The Impact of Students' Perceived Relatedness and Competence upon their Motivated Engagement with Learning Activities: A Self-Determination Theory Perspective

by

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ABSTRACT

The outcomes of empirical research that has applied Self-Determination Theory (SDT) within classrooms suggests that the combined satisfaction of three basic psychological needs predict students’ motivation to engage with learning activities. These three basic needs are relatedness, which, for the purposes of the current research, takes the form of a positive teacher-student relationship, to perceive themselves as being competent and having competence, and to be autonomous

From the current research, it was found that, whilst SDT emphasises the importance of autonomy as a basis for self-determined engagement with learning, the motivation to be autonomous emerges as a potential outcome that is influenced and informed by the students’ perceived competence and the perceived quality of the teacher-student relationship.

These findings were the basis for three posits regarding the impact of the satisfaction of the three basic psychological needs, central to SDT, upon students’ engagement with learning activities. These posits are: that firstly, an individual’s motivation to be autonomous (SDT; autonomy) is an outcome dependent upon students’ satisfied needs for both a positive teacher-student relationship (SDT: relatedness) and perceived competence (SDT: competence); secondly, that perceived competence is informed by and reciprocally informs the quality of the teacher-student relationship; and thirdly, that there is a potential cumulative connection between students’ perceived competence and the quality of the teacher-student relationship, in terms of the combined impact upon the quality and persistence of autonomous motivation. These interpretive claims emerged from and were supported by the findings across the main study and triangulation methods within the current research.

This research begins to unravel how the motivational interplay between the three SDT-centred basic psychological needs purported to inform students’ engagement with learning activities in formal learning settings. The conclusions drawn have led to the development of a proposed SDT-based motivational pathways model. This model, and the proposed interplay therein, is worthy of further testing, explanation and modification by educators as part of their classroom-based research agendas.

DEDICATION

I dedicate this thesis

to

Inge

For your unwavering love, encouragement, support and belief in me and us throughout what has been a true journey of self-determination.

Thank you for being all of my reasons.

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I am extremely grateful to Dr. Tonie Stolberg (my lead supervisor), Dr. Ian Davison (my academic advisor from April 2013) and Professor Stephen Gorard (my second supervisor from September 2011 to March 2013). To them, I extend my thanks for the time, advice, good humour and encouragement that they each put into ensuring that I was able to allow my ideas, conclusions and research to unfold in such a way that the outcomes have begun to illuminate the professional practices which have an impact upon our own students' motivated engagement with learning.

To the children of the main study school: Learn from yesterday, live for today, hope for tomorrow. The important thing is not to stop questioning. Never be afraid to ask what others may regard as the naïve question. To ask questions and to question things does not reveal a lack of knowledge; it reveals someone who is keen to find out and to get things right. It also saves a lot of time trying to 'figure things out'. As Richard Feynman said, "I would rather have questions that can't be answered than answers that can't be questioned." The children were, indeed, refreshingly honest and forthright, and took a great deal of interest in my research as they foresaw benefits for, not least, their enjoyment of science. My time with them, throughout my studies, helped me to retain a sense of proportion and some semblance of sanity.

To the children who attended Highfields School, in Nottinghamshire, between 2004 and 2011: thank you for allowing me to escape your clutches after seven years as Headmaster. The change of direction in my career has enabled me to form an even greater appreciation of what it means to be truly in touch with children's logic, optimism, humour and their unstinting drive to succeed. All without reading a single Dr. Seuss (moral philosophy) book!!

Much love and thanks to my family, who shall remain nameless as it is ever growing in size and I do not want to miss anyone out! However, my two sons, their wives and my grandchildren have been and always will be a constant source of joy, pride and love to me.

Through their example and encouragement, my children, grandchildren and students have taught me and continue to teach me that learning about the world never stops, and that discoveries come from playing and exploring through an unleashed imagination, combined with enthusiasm and curiosity. If ever you are fortunate enough to find a child who will take you on such a voyage, enjoy the journey: you will see the world in a new light. This is just one of the many reasons why I love working with and have been inspired by all of the children I have met.

Most of all, to my wife and best friend, Inge, I give my ever-grateful thanks and love, as the undertaking and completion of this research has been a test of self-determination, self-regulation, motivation and engagement for us both over the past five years! I have dedicated this thesis to you as a modest thank you for your unwavering love, encouragement, support and belief in me and us throughout. Thank you for being all of my reasons.

In the words of Douglas Adams: I may not have gone where I intended to go, but I have ended up where I needed to be.

This thesis was copy edited for conventions of language, spelling and grammar by PaperTrue Ltd.

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GLOSSARY OF DEFINITIONS

Adolescent	Preadolescence / early adolescence (10 to 12 / 13 years old), and adolescence is defined as the developmental period between approximately 10 and 19 years old (Harter, 2012)
Affective Engagement	Where the student's sense of belonging is reinforced through positive interpersonal relationships with the teacher and peers which is complemented by an acceptance of school values.
Agentic Engagement	The active and volitional cognitive contributions that a student makes to the learning activities presented by his or her teacher.
Autonomous Motivation	Autonomous motivation is the desire to be autonomous or to opportunities to be autonomous when afforded by the teacher during learning activities, and is a potential pre-cursor to self-determined motivation (Standage et al, 2003). An individual's autonomy may be regarded as being autonomously motivated when involvement in an activity is both self-initiated and self-regulated, and that the more autonomously motivated a person regards themselves as being, the more intrinsically motivated they will be to engage an activity (Ryan et al, 1995).
Autonomy	Autonomy is the psychological need to feel agentic through being able to exercise some freedom of choice and to make contributions to learning activities (Ryan and Deci, 2000), and "…refers to the need to express one's authentic self and to experience the self as the source of action" (Skinner and Edge, 2002, p. 298). Striving to feel that one can direct and organize one's behaviour, that one can choose and is not controlled and that one can develop and realize goals and values that feel authentic and give a sense of direction and meaning (from Kaplan and Assor, 2012, p. 253).
Autonomy Support	When a teacher provides learning activities within an autonomy supportive learning environment, s/he ensures students' basic psychological need to be autonomous are satisfied, which, in turn, can lead to engagement with learning through self-regulatory learning strategies, mastery of the concepts encountered, and enhanced academic learning and achievement (Assor et al., 2002, 2009; Reeve, 2009b; Reeve et al., 2014; Ryan and Deci, 2009, p. 175; Schunk and Zimmerman, 2008; Vansteenkiste et al., 2004).

Behavioural Engagement	This takes the form of engagement-related prosocial behaviours exhibited through participation in school-based activities, and involvement in, for example, related extra-curricular activities and actively studying a subject area beyond the classroom out of personal interest.
Cognitive Engagement	Where the student invests a personal interest and value in the subject or area under consideration, leading to enjoyment, liking and curiosity.
Competence	Competence is the psychological need to feel effective and confident within learning activities, so that students feel or perceive that they are capable of successfully performing within and completing a learning task (Ryan and Deci, 2002), and "…refers to the need to experience oneself as effective in one's interactions with the social and physical environments" (Skinner and Edge, 2002, p. 301) Within the current research, competence is approached as a need to feel competent. This is referred to, throughout the thesis, as 'perceived competence'. Competence can be translated as based upon perceived self-efficacy and self-concept, which combine to create energy and focus as self-regulated learning (Schunk and Zimmerman, 1989, 1998, 2008). Competence involves being able to achieve and interact effectively within valued activities or activities where success is required by the self or by others (Painter, 2011). Competence and competence motivation are both domain- and means-specific, such as motivation in relation to the formulation of goals and their achievement (Skinner and Edge, 2002, p. 397).
Controlling Motivation	A form of extrinsic, as opposed to intrinsic or self-determined motivation, based upon or driven by external controls, as with the latter choices are either limited or heavily directed by teachers' controlling behaviour.
Disengagement	The opposite of engagement, sometimes known as disaffection. It is defined as the extent to which a student actively refrains from participation in school-based activities. Rather than the positive behavioural and verbal responses manifested by the engaged student, such as excitement, elation or pride, a disaffected student might be disruptive within school in general, be consistently tense, anxious and off-task, and complain of being disinterested within the classroom, or avoid attending school.
Ego-Involving Climate	Within an ego-involving climate teachers typically emphasize

	performance outcomes, competition, and social comparison between students (Achievement Goal Theory - Nicholls, 1984: from Kajala et al, 2009, p. 317).
Emotional Engagement	Students’ affective response (e.g., happiness,anxiety, interest) to learning activities and to the people involved in those activities (Appleton et al. 2008: from Park et al, 2012, p. 390).
Engagement	A motivation-driven mental construct predictive of and predicted by students’ perceptions of positive teacher-student relationships (relatedness) at school in tandem with the cognitive and affective desire to initiate and sustain participation in a range of learning contexts and activities therein (Fredricks et al, 2004). Observable as manifestations of the motivated desire to be involved within learning activities. Engagement has been argued as being synonymous with self-regulated learning through motivation-informed and driven desires or needs, as common behaviours include persistence, attitude, concentration, the management of time, focus upon the main ideas and objectives, and the processing of information (de Bilde et al, 2011; Zimmerman and Schunk, 2008).
Interest	Interest is related to preferences for activities or knowledge domains, with the magnitude and type of interest acting as predictive of motivation to engage with learning activities (Abrahams, 2011). *See Intrinsic Task Value and Utility Task Value.*
Intrinsic Motivation	Engagement in an activity that is based upon motivation based upon feelings of inherent enjoyment, pleasure and / or interest.
Intrinsic Task Value	An intrinsic task value involves the students’ engagement with a learning activity on the basis of the perceived affective enjoyment of and interest in learning for its own sake (Wigfield et al, 2009). The student assigns a positive utility task value to a learning activity when s/he perceives that it will enhance their knowledge and / or understanding of a specific concept, or it will enable them to apply their own understanding to a new problem or scenario.
Motivation	Motivation is defined as the cognitive and affective force that initiates, sustains and directs engagement-predictive behaviours (Reeve, 2012). It has been defined as an inner psychological drive leading to action, i.e. engagement behaviours (Bandura, 1986).
Motivational Climate	Motivational climate refers to a situational psychological

	perception of the activity that directs the goals of action (Ames, 1992: cited by Kajala et al, 2009, p. 317).
Motivated Engagement	The motivation to engage with a specific learning activity.
Perceived Competence	The perception a person has of their abilities resulting from cumulative interactions with the environment (Harter, 1978: from Kajala et al, 2009. p. 318). Perceived competence includes affective and cognitive perceptions of feeling capable, that one is improving, and that one has the ability and capability of being able to perform and succeed within the next or current specific learning task (Harackiewicz and Manderlink, 1984; Harackiewicz et al, 1992).
Relatedness	N.B. For the purpose of the current research, relatedness is defined as the students' perceived quality of the teacher-student relationship. Relatedness is a basic psychological need, in that individuals have a "psychological sense of being with others in secure communion or unity" (Ryan and Deci, 2002, p. 7). Relatedness in the classroom involves the development of meaningful relationships with significant others, such as teachers and peers, through a sense of shared purpose and meaning (Painter, 2011).
Representations	Organized schemata derived from interactions with significant others that can be applied actively in ones' current interpersonal relationships both as anticipatory models and modes of adaptation (Ryan, Avery and Grolnick, 1985). Representations differ from perceptions in that a perception typically concerns one's experience of a specific situation or event, whereas representations are more general and serve an organizational with respect to ongoing perceptions of interpersonal relationships (Ryan, Stiller and Lynch, 1994, p. 228).
Self-Determined Motivation	Volitional, self-regulated engagement behaviours have been asserted as indicative of a strong sense of self-determination which are, in turn, predictive of an individual's positive perceptions of autonomy, competence and relatedness. This involves the combination of identity with the value of the learning activity, in terms of contribution to progress and enhanced competence, and the behaviours that will be needed to undertake and complete the task successfully. This form of motivated regulation shares common features of intrinsic motivation. The emphasis upon intentions leading to self-regulated and self-directed learning behaviours is synonymous with autonomy and the motivation to be autonomous (Ryan and Deci, 2004; Sneddon, 2013).

