend to repeat my original case study with female students. Taking my research in this direction has pertinence to the development of my own practice since I teach female students in Years 12 and 13 at SHSB. Furthermore, in a recent study of able university students in Indonesia it was found that growth mind-set associated beliefs about academic ability, but not about intelligence, were linked with mastery-oriented achievement goals and effort attribution (Aditomo, 2015). Eighty-one percent of the cohort in this study were female, with an average age of 18.67 years. The outcomes of Aditomo's research resonate with some of the findings of my original case study, such as the importance of academic self-efficacy and the value of effort. Adopting an interpretive stance to explore able female students' beliefs and

values about intelligence, effort and motivation in relation to their response to challenge will provide an alternative methodological approach to that chosen by Aditomo, thereby revealing more detailed data than can be obtained through the use of scaled questionnaires.

From a practical perspective, there are two potential locations where a case study that focuses on able female students could be set. The female students at my school are academically able because they have each achieved high GCSE point scores to gain a place in Year 12 to study four A Level subjects. The advantages of choosing female students for the case study are being able to maintain an authentic classroom environment and employ a similar challenging Biology-based task and interview schedule as were used in the original case study with the male students. I will also have the benefit of an established trust with the students. However, direct comparison of the outcomes of the two case studies will be tentative because the female students are older and have different prior learning experiences at their former secondary schools. Alternatively, locating the case study in an academically selective grammar school for girls would allow me to match the ages of the student participants in the two case studies.

There are potential barriers to conducting my research in another school. In the first instance, I would require the approval of the Head Teacher to approach the Science Department Leader and teaching staff to seek their co-operation and collaboration. Success would depend upon clear communication of my purpose, methods, time scale and the potential for my research to impact upon teaching and learning. This critical initial stage in negotiating access was made easier in my workplace because the purpose of my research directly related to a key objective in the SIP. Poor communication of the purpose and value of the research outcomes to teaching and

learning may prompt colleagues in another school to distrust my intentions, which may lead to feelings of threat if I am perceived to be judging the quality of their teaching. For this reason, a sensitive and empathic approach would be essential to developing a working relationship with the Science Department teaching and support staff during the stage of seeking access and co-operation. A critical relationship to establish will be with the Leader of Biology because I would require their collaboration in the administration of the questionnaire, planning of the observed lessons and selection of students for the interview stage. The roles of the teacher and researcher would be discussed and agreed beforehand to establish trust, ensure that confidentiality is maintained and openly state expectations and responsibilities. Conducting research in another school also means that I would not have an established teacher persona with the students and their parents or carers. For this reason, presenting myself as a trustworthy and experienced educational researcher would be an important part of communicating the purpose, methods and value of my research. Describing my teaching role, particularly as an experienced teacher of academically able students, could also contribute to building trust with the students and their parents or carers. As I have discussed earlier in this chapter, following BERA ethical guidelines (2011) when seeking consent and assent for participation and as I conduct each stage of the research will define my responsibilities as researcher and protect the participants from harm or disadvantage. Despite maintaining professional standards of research, as a researcher who has negotiated access to students and classrooms in another school the level of participation may be lower and some students may decide to withdraw from the study.

The potential barriers to conducting research in another school could be reduced through careful planning and clear communication. However, even if the necessary

permissions to carry out the case study in another school are secured, the shift in my role from teacher-researcher to researcher will affect the gathering and analysis of data. In particular, being familiar with the nuances of the language used by the male students was an advantage during the interviews because I could interpret meaning quickly and ask for clarification. Without having an established trust and knowledge of the female student participants, I may find it more difficult to interpret the students' responses during their interviews and miss opportunities to ask probing questions. For this reason, follow-up questions with excerpts from the interview transcript would be given to the participants shortly after their interview as a means of supporting interpretation of their responses. This additional step in the original case study design would place greater demands upon the students, which would need to be evaluated from an ethical perspective to ensure that participation did not affect the learning or welfare of the students.

The potential problems and difficulties of investigating able female students' mind-set associated beliefs, goals and their response to challenge are outweighed by the value of moving toward a better understanding of the helpless response.