Self-efficacy	Self-efficacy is about the beliefs that the individual holds about their competence, which, as a direct influence, inform his/her judgements regarding their self-perceived ability to perform and succeed desire outcomes and learning goals within current and future learning activities (Maddux and Gossellin, 2003). Self-efficacy beliefs are not intentions to behave in a particular way or achieve particular learning goals but can influence competence motivation (Bandura, 2001; Maddux and Gosselin, 2003). Self-efficacy is a precursor to achievement motivation and a need for autonomy as a basis for acquiring increased competence (Elliot and Dweck, 1988, 2005).
Self-regulated learning	The process by which learners personally activate and sustain cognitions, affects and behaviours that are systematically oriented toward the attainment of learning goals (Boekaerts and Cascallar, 2006; Schunk and Zimmerman, 2008, p. vii).
Task-Involving Climate	In a task-involving climate, students are rewarded for effort, and they concentrate on cooperation, learning and task mastery (Ames, 1992: from Kajala et al, 2009, p. 317).
Utility Task Value	The stronger the perception that the learning activity has a utility task value, the more positive the student is likely to be about making a constructive agentic contribution to their own progress and competence within a learning environment that has supported their need for autonomy. The difference between utility task value and intrinsic task value is that, with the former, interest is not necessarily is a motivational driver to engage with an activity. With the latter, interest is more likely to be a precursor informing motivation (Ryan and Deci, 2009; Schunk and Zimmerman, 2008; Zimmerman and Schunk, 2001).

<u>ABBREVIATIONS</u>

ASC	Academic self-concept
BPN	Basic Psychological Need (Within SDT, these are Relatedness (the teacher-student relationship quality), Competence (perceived competence) and Autonomy (the motivation to be autonomous)
DCTB	Direct Controlling Teacher Behaviours
EM	Extrinsic Motivation
FGI	Focus Group Interview
IM	Intrinsic Motivation
IMM	Intrinsic Mastery Motivation
MER	Meta-ethnographic Review
PPF	Positive performance feedback
REM	Reciprocal Effects Model
RER	Reciprocal Effects Relationship

SDEL	Self-Determined Engagement with Learning
SDLE	Self-Determined Learning Engagement
SDM	Self-Determined Motivation
SDT	Self-Determination Theory
SES	Socioeconomic status
SRL	Self-Regulated Learning
TSRQ	Teacher-Student Relationship Quality

CHAPTER ONE
GENERAL INTRODUCTION

1.1 The Research Questions

The main study within this thesis has addressed two research questions. These questions emerged from the literature review. The main study evolved based upon the common findings of a meta-ethnographic review, and was subsequently triangulated by an online questionnaire. The current research has applied the Self-Determination Theory (SDT: Ryan and Deci, 2000) as a single theory-informed means of addressing the following research questions:

1. What does SDT-embedded evidence reveal to be the strongest sociocultural motivational influences upon the students' engagement with learning?

2. What do students regard as the key influences that have an impact upon their motivated engagement with learning activities?

1.2 The background to the Research Questions

This research has sought to identify and explain some of the key contextual variables that enhance students' self-determined engagement with learning activities. These variables have specifically focused upon teacher behaviours and methods that have a positive impact upon students' mtovation to engage with learning. This includes the impact of such behaviours and methods upon students' perceptions of the quality of the teacher-student relationship: within SDT, this is labelled as relatedness.

A review of prior research inestigating students' engagement within classroom-based learning activities revealed common variables that suggest a potential reciprocal relationship between the students' perceived quality of the teacher-student relationship, the students' domain-specfic perceptions that they have the competence to achieve desired outcomes during learning activities, and the extent to which they felt motivated to be autonomous during the said learning activities (for example, Skinner and Belmont, 1993) All three variables are the central constructs of the Self-Determination Theory: the authors of SDT propose that the satisfaction of three basic psychological needs (BPNs) will lead to students' enhanced motivation to engage with learning activities (SDT: Ryan and Deci, 2000, 2009). (For the purposes of the current research, the definition of the SDT construct of 'relatedness' is the students' perceptions of the quality of the teacher-student relationship). On the basis of the common variables, SDT was utilised as a theoretical lens. SDT has been shown, through prior research, to be an effective theory for identifying and explaining why some key classroom-based behaviours and variables appear to influence the students' engagement more than others (Reeve, 2002, 2012). It is a sociocultural motivational theory that has been effectively applied within schools as a basis for developing evidence-based practice (Ryan and Deci, 2009).

The tenets of the three SDT constructs informed the choice of research methods within the current research, and, therein, the choice of statements and questions asked – hence forming the student questionnaires, focus group interviews, and online survey of former students. Such channelling of statements and questions was necessary for the focused understanding and defining of engagement behaviours and motivational factors that influence students' effortful and sustained engagement with learning. As a result, the use of SDT within the current research has enabled the identification and discussion of methods and behaviours that teacher-researchers have used and may use to enhance and sustain their students' engagement during learning activities. In addition, the current study has addressed an identified gap in the prior research: SDT had not previously been tested within the science education provision of a British school.

In conclusion, within the current research, SDT has enabled a critical constructivist approach to the analysis of evidence and the conclusions drawn from such evidence, as the theory has enabled critical meaning, understanding and significance (Kincheloe, 2012, p. 154). Clearly, such evidence and the conclusions drawn will need to be tested and researched further to evaluate how their use in classrooms may impact upon the enhancement of teachers' evidence-based professional practice and further teacher inquiry (Hall, 2009; Thomas and Pring, 2004). Therefore, the next stage in my research journey will be to further apply and embed my conclusions through, for example, school-based action research as a basis for generating living theory that informs and improves teaching and learning (McNiff and Whitehead, 2010, 2011; Pring, 2000; Whitehead, 2008, 2009).

1.3 The Motivation for this Research

This research emerged from my desire to solve a long-standing puzzle central to my professional practice as a science teacher: to gain a greater, informed understanding of how I could improve the learning experiences of my students aged between 8 and 13 years by enhancing motivated engagement with learning. I was keen to understand how and why students are intrinsically and extrinsically engaged in their own learning, and the part that teachers can play in enhancing and encouraging the translation of students' self-determined motivation into engagement. This desire for understanding included the wish to increase my professional awareness of some of the motivating experiences that informed the students' self-reported reasons for why they felt motivated to fully engage in learning activities during lessons. The central aim of the outcomes of this research is to present the areas investigated and the findings obtained in such a way that they can be applied by teachers within their own classrooms as a means of improving and developing both their evidence-informed professional practice and further in-school research (Abrahams, 2011; Cordingley, 2004; IES, 2013; Muschamp, 2013; Southerland et al., 2014: Thomas, 2002, 2004, 2007). This aim is revisited and discussed in Chapter 5.

Prior to the start of my doctorate in September 2011, I had completed 21 years' in teaching: this included thirteen years within a variety of headships and deputy headships. For the majority of my career, I had taught science with students aged between 8 and 13, who appeared to be motivated to learn science and seemed to be fully engaged in the learning activities that I had planned and provided for them. I became increasingly interested in how perceptions of motivation and engagement influenced the students that I was teaching, and, therefore, how I could, through evidence-informed practice, have an increased positive impact upon these perceptions and indirectly, on academic achievement. In terms of outcomes, I wanted to increase the awareness of key classroom variables that have a positive influence upon students' motivational intentions and engaged behaviours within learning activities in general.

The viability of such an approach to undertaking research that is intended to ensure the generalisability of the findings has been influenced by the views of Pring (2000), who notes that no one classroom situation is unique in every respect, and that the research findings that emanate from one setting can be used to inform and suggest similar appropriate practice in other classrooms (p. 133). That is, "… there are sufficient similarities between contexts, and there is often sufficient agreement on understandings and values, for well-tested hypotheses in one situation to illuminate similar practice undertaken by others" (Pring, 2000, pp. 136 – 137). This aim is revisited and discussed in section 6.4.

The motivation for the current research began was the desire to gain a more informed understanding of the key teacher behaviours and methods that have an impact on the students' engagement, as reading related research revealed a number of variables that appeared to be central to such motivated engagement with learning activities. From the research literature, during the first year of my research, I found that Self-Determination Theory (SDT: Ryan and Deci, 2000) had been frequently used within classroom-based research as a means of enhancing the educators' understanding of how students' engagement was motivated (see Chapter 2). However, there were no specific written or diagrammatic motivational pathways considering the interplay between the perceived quality of the teacher-student relationship (relatedness), competence and autonomy centred upon learning activities, and all three constructs were usually shown as being simultaneous. The application of SDT as a focal lens has not been about finding supporting evidence for its applicability as a theory or, indeed, regarding SDT as evidence. Instead, the purpose has been to use SDT as a means of gaining an informed understanding of some of the key teacher behaviours and methods that, from students' perspectives, have a significant impact upon the students' motivation to engage with learning (further information in section 1.5).

1.4 Objectives of the Research

Gaps in the research literature (see section 1.6), together with the professional desire to gain an informed in-depth understanding of some of the factors influencing students' engagement with learning activities, have influenced the following research objectives:

1. To identify and understand the key motivational variables that teachers can devote their energies to as informed means of supporting and enhancing their students' engagement behaviours and responses within classrooms;

2. To outline key common behaviours and characteristics of teachers that students regard as being most influential upon their engagement with learning activities, and;

3. To investigate the motivational relationships between teachers' relational behaviours, students' self-attributes (especially, perceived competence), and their perception of

autonomy supported learning, together with the relative influential hierarchies of such variables based upon students' self-reported perceptions of their engagement with learning.

1.5 The Significance of the Research

Students' declining motivation to engage with learning has been reported across the whole range of school grades over several decades (for example, Eccles et al, 1984; Fredricks and Eccles, 2002; Fredricks et al, 2004). Positive psychosocial development is embedded in multiple interrelated sociocultural contexts that influence students' motivated engagement as a result of repeated positive experiences that lead to sustained positive outcomes (Eccles and Gootman, 2002) such as academic achievement (Connell et al, 1994; Connell and Wellborn, 1991. 1994; Skinner et al, 1990), social functioning, well-being (Fredricks, 2011), as well as reduced dropout rates, boredom and disengagement with learning activities (Fredricks, 2011: Fredricks et al, 2004; Fredricks and Eccles, 2006).

The individual teacher has been asserted as the key factor in motivating students to engage with learning activities within their specific educational contexts (Martin and Dowson, 2009; Reeve, 2002, 2012; Reeve and Tseng, 2011; Royal Society, 2007; Ryan and Deci, 2009: Willms, 2003). A teacher whose behaviours reveal a positive attitude and enthusiasm for learning within a specific curricula subject is more likely to have students who develop positive affect and enthusiasm for learning and achievement within the subject (Fredricks et al., 2004; Jarvis and Pell, 2005; Jennings, 2003; Jimerson et al., 2003; Tymms et al., 2008).

Teachers' ability to engage students' interest and participation in their schooling in general (Christenson et al., 2012; Klem and Connell, 2004; Skinner and Belmont, 1993) and specifically within science (Ainley and Ainley, 2011ab; Darby, 2005; Royal Society, 2010) is regarded as essential for a sustained academic achievement (Christenson et al., 2012; Fredricks et al., 2004; Marsh and Martin, 2011; Reeve, 2002, 2012). Some of the aforementioned claim a reciprocal relationship between positive engagement and academic achievement within specific curriculum areas, such as science (for example, Darby, 2005; Marsh and Martin, 2011). For example, the Programme for International Student Assessment (PISA: OECD, 2000, 2013) and Trends in International Mathematics and Science Study (TIMSS: Martin et al., 2012), have proposed a causal link between students' positive academic engagement and the subsequent improvements that students make in their academic achievement in that subject (Willms, 2003). One of the aims of developing an engaging science education within school settings is to develop and maintain a scientifically literate and capable workforce (Painter, 2011). However, this aim may not have been universally met, as a review of PISA 2009 (OECD, 2010) revealed that:

> "Consistent with PISA results, the average scores of U.S. students on … (TIMSS) from 1995 to 2007 remained flat … The 2009 National Assessment of Educational Progress (NAEP) in science revealed that only 34% of fourth graders, 30% of eighth graders, and 21% of 12^{th} graders performed at or above the proficiency level in science ... Even more distressing, only 1% of fourth graders, 2% of eighth graders, and 1% of 12th graders performed at an advanced level."
>
> (Painter, 2011, pp. 1 – 2)

This reported disengagement with science as a school-based subject was reported as prevalent amongst children aged 9+ years across 26 countries in TIMSS 2007 (IEA, 2008). It was reported that between 40 % and 60 % of high school students were chronically disengaged within their academic studies including science (Tymms et al., 2008). This had been also reported in the results of the TIMSS surveys of 1995, 1999 (Mullis et al, 2000) and 2003, which have suggested a continuing trend in that students have reported that they have enjoyed or are studying science less over time (Abrahams, 2007; Dunbar, 1995; Lee and Anderson, 1993; Martin et al., 1997, 2004; Osborne et al., 2003; Tymms et al., 2008; Vedder-Weiss and Fortus, 2011, 2012). Indeed, the House of Commons Science Technology Committee (2002), OECD (2007) and Royal Society (2006, 2008, 2010) had independently reported a decline in the percentages of students who were choosing to study science beyond compulsory schooling. This same report made a recommendation that those involved in the policy and practice of science education needed to consider ways of engaging more students with science, and thus reverse the recorded decline in interest in the subject. The outcomes of OECD (2007) revealed that there had been little positive change, over time, in students' overall motivation for science, particularly in Great Britain.

Amongst the key findings of TIMSS 2011 (Martin et al., 2012) there was a reported significant positive correlation between higher levels of academic achievement within science assessments and students' liking of science as a subject, academic self-concept, perceived value of, and engagement with science (Martin et al., 2012). The report highlighted the continuing on-going decline in students' enjoyment, confidence, engagement and perceived value of science between the ages of 10 and 15 years (pp. 17-21). While the results asserted that positive attitudes and engagement with science had a positive relationship with improvement within science achievement, the survey found that attitudes were more positive at Fourth Grade (students aged 9-10) than Eighth Grade (students aged 13-14). By the Eighth Grade, only a quarter of the student respondents stated that they were engaged by science lessons with almost another quarter stating that they were not engaged by science lessons (Martin et al., 2012, p. 329). This asserted disengagement with science and the purported influence of the teacher upon students' enjoyment, engagement and mastery of science within classrooms across a wide range of countries was a key motivator for this research study: the desire to investigate and understand the classroom contextual variables that could be implemented by teacher within schools as a means of influencing their students' affective, cognitive and academic engagement with both science (investigated within the main study) and school-based learning in general (investigated through the MER and online survey herein).

The desire for such understanding is central to many research studies that have investigated school-based engagement (Martin et al., 2012). Fredricks et al. (2004) noted that the degree to which the three SDT needs mediate between teacher behaviour contextual factors and engagement had not been investigated by most studies seeking to understand engagement, and that least studied are the motivational relationships between perceived competence and students' persistent engagement with learning (p. 82). They suggest that further research is needed to investigate the interplay between different components informing engagement as a multidimensional concept, as many studies have not encompassed a consideration of how cognitive factors such as perceived competence and self-efficacy interplay with affect and behavioural outcomes to inform students' motivated engagement with learning activities (Fredricks et al, 2004, p. 83). Where models have been posited, the antecedents are often shown as simultaneous or as a simplistic linear relationship. However, nonlinear relationships could be proposed where it found that particular needs and components informing motivation and engagement appear to have a greater impact comparative to others, whether some needs are required as the threshold for other needs to be motivated, or whether a larger amount of one component is sufficient to compensate for less of another (p. 83). As part of such research, the reciprocal relations between social contextual factors, academic perceptions and engagement could be investigated (Fredricks et al, 2004; Skinner and Belmont, 1993). In addition, there may be differences in the interplay between how needs and contextual variables influence engagement across different developmental stages, as “students may not become deeply invested in learning until they have the intellectual capacity to self-regulate and become intentional learners, which tends to occur at later ages” (Fredricks et al, 2004, p. 84). In addition, it was noted that ‘The presumption is that support from the teacher meets an individual’s need for relatedness; but, for the most part, the mediation assumption has not been tested’ (Fredricks et al, 2004, p. 86).

The current research was approached with the view that it may be, therefore, that engagement is an outcome in response to the motivation that students gain from the teacher satisfying the need for competence or autonomy, or both. Further to the meta-ethnographic review (MER), it appeared that there may be a hierarchy amongst SDT constructs in terms of their impact upon each other and, as an outcome, engagement. Indeed, a hierarchy amongst types of engagement has previously been proposed by Reschly and Christenson (2006, 2012) in that they argue that cognitive and emotional engagement precede and inform the quality and persistence of behavioural engagement. The evidence and interpretations within the current research is significant in that has suggested a hierarchical motivational pathway as a potential means of informing teachers’ understanding of how they have a direct impact upon their students’ motivated engagement. These interpretations are discussed and illustrated within the current research.

Therefore, this study is significant in that it has led to an informed conceptual understanding, based upon the proposed hierarchy and motivational interplay between the three SDT constructs, of some of the key teacher behaviour factors that have a particular impact upon students’ motivation to engage in learning activities. This understanding may be used to inform practitioners’ evidence-based practice. For example, these identified factors and the associated understanding of the interplay between them may be used in the design and implementation of interventions with the objective of teachers successfully enhancing their students’ engagement with learning: however, this is beyond the remit of this research study but will form the basis of my post-doctoral research.

1.6 Identified Gaps within Prior Research

To date, there has been a plethora of research relating to specific teacher influences upon student engagement within schooling and the classroom in general. There is a wealth of empirical support for positively correlating student engagement as a predictor of academic achievement and motivated involvement within school in general (Connell and Wellborn, 1991; Finn, 1989; Klem and Connell, 2004; Voelkl, 1995, 1996, 1997). The main domain- or subject-specific areas of student engagement research have been health and exercise (Gillison 2007; Sebire, 2009), reading (Guthrie and Anderson, 1999; Guthrie and Wigfield, 2000) and maths (Hughes et al., 2008). By comparison, there has been a paucity of research regarding domain-specific or subject-specific engagement factors in science.

Despite such a paucity, engagement-enhancing factors specific to children's positive perceptions of science have been investigated within a number of prior studies (Abrahams, 2009, 2011; Abrahams and Millar, 2008; Ainley and Ainley, 2011a, 2011b; Blumenfeld and Meece; 1988; Darby, 2005; Lee and Anderson, 1993; Lee and Brophy, 1996; Murphy et al., 2012). These have reported, to varying degrees, that there are several common key elements central to an engaging science education, including teaching methods / behaviours that promote autonomous learning and strong teacher-student interpersonal relationships. While the findings of these studies have defined some of the key factors regarded as being central to engaging students with science, none of them included the consideration of a potential reciprocal effects relationship between science teacher behaviours and student engagement with science as called for by Klem and Connell (2004, p. 270). The presence of a reciprocal effects relationship within the dynamics of engagement with learning has also been raised by, for example, Marsh and Craven (2006), Marsh and Martin (2011) and Skinner and Belmont (1993). Therefore, the methods used within the current research have investigated and discussed the potential reciprocal relationship between relatedness, competence and autonomy in terms of their motivational impact upon students' academic engagement.

Searches of ten literature databases (section 2.12) also revealed that there have been no systematic reviews or meta-ethnographic reviews of the variables central to student engagement in schools in general or science specifically, particularly for children aged 8 to 13 years. I chose this age range as these were not only the ages of the children that I was working with but also this was the age group in which there was reported to be an on-going decline in students' engagement with and the perceived value of science between the ages of 10 and 15 years (Martin et al., 2012; OECD, 2007; Tymms et al., 2008). Most of the accessed studies had focused upon children aged between 4 and 7, and students from 13+ to 18+ including university undergraduates. In addition, within science education there had not been any published studies that had tested the generalisability of SDT to science education within British schools.