Furthermore, carrying out case studies in my workplace and at another school would provide valuable data about able female students in different schools. The findings would be useful to classroom practitioners and policy makers in both schools, and contribute new knowledge about the applicability of the model of ITI mind-set to teaching and learning in the context of able students in selective schools.

6.5 Concluding Statement

My research question asked how able male students' ITI mind-set impacted on their engagement with a challenging problem-solving task in the classroom. By taking an interpretive approach to answering the question, a more complex and detailed picture emerged of students' beliefs about intelligence, achievement goals and learning behaviours than is presented by the model of ITI mind-sets. These findings directly informed the development of practice and policy in my school in relation to the value afforded to effort in assessment procedures and promoting growth mind-set learning behaviours across the curriculum. The key issues affecting students' responses to the challenging task were collated as an alternative framework (see Figure 5.2.3) that identified potential areas for intervention strategies to support students at risk of underachieving.

The strengths of the alternative framework as a signpost for school policy and practice were the importance afforded to the student voice during data collection and analyses, and the school-based setting for the research. These characteristics of the case study design ensured that the conclusions drawn had relevance to the students in the specific context of their learning environment and increased the reliability of the outcomes as evidence upon which change to policy and practice could be based.

The lack of generalisability of the alternative framework to other schools was a drawback of the case study design. Nevertheless, the research findings contribute to a small, under-represented body of evidence that collectively propose a revision of the current model of ITI mind-sets to accommodate a dynamic continuum of values, beliefs and learning behaviours. Expressed in terms of thinking skills, five of the six students who participated in this study blended together concepts of improving their ability to solve problems, through the effort made when engaging with challenging

learning tasks, toward a set potential. As the students exhibited different positive and helpless responses in the face of difficulty, these findings do not support the causal relationship between beliefs about intelligence and learning behaviours that is a central component of the model of ITI mind-sets. This conclusion has led me to caution practitioners against using a questionnaire to assign students as fixed or growth mind-set as a means to identify those at risk of underachieving.

The outcomes of my research are significant to the wider debate about application of theory to practice in the classroom. The unique and complex narratives presented by the student participants emphasised the individual nature of their conceptualisations and the experiences that have shaped them. This evidence argued against adopting a single, unifying theory as the basis for understanding why some students have a helpless response to challenge and as a framework for a programme of intervention. The dissonance between the positivist studies in literature that support the premises and predictions of the model of ITI mind-sets and the outcomes of mine and others' research that took an interpretivist approach revealed a need to consider evidence from the perspective of methodology. This has an impact on the implementation of the Education Excellence Everywhere (2016) policy, which describes an evidence-informed teaching profession committed to building resilience in every child and stretching students of all abilities. The findings of my research redefine the meaning of "best evidence" in the policy by questioning the assumption that evidence generated from a scientific method can be universally applied to classroom-based issues.

Overall, my research represents an example of practice-based evidence that has impact beyond its direct application to policy and practice in my school. By contributing new knowledge about the theory and application of the model of ITI

mind-sets to teaching and learning, I have fulfilled the requirements of the professional doctorate and embarked upon the next phase of my career as an education researcher.

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Unit 3: Developing a Research Approach

Louise Brown



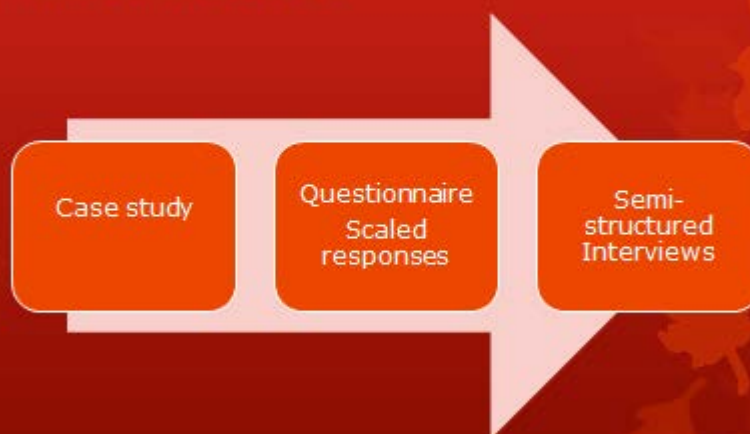
Research Question

- How do able students' *implicit theories of intelligence* (ITI) impact on their engagement with challenging learning tasks?