Finally, while some studies have focused upon mixed methods research designs using a combination of questionnaires and interviews, there was a further identified gap in the research in that the findings of the vast majority of studies were only informed by the use of in-situ data collected through questionnaires. However, the emergent common themes were rarely explored by researchers through discussions with students during focus group interviews, and none of them included online surveys of students who had completed their formal education. The current research addresses these identified gaps.

1.7 Original contributions made by this research

The findings of this research have led to four original contributions to knowledge. The first contribution is, at a simple level, the in-situ testing of the generalisation of SDT within a British school as one way to identify and understand some of the key antecedents that inform engagement within science education lessons. To date, the majority of the published studies testing SDT have taken place in the USA, Canada and Belgium. The meta-ethnographic review (MER) unearthed two studies based within Britain, both of which had focused upon the informed use of SDT within physical education lessons. Only five of the retrieved studies focused upon science education; two in Canada, one in Germany and two in the USA. Of these, two studies had samples of 18-20+ year-olds, one being a sample of 17-18 year-olds studying physics, and 15-year-olds studying high school science. Only one study investigated the perceptions of students as young as 11, focusing on the differences between the perceptions of American and Chinese students towards their teachers' perceived autonomy supportive behaviours. An extensive search of ten literature databases revealed that there have not been any published, peer-reviewed tests of the self-determination meta-theory within science education for the 8 to 13 age range in Britain (Chapter 2, Part 2).

Arising from analysis of the emergent research findings within the meta-ethnographic review (MER), further testing of the generalisability of such findings within the main study, and their confirmed triangulation through the online survey. The second contribution is the assertion, that the three constructs within SDT are variant in their reciprocal impact upon students' perceived motivation for and engagement within the classroom. That is, rather than the three SDT constructs either being of equal impact, or similar influence, or being manifested simultaneously, the evidence from the three studies has revealed that the strongest influences within SDT are the reciprocal relationships between relatedness and competence. Specifically, it has emerged that the perceived quality of the teacher-student relationship has an impact upon students' perceived competence, both of which appear, in turn, predictive of the extent to which students feel the need to be autonomous and / or that they are learning within an autonomy supportive classroom. However, it emerged that the potential reciprocal relationship between relatedness and competence has a stronger influence upon students' sustained engagement with learning, and that the need to be autonomous (in terms of what and how subject matter should be learnt) is not as strong and has a lesser comparative motivational impact upon students' engagement with learning (see section 5.1.).

The official SDT website (www.selfdeterminationtheory.org [last accessed 5th January 2015]) presented fifteen questionnaires that have been used to measure self-determination through participants' self-reported responses. These questionnaires have been developed to assess the impact of the different constructs within the theory. A review of the fifteen SDT-related questionnaires revealed that not one questionnaire nor a series of questionnaires had been developed to measure all three constructs of SDT in a format that would enable the investigation of the students' self-determined perceptions of specific and potentially simultaneously engaging aspects of their science lessons and schooling in general. Therefore, this research also contributes to knowledge through the questionnaires that have been developed for the purposes of the main study, which, through their evolution and testing, may be added to the bank of SDT-informed questionnaires that may be used with younger students (see section 3.7.3: Appendices 3.15 to 3.19).

Based upon the MER, together with the cumulative findings across the research herein, the final contribution to knowledge is a proposed motivational pathway for the impact of SDT constructs upon engagement: that is, that relatedness and competence have a variant and combined reinforcing impact upon students' self-determined engagement and autonomy with learning (see Figures 5.2 and 5.3). This pathway is based upon the proposal that there are posited reciprocal interaction between the students' perceived relationship with their teacher and the enhancement of students' domain-specific competence, and the teacher behaviours and learning methods that influence students' sense of relatedness and competence within an autonomy-supportive learning environment.

1.8 Outline and Development of the Current Research

Within the current research, I investigated students' engagement with learning activities through the theoretical lens of SDT. SDT is a sociocultural motivational theory that, through extensive empirical classroom-based testing, has revealed its potential to be applied by teachers within their own classrooms as a basis for enhanced evidence-based practice in education. For such findings to be more applicable as the basis of evidence-informed practice, the outcomes of this research have been presented so that they may form the starting point for further research involving teachers within their own classrooms.

As the research process unfolded, it was repeatedly clear that whilst '... there is generally accepted to be no particular, no correct or proper way of generating or marshalling evidence' (Thomas, 2004, p. 3). One of the best outcomes of the interpretation of such evidence would be to create a more lucid image of how SDT-related motivational variables have an impact upon students' engagement with learning activities. Indeed, given the social and interpretative context of the evidence herein, from the interpretation and enhanced understanding of such through the use of theory as an explanatory framework, 'rational belief is perhaps all that can be hoped for in practical circumstances, and it is unlikely that a practitioner will find conclusive evidence for a proposition' (Thomas, 2004, p. 7). In addition, given that researchers have asserted that causal connections can be inferred without the use of randomised controlled trials (RCT: Goldstein, 2002, p. 2), the qualitative and mixed methods inquiries herein are asserted as viable means of gaining an understanding of students' motivation and engagement through intuitive thinking that has taken prior evidence into account as the basis for contextualising the new evidence generated (Thomas, 2004, p. 12).

The adopted research approach is a phenomenological one in that the evidence collected has enabled the exploration and understanding of students' experiences and how such experiences are interpreted by the students within the different sample populations (Savin-Baden and Major, 2013). Phenomenological research, based upon the underlying philosophy of phenomenology, is built upon the assumption that knowledge is formed, developed and modified through experiences (p. 223). That is, that individuals gain a personal knowledge of their own worldview as they regard them to be through their consciousness of experiences based upon intuitive reflection.

SDT (Ryan and Deci, 2000) was selected as a focal theoretical lens which has supported researchers' facilitated understanding of sociocultural conditions within the classroom that satisfy as opposed to thwarting the psychological needs central to students' engagement with learning. Therefore, the impetus throughout this research study has been upon the utilisation of SDT as an applied theoretical means of gaining a more informed understanding of motivating students' engagement with learning (Southerland et al., 2014). Prior empirical testing has shown the positive application of SDT to be a reliable predictor of motivation and engagement of students within the classroom (Reeve, 2002, 2012; Ryan and Deci, 2009) results in the interplay between the teacher behaviours and methods conducive to engagement with activities and the psychological motivational drive to initiate and sustain engagement. Indeed, throughout this research, the data collection process central to each of the research methods has been more simplistic and "…very down-to-earth" in comparison to the theorising at the heart of the analysis (Brewer and Hunter, 2006, p. 18).

The three motivational constructs (BPNs) central to SDT were used to define the theoretical boundaries for the research within this thesis. As discussed (Chapter 2, Part 2), the starting point, prior to formation of the research process and data collection, was upon the development of an informed understanding of the defining characteristics and indicators of students' engagement with learning. This understanding was then traced backwards from the behaviours indicative of engagement to the underlying psychological processes informing an individual's motivation for learning.

Between September 2011 and October 2013, I was a part-time volunteer within the school that was the research setting for the main study. Initially, the plan was that the research design would centre upon the principles of action research. Indeed, during meetings with the science teachers in the school, the agreed objective was to use Self-Determination Theory as the basis for the design, implementation, evaluation and evolution of interventions that may enhance the students' current levels of engagement within science lessons. However, the research design had to be modified after the pilot study (March 2013) and before the second wave of questionnaires (June 2013). This was because of the constraints of access to different sections of the student population due to differing accountability pressures upon the three science teachers, in addition to numerous unforeseen and late changes to the science timetable due to the school's very busy events calendar. This led to the decision in late May 2013 that given that an action research approach using interventions would not be possible, and mindful of the constraints of this doctoral research, a retrospective research design was used.

Despite the changes in the research design of the main study, the same timetable for data collection and the same questionnaires that had been designed for the pilot study could be utilised. The research design is illustrated in Figure 1.1 (above). In addition to the use of questionnaires, focus group interviews were chosen as a method for exploring the self-perceptions of the students' responses regarding their experiences within science lessons: these included the exploration of students' interpretations of their self-perceptions and how these informed their expectations of their competence, their opportunities to be autonomous, and the extent of the influence that teacher behaviours and relationships have upon these self-perceptions.

Figure 1.1 *Design and Methods pathway for the current research*

META-ETHNOGRAPHIC REVIEW		MAIN STUDY		TRIANGULATION of the Main Study and MER using an online survey
META-ETHNOGRAPHIC REVIEW (Noblit and Hare, 1988) of 32 studies which have tested and / or applied SDT as a basis for investigating factors that influence students' engagement with learning. Translation and synthesis using Best Evidence Synthesis (Slavin, 1986, 1987). (*n = 20,949*)	→	**MAIN STUDY** **Retrospective longitudinal (multi-cohort, multi-occasion) design** In-school testing of the emergent findings of Study One based upon the second- and third order interpretations formed further to the BES Use of questionnaires and focus group interviews. (*n = 70 / 92*)	→	**TRIANGULATION of the Main Study and MER using** an online survey. Testing of emergent findings and three claims to knowledge regarding the interplay of SDT basic needs in the classroom. (*n = 191*)

One of the aims of the current research has been, further to the view that '"It is teachers who in the end will change the world of the school by understanding it" (Stenhouse, 1981, p.104), to build upon prior research by generating sufficient primary evidence that is both corroborative and confirmatory in nature as the basis for practitioners' assured use of such evidence and the accompanying interpretations within their own settings. The sufficiency of the evidence herein is asserted, based upon the definition of sufficiency as "corroboration with other instances of the same kind of evidence or other kinds of evidence"' (Thomas, 2004, p.5). The sufficiency of the evidence within the current research has been assured through the collection and collation of good quality, reliable evidence, with the evidence from the MER being used as the basis for the collection of evidence that has not only tested the emergent proposition in the light of the two research questions but has also resulted in additional corroborative evidence (Thomas, 2004, p. 8). Sufficiency has been one of the central guiding principle from the original inspiration from the literature review that led to the two research questions, the discovery stage being an initial proposition that emerged from the MER through the generation of corroborative evidence during the main study (Chapters 3 and 4) and online survey (section 5.1). This led to the formation and support of inductive beliefs and three proposed claims to knowledge. The evidence generated was sufficient to enable the corroboration of the proposition, which became three claims that were tested and corroborated by the online survey. Therefore, the discovery stage – the MER has been successfully tested for sufficiency through corroborative and confirmatory research (sections

2.10 to 2.19) (further to Thomas, 2004, p. 10). Various forms of internal triangulation were used to ensure the consistency of student responses across questionnaires and during the focus group interviews: to ensure, as much as it is possible to do so, that students were not stating what they thought the teacher-research wanted to hear but were, instead, presenting their own perceptions in a variety of ways. For example, some of the statements within the questionnaires were separately both positively and negatively phrased and coded. In these cases, the positive and negative statements exploring the same area were situated in different sections of the same and other questionnaires. Questionnaires were also administered across several days, rather than at single sittings, and in March, June and September 2013. Within the FGis, for example, some questions were repeated but phrased differently as a means of checking for the consistency of responses.

In summary, the critical consideration of the substantive student engagement and associated SDT literature (Chapter 2, Part 1) led to a MER (Chapter 2, Part 2). The review focused upon research questions, and led to a tentative proposition based upon the synthesized qualitative interpretations of the data within 32 accessible studies selected following extensive searches of research literature databases: that when SDT is considered within formal learning activities, autonomy may be an outcome of the influence of relatedness and competence. That is, that the SDT constructs are hierarchical, and have a potential order of influence from the teacher-student relationship quality (SDT: relatedness) and perceived competence (SDT: competence) upon the quality and persistence of students' motivated desire to be autonomous during learning activities (SDT: autonomy).

CHAPTER TWO

Student Engagement through Self-Determination Theory: a two-part Literature Review using Meta-Ethnographic Review protocols

2.1 Introduction to the Literature Review

Within the first half of this chapter (sections 2.2 to 2.7), a general critical review of the research literature encompassing student engagement with learning has been undertaken. This included a number of prior research studies that have applied SDT as a means of identifying and explaining why and how key teacher behaviours and methods appear to inform students' motivation to engage with learning. The consideration of these studies led to a number of criticisms in terms of how the interplay between the three SDT constructs has been reported (see section 2.9). In particular, further to the criticisms of SDT discussed in section 2.9, a puzzle arose: the possibility of a hierarchy between the three SDT constructs when considered in relation to the influences that motivate students to engage positively with learning activities. These puzzles led to the formation of the two research questions central to the current research. These have been initially addressed within the second half of this review using meta-ethnographic review (MER) and Best Evidence synthesis protocols (section 2.10 onwards). This methodical approach led to a more in-depth review that looks beyond the constraints of SDT as a motivational theory. This review leads to the posit that such a hierarchical interplay does exist, with a more informed understanding of the motivational processes being formed through integration with other motivational theories. Essentially this, in its own right, is a contribution to knowledge in the form of synthesised evidence from a potentially unique combination of research studies: through a linked narrative, this makes explicit which interventions, whether intentional or otherwise, appear to work with regards enhancing students' engagement with learning through the grounding of SDT within classrooms. In summary, this MER has made clear the emergent patterns with regards to behaviours and methods that regularly have an impact, for whom, and where and when (Atkins et al., 2008; Noblit and Hare, 1988; Petticrew and Roberts, 2006).

2.2 Introduction to Student Engagement with Learning Activities

Parsons and Taylor (2011) state that there are three substantive reasons for researching and understanding engagement: defining different types of engagement and their observable indicators; “to help disengaged and disadvantaged students achieve and participate (or to reduce drop outs); to assist in classroom management (reduce classroom disruptions and discipline issues); and, finally, to engage students in learning about learning (to help them to become skilled life-long learners as opposed to well-behaved, attentive students)” (p. 9). Student engagement is, therefore, of immense significance within the classroom as a measurable multidimensional construct in the form of a dynamic, malleable outcome of students’ motivation for learning through affective, verbal and behavioural responses that are, reciprocally, predictive of students’ motivational inclinations (Klem and Connell, 2004; NRC, 2004). Engagement has been posited as a significant predictor and indicator of students’ motivation and well-being within formal learning environments (Baumeister and Vohs, 2007; Fredricks et al., 2004; Ryan and Deci, 2009). Therefore, students’ engagement with learning in general is regarded as essential for the long-term commitment of students to their learning goals and prosocial approaches to academic success (Fredricks et al., 2004; Lawson and Lawson, 2013; Reeve, 2002, 2012). The converse of engagement is disengagement (also known as disaffection). Disengagement has been empirically asserted to be a cause of increased school drop-out rates, reduced attendance levels, and ultimately students not achieving their own self-perceived or their teacher-regarded potential (OECD, 2000). Christenson et al. (2008) noted that, “the importance of engagement at school and with learning is undisputed by educators …” (p. 1099) However, OECD (2000) stated that, despite the recognised importance of engagement within the classroom:

> “Most students participate in academic and non-academic activities at school, and develop a sense of belonging …they have good relations with teachers and other students, and they identify with and value schooling outcomes. But many students are not engaged. They do not believe their school experience has much bearing on their future, and they do not feel accepted by their classmates or teachers. Gradually these students withdraw from school life, and become disaffected from school.”
>
> (p. 3)

Consequently, it is easy to understand why the enhancement of engagement has come to be regarded as essential in assuring students' enthusiasm for learning, improving the quality of their relationships with teachers and other students, and as a means of reducing school dropout rates (van Uden et al., 2013). In addition, engagement has come to be regarded as "… an alterable state of being that is highly influenced by the capacity of school … to provide consistent expectations and supports for learning (Christenson et al., 2012, pp. v-vi). It has been noted across numerous similar studies that:

> "The concept of school engagement has attracted increasing attention as representing a possible antidote to declining academic motivation and achievement. Engagement is presumed to be malleable, responsive to contextual features, and amenable to environmental change."
>
> (Fredricks et al., 2004, p. 59)

On the basis of the above thinking, interest in understanding student engagement has increased over the past twenty five years, and especially the last ten years (Christenson et al., 2012; Fredricks et al., 2004), leading to empirically-supported models that propose that students will develop as self-motivated, self-regulated learners who are engaged with their learning through the afforded combination of a myriad of cognitive, metacognitive and motivational factors (Bandura, 1977, 1986ab, 1993, 1997, 2001; Dewey, 1900, 1902, 1929, 1938ab; Vygotsky, 1978; Schunk and Zimmerman, 2008).

As engagement has a positive association with improved educational outcomes such as achievement levels, for teachers, "… the primary appeal of the engagement construct is that it is relevant for *all* students." (Christenson et al., 2012, p. vii) With regards to academic achievement and enjoyment of learning, "considerable evidence now reveals that students who are intrinsically motivated and inherently interested or engaged in the learning process will more effectively master classroom assignments and achieve at higher levels" (Harter, 2012a, p. 273).

Engagement may be synonymous with self-regulated learning through motivation-informed and driven desires or needs, as common behaviours include persistence, attitude, concentration, the management of time, focus upon the main ideas and objectives, and the processing of information (de Bilde et al., 2011; Wolters and Taylor, 2012; Zimmerman and Schunk, 2008). Behaviourally, engagement is manifested as attendance (both by attending school and lessons, and attending to the subject matter and learning activities within individual lessons) concentration, persistence in the mastery and understanding of knowledge and concepts, participation, positive collaboration with peers and teachers within learning activities and contexts, and a affect-driven desire to succeed (Fredricks, 2011; Fredricks et al., 2004).

Prior empirical research has revealed that “at the classroom level, teacher support, positive teacher-student relationships … autonomy support and authentic and challenging tasks have been associated with student engagement” (van Uden et al., 2013, p. 44). Three essential factors have consistently been identified as having a positive influence upon the optimal development of students’ self-regulated academic motivation and achievement within classroom learning activities (Connell and Wellborn, 1991; Hattie, 2012). These are the quality of teacher-student interpersonal relationships, the extent to which learning activities are autonomously directed by students, and the nature and timing of competence-related feedback given by the teacher to the student. Therefore, within the current research, student engagement has been approached as an outcome of motivational informants, and takes the form of a combination of observable behaviours and self-reported affect-driven perceptions (Christenson et al., 2012; Fredricks et al., 2004; Klem and Connell, 2004; NRC, 2004). These perceptions and their informants are discussed in detail later in this chapter as they are common to the three constructs that have been integrated to form Self-Determination Theory (Ryan and Deci, 2000).

2.3 Defining student engagement with learning

Engagement within academic environments, such as schools and classrooms, is defined as the extent of a student’s active involvement, in terms of the time and effort expended, in a specific learning activity or learning activities over a longitudinal timeframe (for example, Christenson et al., 2012; Reeve, 2012; Wellborn, 1991). It is manifested as “… active, goal-directed, flexible, constructive, persistent, focused interactions within social and physical environments.” (Skinner and Edge, 2002, pp. 299-300), based upon “the student’s psychological investment in, and effort directed toward, learning, understanding, or mastering the knowledge, skills, and crafts that academic work is intended to promote” (Newmann, 1992, p. 12). Conversely, disengagement has been defined as “… when individuals are emotionally alienated or behaviourally disengaged from participation in an enterprise” (Skinner and Edge, 2002, p. 300). Specifically, Mosher and McGowan (1985) defined student engagement as students’ participation within the activities offered and made available by teachers within a school’s learning programme. The joint implementation of classroom-based motivational practices and enjoyable teacher-afforded learning activities appear to facilitate students' engagement in domain-specific areas of education (Park et al., 2012; Wigfield et al., 2008).

Engagement behaviours are intentional, persistent, and focused efforts that are maintained in order to produce an effect such as academic achievement and enhanced competence levels (Elliot et al., 2002, p. 363). Both engaged and disengaged behaviours and responses are the direct consequence of cognitive and affect-based motivational processes (Skinner and Edge, 2002; Wellborn, 1991). Such motivation has been asserted as the basis of engagement in the form of directed and energised actions (Skinner and Edge, 2002, p. 299). Engagement behaviours are, in turn, indicative of motivation, through observable behaviours predictive of the internalisation of enjoyment, confidence, personal value and interest, curiosity, and relatedness, for instance (Fredricks et al., 2004; Jimerson et al., 2003). Therefore, motivational perceptions and the factors informing those perceptions are predictive of manifested engagement in the form of persistent self-regulated behaviours – such as effort. The more intense and persistent the engagement, the more positive an individual's motivation is predicted to be. Such intense, persistent engagement should lead to more assured academic achievement and attainment, which appears to influence the student's perceived competence and consequent sustained motivation (Christenson et al., 2012; Deci and Ryan, 1992; Pittman and Boggiano, 1992).

2.4 Defining four types of student engagement

The three most frequently mentioned forms of engagement within classroom-based learning are affective engagement, cognitive engagement and behavioural engagement (Fredricks et al., 2004; Parsons and Taylor, 2011). In addition, a further form of engagement – agentic engagement – has recently been proposed by Reeve and Tseng (2011). Within the substantive research literature, affective, cognitive and behaviours engagement are asserted as combining to inform behaviours indicative of student engagement within classroom-based learning (NRC, 2004). However, Reeve (2012) proposes that all four subtypes of student engagement should be considered together when seeking to understand and enhance students' academic engagement. Within each, engagement behaviours are viewed as initiated by psychological responses and physical actions underpinned by motivational constructs (Connell and Wellborn, 1991; Deci and Ryan, 1985; Reschly and Christenson, 2012; Skinner and Pitzer, 2012).