Research approaches taken



Proposed research approach - mixed methods



Pilot Studies

1. Check the questionnaire is accessible to the students.
2. Pilot the interview questions
 1. Are they specific to the research question?
 2. Are they open-ended?
 3. Order of questions?

Alternative approaches

Quantitative

- Devise a scale to measure students' responses to challenge
- Measure students' level of success in completing challenging problems

Qualitative

- Questionnaire – qualitative analysis methods
- Lesson observations
- Documentary analysis of students' written responses

Appendix II: Notes on discussion following presentation

- 1 Louise – curriculum and challenge – students who have ‘helpless response’
- 2 and avoidance – extrinsic drivers, ignored of students values and beliefs,
- 3 intrinsic side of work has the gap – implicit theories
- 4 Dweck questionnaire used widely with correlations
- 5 2 qualitative studies – semi-structured interviews
- 6 Plans to do case study – clear boundaries, context, mixed method –
- 7 will start with Dweck questionnaire for 150 boys in Y9.
- 8 Y10 will be semi-structured interviews – key intervention/ change point.
- 9 Debbie thought – can you video groups doing biology experiment, and then
- 10 use that for individual interviews when you talk through with the child?
- 11 Q? What is difference Y9 to Y10?
- 12 Longitudinal study?
- 13 Ethical issues recognised?
- 14 Sample numbers for interview? Selection criteria?
- 15 Hazel: think about link between questionnaire and interview.

Appendix III: (a) Information sheet given to participants, parents and carers



Research Project: *Able students, ideas of intelligence and engagement in the classroom*

Mrs L. Brown, Leader of Biology, Southend High School for Boys

LBR@shsb.org

I am investigating the impact of able students' ideas of intelligence upon their levels of engagement with challenging learning activities in the classroom. This project will contribute to our understanding of how and why able students' levels of engagement vary and indicate strategies to raise educational achievement. The project is being conducted by me, under the supervision of Dr G. Davis and Dr P. Howlett (Department of Education, Faculty of Health, Social Care and Education, Anglia Ruskin University), as part of my Professional Doctoral studies. As an able student in an academically high achieving school, your Son is invited to participate in the first stage of this research, a pilot study designed to test the methods that will be later employed in the main study.

If you and your Son agree to his participation in the research, the expectation will be that he completes a questionnaire about his ideas of intelligence. Following this, your Son may be selected for interview, during which video footage of him working in a Biology lesson will be used to prompt discussion of how his ideas of intelligence affect engagement with challenging activities. An audio recording of the interview will be made and later transcribed. The data collected will be stored in a secure place, such as a password protected laptop. The findings of the project will be included in my doctoral thesis, however, no mention of names or any other identification measure will be included in any written or verbal form. The findings may also be presented at education conferences and as articles written for journals about able learners.

There are no potential risks associated with your Son's participation in the study and participation will not affect your Son's school studies. You and your Son's agreement to taking part in the study will be recorded through a consent form, which you can both sign and give back to Mrs L. Brown. If consent is given and you later change your mind, your Son can still withdraw from the study by completing the withdrawal slip on the attached consent form and giving it to Mrs L. Brown.

I hope that your Son will enjoy his participation in this study and that the experience will benefit his wider understanding of how knowledge is generated through research. Thank you for your consideration and support.

Mrs L. Brown

Appendix III: (b) Participant consent form



Participant Consent Form

Name of participant: Form class:

Project title: Able students, ideas of intelligence and engagement in the classroom (Pilot Study).

Main investigator: Mrs L. Brown, Leader of Biology, Southend High School for Boys, Prittlewell Chase, Southend-on-Sea, SS0 0RG. LBR@shsb.org

1. I agree to my Son taking part in the above research. I have read the Participant Information Sheet which is attached to this form. I understand what my Son's role will be in this research and all my questions have been answered to my satisfaction.
2. I understand that my Son is free to withdraw from the research at any time, for any reason and without prejudice.
3. I have been informed that the confidentiality of the information my Son provides will be safeguarded.
4. I and my Son are free to ask any questions at any time before and during the study.
5. I have been provided with a copy of this form and the Participant Information Sheet.

Please indicate your consent to your Son participating in each of the following stages of the pilot study by ticking the boxes:

- ☐ Questionnaire
- ☐ Being video-recorded
- ☐ Interview and audio-recording

Data protection: I agree to Anglia Ruskin University and its partner colleges processing personal data which I have supplied. I agree to the processing of such data for any purposes connected to the research project as outlined to me.

Name of participant
(print).....

Signed (Parent/Carer).....**Date**.....

Signed
(Student).....**Date**.....

YOU WILL BE GIVEN A COPY OF THIS FORM TO KEEP

If you wish to withdraw from the research, please complete the form below and return to Mrs L. Brown.

Research project: Able students, ideas of intelligence and engagement in the classroom.

I WISH TO WITHDRAW FROM THIS STUDY

Signed (Parent)..... Signed
(Student).....

Date.....

Appendix IV: ITI Mind-set questionnaire given to student participants

Questionnaire items (from 'Implicit Theories of Intelligence Scale for Children – Self-form for Children Age 10 and Older' in Self-Theories: Their Role in Motivation, personality and Development, Dweck, 2000)

- 1. You have a certain amount of intelligence, and you really can't do much to change it.**

1	2	3	4	5	6
Strongly Agree	Agree	Mostly Agree	Mostly Disagree	Disagree	Strongly Disagree

- 2. Your intelligence is something about you that you can't change very much.**

1	2	3	4	5	6
Strongly Agree	Agree	Mostly Agree	Mostly Disagree	Disagree	Strongly Disagree

- 3. You can learn new things, but you can't really change your basic intelligence.**

1	2	3	4	5	6
Strongly Agree	Agree	Mostly Agree	Mostly Disagree	Disagree	Strongly Disagree

Appendix V: Summary of the content and structure of the observed lessons

Topic: Osmosis – what is the concentration of sugar solution inside potato tissue?

Class: Y11 GCSE Biology

Learning outcomes: Students will be able to collect quantitative data from two osmosis investigations, process these data and apply their knowledge of osmosis to identify the concentration of sugar solution inside potato tissue.

Resources: Cylinders of potato tissue of the similar size and mass; boiling tubes in racks; a range of sucrose solutions of different known concentrations; measuring cylinders; rulers; electronic balances; dropping pipettes; methylene blue (stain); stopwatches; calculators; A3 paper and graph paper.

Lesson 1: During a previous lesson, small groups of students set up five boiling tubes each containing a core of potato tissue submerged in a sugar solution of known concentration. In lesson one, the student groups followed given protocols to collect quantitative data about the movement of water into and out of the potato tissue. The first method required students to remove the core of potato from each tube, measure the mass and find the difference between this value and the starting mass. The second method required students to remove a small set volume of the sugar solution from each tube to a second tube and add a set volume of the stain methylene blue. Using a dropping pipette, the students released a drop of the stained sugar solution in the mid-point of a tube containing fresh sugar solution. The students observed if the drop rose or fell, and measured the distance the drop travelled and time taken. This was repeated for each of the solutions that had surrounded the potato tissue cores.

Lesson 2: Working in the same groups, students were given calculators and paper to process the two sets of data, to find the concentration of sugar solution inside the potato tissue. No further guidance was given as to the method of data analysis. The first method required students to work out the percentage change in mass of the potato cores, and to plot these data as a line graph against concentration of sugar solution. The point where their line of best fit crossed the x-axis was the where there was no net movement of water into or out of the potato tissue and, therefore, the concentration of sugar solution the same as that inside the potato tissue (isotonic solution). The second method required students to work out that if water had left the potato tissue and entered the surrounding sugar solution, then the solution would have become more dilute and less dense. Consequently, a droplet of this more dilute solution would rise when released in the middle of a sample of sugar solution of the original concentration. The greater the movement of water into or out of the potato tissue, the faster the fall or rise of the droplet. To find the concentration of sugar solution inside the potato tissue, students calculated the speed of the movement of the droplet and plotted this as a line graph against concentration of sugar. Where the line of best fit crossed the x-axis indicated the isotonic solution. For both methods, the students had to account for positive and negative values when plotting their data.