The majority of engagement-indicative outcomes have, to date, included students' active participation within learning activities in the form of the emotional and behavioural investment and commitment that students make to learning (Appleton et al., 2008). For instance, negative feedback by the teacher was associated with low motivation and engagement in the classroom, which was further associated with disruptive behaviour by such disengaged students. Only behavioural and agentic engagement may be observed as state variables. Conversely, affective and cognitive engagement are posited as internalised processes, with the researcher reliant upon gathering data in the form of students' self-reported perceptions (Christenson et al., 2008). The indicators of cognitive, affective and academic engagement are manifested as observable characteristics indicative of behavioural engagement within learning activities (Fredricks et al., 2004). Indeed, their manifestation has been asserted as being predictive of probabilistic causal factors informing unseen or unobservable motivational perceptions, reactions and affective responses such as enthusiasm, pride, anxiety, and interest (NRC, 2004).

Behavioural engagement is defined as the amount of time that a student invests within a specific learning activity or participates within the classroom in general (Janosz, 2012). Specifically, it draws upon "… the idea of participation; it includes involvement in academic, social or extracurricular activities, and is considered crucial for achieving positive academic outcomes and preventing dropping out." (Fredricks et al., 2004, p. 60) Indicators other than the time invested in learning include students' attendance at and within lessons, positive conduct within lessons, participation in extra-curricular activities, and sustained, resilient efforts during learning activities. Other indicators of positive behavioural engagement include initiation of self-directed action, exertion, making attempts to master concepts, persistence and intensity of concentration, focus, absorption and involvement. Effort, in the case of behavioural engagement, refers to participating in and completing learning activities (Fredricks et al., 2004, p. 64). Conversely, indicators of behavioural disengagement include procrastination, lack of resilience in the face of challenges, restlessness, lack of effort or sustained effort, being easily distracted, and showing a disinclination to work hard or be prepared to participate (Skinner and Pitzer, 2012, p. 25).

Affective engagement "…encompasses positive and negative reactions to teachers, classmates, academics, and school and is presumed to create ties to an institution and influence willingness to do the work" (Fredricks et al., 2004, p. 60), and is usually manifested as emotions in response to the process and outcomes of learning activities. These involve the interplay of a myriad of cognitive, psychological, contextual, teacher behaviour and motivational factors (Pekrun and Linnenbrink-Garcia, 2012). Indicators of positive affective engagement during learning activities include enthusiasm, interest, enjoyment, satisfaction, pride, vitality and zest (Ryan and Deci, 2008; Skinner and Pitzer, 2012). Conversely, indicators of affective disaffection include boredom, disinterest, frustration, anger, sadness, worry, anxiety, shame and self-blame (Skinner and Pitzer, 2012, p. 25). Behavioural indicators of positive affective engagement include excitement, elation, happiness, hope, joy, pride and gratitude. Negative indicators include tension, anger, sadness, frustration, anxiety and shame (Pekrun and Linnenbrink-Garcia, 2012, pp. 261 – 262).

Cognitive engagement consists of inherently different internal psychological processes from those of affective engagement, in that cognitive engagement acts as the mediating bridge between context and learning outcomes (Connell and Wellborn, 1991; Reschly and Christenson, 2012). Cognitive engagement has been defined as drawing "… on the idea of investment; it incorporates thoughtfulness and willingness to exert the effort necessary to comprehend complex ideas and master difficult skills" (Fredricks et al., 2004, p. 60). Indicators of positive cognitive engagement include observations that a student is purposeful, approaches learning activities with enthusiasm, strives to achieve a variety of learning goals, is a willing participant in learning activities, actively seeks challenges, and exhibits a thoroughness and desire to achieve the best possible learning outcomes (Skinner and Pitzer, 2012). In contrast to behavioural engagement, effort based upon cognitive engagement is defined as a focus upon the learning and mastering of concepts and knowledge (Fredricks et al., 2004). Indicators of cognitive disengagement include a lack of self-direction, presenting themselves as helpless, unwilling or opposed to tackling learning challenges, avoiding or being apathetic during learning activities, and presenting themselves as incapable, incompetent or under undue pressure (Skinner and Pitzer, 2012).

The fourth subtype is agentic engagement. This centres upon the active and volitional cognitive contributions that students make to the learning activities presented by their teacher (Reeve and Tseng, 2011): that is, "…students' constructive contribution into the flow of the instruction they receive [and] …captures the process in which students intentionally and somewhat proactively try to personalise and otherwise enrich both what is to be learned and the conditions and circumstances under which it is to be learned." (p. 258) This, in turn, is predicted by manifestations of cognitive, affective and behavioural engagement, as well as being argued to be an independent predictor of achievement within the classroom. Agentic engagement has been proposed as a form of enacted agency, whereby students make constructive contributions to learning activities (Reeve, 2013; Reeve and Tseng, 2011).

Reeve and Tseng (2011) define agentic engagement as "… the process in which students intentionally and somewhat proactively try to personalise and otherwise enrich both what is to be learned and the conditions and circumstances under which it is to be learned "(p. 258). It can be observed through engagement-indicative behaviours such as:

> "… students might offer input, express a preference, offer a suggestion or contribution, ask a question, communicate what they are thinking and needing, recommend a goal or objective to be pursued, communicate their level of interest, solicit resources or learning opportunities, seek ways to add personal relevance to the lesson, ask for a say in how problems are to be solved, seek clarification, generate options, communicate likes and dislikes, or request assistance such as modeling, tutoring, feedback, background knowledge, or a concrete example of an abstract concept."
>
> (Reeve and Tseng, 2011, p. 258)

While agentic engagement appears to be a behavioural outcome indicative of autonomous motivation, it is also a form of engagement that may reveal insights about student-teacher interactions that create a positive emphasis upon students' autonomous self-regulating and self-directing approaches to the learning of concepts and the mastery of knowledge. Indeed, agentic engagement has been asserted as occurring more frequently in classrooms where students regard their teacher as autonomy-supportive (Fiedler, 1975; Reeve et al., 2004; Reeve and Tseng, 2011). In addition, given that agentic engagement consists of both an unseen, internalised psychological process and observable behaviours, it may be that agentic engagement can be used as a reliable indicator predictive of a positive teacher-student relationship (Reeve, 2013).

As a means of drawing together three of the four subtypes outlined above, academic engagement has been asserted as being the cumulative combination of cognitive, affective and behavioural engagement (Christenson et al., 2008). Interestingly, it has also been proposed that academic, cognitive and affective engagement may be manifested as behavioural engagement which is, in turn, influenced by the students' agentic engagement, as agentic engagement refers to the extent to which a student feels efficacious in self-determining and being successful within active learning contexts (Jang et al., 2010; Reeve et al., 2004; Reeve and Tseng 2011). This is the view of several researchers, each of whom has argued that a full picture of engagement may only be claimed when all components were considered together, rather than in isolation, and in association with potential motivators within classrooms (Fredricks et al. 2004; Guthrie and Anderson, 1999; Guthrie and Wigfield, 2000).

2.5 Engagement within the classroom

Every classroom is a social psychodynamic context, influential upon children's adjustment to learning and to their longer-term perceptions about the value of and competence within learning activities (Connell and Wellborn, 1991; Hughes and Chen, 2011; Hughes et al., 2008). The quality of the teacher-student relationship, in social-constructivist terms, has been frequently asserted as being one a number of key factors which has a direct impact upon children's perceptions of their early school and transition from one stage of their schooling to the next in terms of the impact upon their social, behavioural and academic development (Connell and Wellborn, 1991; Furrer and Skinner, 2003; Hamre and Pianta, 2006; Krapp, 2000; Ladd, 1999). A social-constructivist philosophy refers to the impact that the quality of the teacher-student relationship has upon a student's receptiveness to learning (Biesta and Burbules, 2003; Sleeper, 1986). Where positive teacher-student interpersonal relationships are reinforced and sustained, this can "engender the will to participate cooperatively in classroom activities and to try hard and persist in the face of challenges" (Hughes and Chen, 2011, p. 278). On the basis of this premise alone, the view may be taken that the ability of teachers to influence their students' engagement with learning and to motivate their affective and cognitive investment towards learning goals is a universally desired one across schools (for example, Hamre and Pianta, 2001; Pianta, 1999; Ryan and Deci, 2009; Wentzel, 1998, 2002; Wigfield et al., 2006).

Therefore, the nature and content of the interactions that inform the continued growth or decline of the teacher-student relationship quality may prove to be the key predictor of students' self-attributional expectancies, intrinsic motivation for learning, and engagement-driven efforts to make progress and achieve within the classroom (Fredricks et al., 2004; Jimerson et al., 2003; Reeve, 2012, 2013; Wentzel, 2002). If this proves to be the case, it is argued that such interactions need to emphasize, "…teacher empathy (understanding), unconditional positive regard (warmth), genuineness (self-awareness), nondirectivity (student-initiated and student-regulated activities) and the encouragement of critical thinking (as opposed to traditional memory emphasis)" (Cornelius-White, 2007, p. 113).

The more quickly a positive and supportive teacher-student relationship may be established and has the impact of enhancing the students' sense of competence, happiness and well-being, the more likely it is that the individual will adjust to their schooling in the long-term (Hamre and Pianta, 2001, 2005, 2006; Hughes et al., 2008; Lerner, 1998). The presence of this influential set of variables within the classroom has been shown to be predictive of students' motivation to learn, and the incentive that this provides to engage and sustain their engagement with learning through, for example, the influence of teachers' autonomy supportive learning behaviours (Reeve et al. 2004; Reeve, 2012; Reeve and Tseng, 2011).

It has been asserted that the classroom environment that has an optimal impact upon students' motivation to be autonomous during learning will have a number of key features in place. First, it should enable students to make choices within learning activities, pursue their own ideas based upon interest and enjoyment, and value the work they are doing for its own sake. Second, students should develop a positive and realistic view of their competences and abilities which will, in turn, inform their self-efficacy; that is, their expectations of further success within learning (Bandura, 1997; Jang et al., 2010; Skinner and Belmont, 1993). In terms of expectations, there have been found to be gender differences in relation to the strength of optimism underpinning their competence and self-efficacy perceptions. For example, female students often self-report higher levels of competence regardless of actual achievement (Marsh, 1989; Saunders et al., 2004). The other main difference was the intensity of the teacher-student relationship quality, as it was reported that girls value their social relationship with their teachers more highly than boys (Crick et al., 2007, cited by Hughes and Chen, 2011). Such teacher-student relationships were more likely to be seen by girls as less confrontational and regarded than by boys (Hughes et al., 2006; Silver et al., 2005).

2.6 The motivation to engage with learning activities

As discussed, motivation has been defined as a cognitive and affective force that initiates, sustains and directs engagement behaviours, as an internalised process of formation drawn from the individual's experiences, perceptions and interpretations (Reeve, 2012). The antecedents for engagement are unobservable cognitive and affective processes that can only be observed as outcomes when the student manifests these motivational intentions as engagement-indicative behaviours (Reeve, 2012). That is, that engagement is the outcome of motivational processes informed by contextual influences such as the quality of the teacher-student relationship (Christenson et al., 2012). Such student engagement has been presented as a motivation-driven, perception- and experience-informed construct that is predictive of and predicted by students' perceptions of positive interpersonal relationships (relatedness) at school and the cognitive and affective desire to initiate and sustain participation in a range of learning contexts and activities therein (Fredricks et al., 2004).

Motivation and engagement are usually manifested on the basis of an individual's self-perceptions of actual achievements and perceived competence (Schunk and Pajares, 2005). These two perceptions are purported to act as motivational precursors of self-efficacy, which act, in turn, as predictors of sustained and effortful engagement within an activity (Bandura, 1997). Motivation sequences and competence perceptions, and their impact upon the need to achieve and actual achievement outcomes, appear to be causally interrelated and form the basis of positive or negative affect, which, in turn, will determine the direction and strength of volitional behaviours and engagement (Weiner, 1995). Such engagement involves the expenditure and sustaining of effort which is optimally catalysed when the causes of competence are regarded as controllable.

Self-concept has been confirmed as self-evaluative, multi-faceted and developmental (Shavelson and Marsh, 1986). For example, academic self-concept in relation to classroom-based learning encompasses a combination of self-perception, self-awareness, competence, self-efficacy, self-evaluation and self-appraisal. Academic self-concept has been presented as hierarchical in that self-perceptions vary in terms of intensity and longevity based upon specific domains and the associated expectations of success. This includes specific academic domains and subject-specific self-perceptions (Schunk and Pajares, 2005). As the basis for motivational perceptions to be manifested as behaviours indicative of engagement during learning activities, a student's sense of academic self-concept is typically composed of two informing factors. The first is competence, which acts as an informant of self-efficacy, which, in turn, informs the strength and direction of autonomy. Autonomy is ultimately about self-governance: "… competence conditions specify the psychological details of governance." (Sneddon, 2013, p. 26) The need to be competent, to be regarded as competent and to perceive oneself as being competent all combine to form an optimal motivational basis for self-regulated engaged behaviours and engagement within learning activities (Boekaerts and Cascallar, 2006; Zimmerman, 2001). These lead to a combination of competence-related perceptions, such as perceived agency and control over learning directions and outcomes. The extent to which these are perceived as being positive will often determine the extent to which an individual feels self-efficacious about succeeding within the currently presented and / or future learning activities. These perceptions are translated into motivational intentions which, in turn, are usually manifested as engaged, self-regulated learning behaviours (Zimmerman, 2001, pp. 31 – 32). Mace et al. (2001) presented the view that self-regulation is the same as self-determination, with the pursuit of self-determination resulting in behavioural changes including self-control, self-correction, self-reinforcement, commitment to engaging within learning activities to varying degrees, self-monitoring as the basis for choosing amongst a series of alternative responses, and whether to persist with, delay, modify or cease to be self-regulating. These motivational factors and consequential self-regulated engagement behaviours have been asserted to operate at the level of the individual (Zimmerman, 2001).

Numerous studies have reported a positive correlation between teachers' perceptions of their students' engagement at the classroom level, and the manifested affective and cognitive outcomes of their students (for example, den Brok et al., 2005; Maulana et al., 2011; Wubbels et al., 2006). Two studies, for example, reported a specific relationship between teachers' interpersonal behaviours and students' positive engagement and attitudes to their learning in science (den Brok et al. 2005, 2006b). Whilst van Uden et al. (2013) argued that there is a significant link between teachers' perceptions of their students' engagement and the potential influence of this upon the teachers' interpersonal behaviours towards the students, there remains room for this research area to be developed further by going beyond a study that looks exclusively at teachers' views. This could include measuring students' self-reported perceptions of their reactions to their teachers' interpersonal behaviours towards them, and the impact that this has upon their motivation to engage with learning activities provided by different teachers. In turn, these may be manifested as behavioural engagement outcomes that can be used as a means of measuring the influence of different factors upon students' engagement behaviours. These behavioural manifestations of academic engagement, in turn, can be measurable through classroom observations. These, therefore, could be used as an informed basis for the implementation of classroom-based interventions that predict the enhancement and improvement of students' motivation for and engagement within learning activities (Parsons and Taylor, 2011; Reeve, 2012).

Sustained engagement and involvement in learning activities requires self-regulatory capabilities in anticipation of a successful outcome: known as self-efficacy. Self-efficacy is predictive of the direction and persistence of engagement behaviours: "Efficacy beliefs play a crucial role in the ongoing self-regulation of motivation" (Bandura, 1997, p. 14). The decision to engage in learning activities is based upon the anticipation of success, with such anticipation drawing upon perceived capabilities and prior effectance as the resulting self-efficacy behaviours "…provide a basis for predicting the occurrence, generality, and persistence of [engagement] behaviour" (Bandura, 1997, p. 14). Self-efficacy and its impact upon engagement is discussed within the next section.

2.6.1 The influence of students' perceived competences upon self-efficacy and the resultant motivation to engage with learning activities

Perceived competence is an evaluative self-attribute, informed by cognitive and affective perceptions in terms of "…the individual's actual skill and ability to interact effectively with the environment" (Elliot et al., 2002, p. 363). In this regard, attribution theory outlines the factors that influence the sense of personal control that an individual perceives that s/he has or does not have over the development of self-attributes (Weiner, 1986). These factors include competence and autonomy. Support for competence motivation as a contributory factor within student engagement is a central focus of attribution research. Attributions are posited as the basis for the locus of control and personal causality, in terms of the extent to which an individual perceives that they are able to exert some control over their own learning direction and outcomes (Dweck, 1999). Competence is asserted as a grounded self-attribute, at the heart of which is an innate psychological need to be competent (Dweck and Elliot, 1983; Ryan and Deci, 2000ab). Whether engagement is undertaken for the hope of competence or the fear of feeling or being regarded as incompetent, this still appears to drive a need to achieve and gain mastery within specific domains. The need to feel and be regarded as competent as a basis for individual positive self-regard (Bandura, 2001; Heine et al., 1999). Such perceptions of achievement and competence are dependent upon contextual and internal factors that the student has control over. In its optimal form, this will result in the student feeling more motivated and, as a result, more engaged in their own learning (deCharms, 1968, 1976; Pintrich, 2004; Weiner, 1986). This supports the view that a key role of the teacher is to help students to recognise their own competence and achievements, and to emphasise the part that the student has played in their own successes. There would, therefore, be an emphasis upon the teacher making explicit to the student the outcomes and successes that have been due to the student's efforts and use of learning strategies appropriate to the learning activity (Ryan and Grolnick, 1986).

Competence within school-based activities has been asserted as the basis of the motivational drive to be fully engaged in and make persistent efforts within learning activities (Schunk and Pajares, 2007). An individual's perceived competence forms the basis of both intrinsic and extrinsic motivation orientations, including the preference for challenge, the level of interest, and the preference for independent mastery of concepts and their application within future learning activities (Harter, 1981, 1992). For example, "Those students who did not perceive themselves to be very competent felt relatively bad about their performance and appeared to opt for an extrinsic motivational orientation … These extrinsically motivated individuals showed virtually no self-motivation of either form, intrinsic or internalised" (Harter, 1992, p. 104).

Zimmerman (1995) states that the evolution and sustaining of academic competencies is one of the most demanding motivational and cognitive challenges that developing children face (p. 202). Such perceptions of competence are constantly evolving and are usually informed by factors such as feedback from teachers, personal aspirations, intrinsically motivated goals, self-endorsed values, and a self-determined approach to activities through perceived autonomy-orientated causation. All are informed by and internalised through context-specific experiences and self-perceptions (Reeve, 2012). These may act as the causality orientations within learning contexts, and, especially, a student's predictions regarding a teacher's verbal and non-verbal responses to the student's efforts and achievement. From perceived verbal and behavioural indicators of teacher warmth and expectation, each individual student will form their own worldview of a teacher based upon their experience of prior interactions. This colours the student's perception of the strength of their attachment to each of their teachers, and is likely to influence future responses. The worldview formed is based upon criteria that experience has moulded as a means of interpreting a teacher's intentions, reliability and trustworthiness (Bretherton, 1987).

Harter (1992) argued that a variety of factors have a cumulative influence upon a student's perceived competence. For example, competence may be defined differently according to the nature of the activity being undertaken and the subjective level of importance that an individual has assigned to the activity. It could be defined as the need to achieve a desired level of performance within formal assessments (in relation to performance goals), or competence in relation to mastery and understanding of school-driven and individual curiosity- driven knowledge acquisition (Schunk and Pajares, 2007). Perceived competence is presented as a precursor that informs an individual's sense of self-efficacy in terms of perceived capability of achieving further competence within a specific domain or context, and self-agency, in the form of motivation to be autonomous and self-determined in working towards further competence. These perceptions, motivational drives and need for competence are at the heart of achievement motivation (Elliot and Dweck, 2007b). The stronger and more positive the direction of competence motivation, the more likely it is that an individual's behaviours will be energised and focused in terms of persistence and resilience within learning activities.

With younger students, the primary motivation may be the desire to please the teacher and to attain good grades, as opposed to seeking challenge, autonomy and independent mastery of concepts for their own sake. That is, as the student progresses through each developmental stage, s/he begins to develop a "... tendency to engage in independent mastery attempts versus a tendency to depend upon the teacher" (Harter, 1992, p. 81). Therefore, over the course of a student's passage through the developmental stages, there appears to be an increasing impetus created by self-reward, and that there are "… strong relationships between a child's perceived scholastic competence, affect about school performance, and motivational orientation" (Harter, 1992, p. 108).

An important outcome of perceived competence are an individual's self-efficacy judgements (Bandura, 1986, 1997). These are based upon personal capability, judgements which take into account past and current achievements which, in turn, inform a student's perceptions as to the extent to which s/he may achieve success within, for example, specific learning activities (Zimmerman, 1995). Sources of self-efficacy include perceptions that are related to competence, mastery experiences, performance feedback and verbal persuasion by trusted others through social mediation. Of these, competence and mastery perceptions have been posited as the most influential sources of self-efficacy (Usher and Pajares, 2006). Motivation develops through psychosocial dynamics that vary according to the specific nature of a learning activity, specific points in the chronology of an individual's development within specific learning contexts and with a specific teacher (Ainley et al., 2009).

As discussed above, the influence of self-efficacy upon academic self-concept depends upon the value that the student places upon the learning activity, which may include the importance they assign to being capable within a given area. These self-attributes are often formed retrospectively and are based upon experience-inferred causal beliefs that have been applied by the individual learner to desired educational outcomes. These may take the form of expectations of self-efficacy which are based upon affect and cognition-informed perceptions (Bandura, 1997). Through the lens of SDT, autonomously–motivated engagement is partly explained by students' perceived competence based upon sustained achievement, enjoyment and preference for challenging learning activities as well as the impact of the teacher upon the quality of students' competence-driven motivation to engage in autonomy-rich learning activities (Eccles and Midgeley, 1989).

Self-efficacy is manifested as behaviours such as curiosity verbalised during learning activities, an interest in and an enjoyment of learning, a desire to be independent and to make suggestions as a means of directing his / her own learning, the seeking of challenges, and opportunities to master and understand concepts (Harter, 1992). Teachers may use such behaviours to predict a student's perceptions of self-efficacy prior to and during learning activities, as perceived competence informs self-concept, and can be specific to the academic domain and, there-in, specific to the individual subject within the curriculum (Marsh and Craven, 1997, 2006; Marsh and O'Mara, 2008; Schunk and Pajares, 2007; Valentine et al., 2004). Self-efficacy beliefs develop from a variety of sources including vicarious experiences, social evaluations by teachers and peers, and dynamic self-perceptions of current and future competencies. Such beliefs and influences are dependent upon sociocultural factors, as different contexts, and scenarios and activities therein, will influence the constantly changing dynamics of self-regulatory learning behaviours (Bandura, 1977, 1997). (Self-efficacy differs from attribution theory, in that the former is felt at the individual level whilst the latter is often presented as being applicable at the level of the context (Graham and Weiner, 1996; Weiner, 1974, 1986)).

A reciprocal relationship has been asserted between perceived competence and self-efficacy (Schunk, 1981, 1984), and between students' academic self-concept and subsequent achievement (Marsh and Craven, 1997, 2006; Marsh and Martin, 2011; Shavelson et al., 1976). Self-efficacy perceptions and their impact upon sustained engagement are influenced by perceived competence (Schunk, 1984). Self-efficacy has a strength and direction of certainty, which is based purely upon an individual's judgement of their capability to perform a particular task successfully. Self-efficacious beliefs are context-dependent and have a predictive influence upon an individual's level and persistence of engagement behaviours within learning (Bandura, 1997).

Ultimately, self-efficacy consists of outcome expectations based upon "…one's collective self-perceptions formed through experiences with and interpretations of the environment, and heavily influenced by reinforcements and evaluations by significant other persons" (Schunk and Pajares, 2005, p, 88). Self-directed, self-determined learning and perceived competence enhances an individual's perceived self-efficacy, their rate of problem-solving and subsequent academic achievement (Zimmerman, 1995). In consequence, self-efficacy becomes the impetus for the exercise of control through self-determinism within a network of sociocultural influences, such as the teacher within the classroom, based upon "people's beliefs in their capabilities to produce desired effects by their actions" (Badura, 1997, p. vii). Self-efficacy also influences the rate of performance and the amount of energy expended within learning (Bandura, 1993; Schunk, 1981, 1984. Indeed, higher levels of self-efficacy within a specific learning situation are regarded as indicative of the individual's willingness to readily undertake tasks that they might previously have regarded as challenging or difficult.

Affective perceptions inform the positive or negative quality of self-efficacy, which, in turn, impact upon self-efficacy as an antecedent and the resulting intensity and persistence of engagement. Therefore, self-efficacy and perceived competence have an influence upon and are influenced by affect. This sense of affect may depend upon how attainment is judges against and in relation to the individualised internalised standards and desired attainment levels. That is, although achievement may be tangible and measurable it may be that the overall attainment is regarded by the individual student as falling short of their internalised perceptions of what they regard as a measure of being competent. Therefore, although a teacher may be satisfied with a student's achievements, if the student does not regard the attainment as being of a sufficiently competent level this may lead to discontent and feelings of amotivation and disengagement (Bandura, 1997).

An individual's self-efficacy has been shown as predictive of their motivation to be autonomous, and for the development of self-determined, self-regulating learners who are able to make the most of opportunities to enhance their competence, engagement and social mediation within the classroom (Bandura, 1986, 1997; Connell and Wellborn, 1991; Reeve, 2012; Reeve et al., 2008; Ryan and Deci, 2009). An individual's need for and satisfaction of autonomy is linked to their cognitive and affective perceptions of their ability to achieve self-determined or externally-regulated goals (Bandura, 1997). Therefore, perceptions of competence should act as initiators of persistence, autonomy and sustained engagement during learning activities (Roberts et al., 1981).

Given the important role that perceived competence plays in promoting students' motivated engagement and desire for autonomy, the teacher plays an essential role in encouraging the student to approach learning activities in an optimistic, self-efficacious way, such that "...self-directed learning is supplemented with instructional social influences that can affect children's beliefs of their cognitive efficacy" (Bandura, 1997, p. 215). This includes pedagogical methods that may include the teacher modelling strategies for academic success, including higher-order thinking skills, and performance feedback that enables the student to internalise expected standards as a basis for self-reflecting upon his/her own competencies. The nature and use of timely feedback by the teacher, as children with the same levels of cognitive skill have been found to differ in the quality of their academic performance on the basis of differing perceptions of self-efficacy (Bandura, 1997, p. 216). The mediating psychological links between perceived competence, self-efficacy and autonomy may be regarded as predictive in that the greater the individual's awareness of their competence, the more motivated that person is likely to be in terms of wishing to exercise their autonomy and to be positively engaged in their learning (Sneddon, 2013, p. 50). Autonomy is, therefore, an outcome of an individual's academic self-concept, and is primarily informed by the strength and direction of his / her sense of self-efficacy (Bong, 1997; Bong and Skaalvik, 2003).The implication, therefore, is that a positive teacher-student relationship should be based upon the enhancement of children's self-efficacy within a specific domain, their enhanced belief in their ability to interact prosocially with their teachers, and positive motivational beliefs regarding their autonomy within their learning activities (Harter, 1978; Raider-Roth, 2005; Schunk and Zimmerman, 1998, 2008; Zimmerman and Schunk, 2001a).

Elliot and Dweck (2007b) contend that achievement should be viewed through the lens of competence as the mediator from motivation to engagement. This postulation has been based upon the hypothesis that competence-relevant behaviours appear to be the manifested outcomes of motivational energy for self-regulatory learning influenced by a continuum of perceived competence: an individual may be equally motivated by positive perceptions of competence and demotivated by feelings of incompetence. The need for competence acts as a motivational incentive, directing and energising engagement ((Elliot and Church, 1997, 2002; Elliot and Dweck, 2007ab; Kuyper et al., 2000; NRC, 2004; Pajares, 2008; Zimmerman, 2001).). The likelihood of motivational perceptions being translated into engagement behaviours appears to be enhanced by goals and learning strategies which result in experiences and outcomes that will continue to satisfy the need for competence (Boggiano and Pittman. 1992; Zimmerman and Schunk, 2001). These perceptions of competence are argued to act as the basis of self-efficacy (Bandura, 1997; Elliot and Dweck, 2005). Equally, an avoidance of engagement in learning activities may be based upon negative perceived competence within similar prior learning activities. Such resultant amotivation or avoidance may lead to affect based upon feeling ineffectual, incapable and insufficient, and, in turn, to the manifestation of behaviours indicative of demotivation and disengagement.

The question arises as which is the precursor and / or is the more influential of the two: perceived competence or self-determined motivation within learning activities? This long-standing question was used by Vallerand and Reid (1984) within their study of perceived competence. They found that positive performance feedback from the teacher led to students' self-reported perceptions of enhanced competence, which then led to increased perceptions of intrinsic motivation (Vallerand and Reid, 1984). This suggests that perceived competence may have a mediating effect upon intrinsic motivation, where the student develops the view that learning activities are enjoyable for their own sake (Deci and Ryan, 1980). This view may be based upon the hope and / or anticipation of further competence-based success, especially when one notes that perceived competence explained a 40 % variance in intrinsic motivation while positive performance feedback accounted for less than 8 % of the variance (Vallerand and Reid, 1984, p. 99). However, competence has also been found to be dependent upon the feedback that a student receives from a teacher, as this appears to influence internalised cognitive and affective constructs. Therefore, performance feedback, as a situation-specific sociocultural variable, has an influence upon the internalised, self-attribute of perceived competence which then determines the individual's involvement in a learning activity through a sense of intrinsic motivation (Vallerand and Reid, 1984).

2.6.2 Promoting students' engagement with learning through the reciprocal development of the teacher-student relationship and the enhancement of students' perceived competence

The contextual perceptions that inform students of the extent to which learning scenarios are likely to be motivating and engaging evolve from experience-informed interpretations. These are specific to different areas of the students' schooling from wide generalisations relating to the curricula subject to more specific, perceived situational variables, such as the current learning task and the students' view of the teacher leading the lesson. Such interpretations will have been informed by and will lead to affective and cognitive responses. These responses have been shown to impact upon the quality of students' self-determined motivation, and its translation as manifested engagement, the quality of autonomous motivation, and self-regulated learning behaviours predictive of motivation (Appleton et al., 2006, 2008).

For a classroom sociocultural context to be predictive of engagement and achievement, it has been posited that students should perceive that there is a relevance and value to learning activities; a positive emotional climate within which students perceive a warm caring interpersonal relationship with their teacher; that the teacher is attuned and responsive to the individual responses and needs of students; that the students are making academic progress and are capable of making further progress (both independently and through teachers' autonomy-supportive behaviours), and; that the students enjoy the time they spend in the classroom with that teacher (Pianta et al., 2012, p. 373; Reeve, 2009, 2012; Reeve and Halusic, 2009). Primarily, in order to promote a positive cumulative and reciprocal teacher-student relationship through the enhancement of students' perceived competence, teachers should aim to support and encourage students through the enhancement of students' abilities to internalise the standards necessary for recognising and celebrating their competence within current learning activities. Such standards appear to act as a basis for positive self-efficacious decisions when faced with further similar learning activities. These contextual factors are likely to have a reciprocal impact, in turn, upon students' perceived competence (Hipkins, 2012; Hughes et al., 2011; Lam et al., 2012).

A number of studies have suggested there is a bidirectional, reciprocal motivational relationship between high-quality teacher-student relationships and students' receptiveness to teachers' instructional and pedagogical methods (for example, (Skinner and Belmont, 1993). This reciprocal relationship has been shown to result in motivation-driven engagement behaviours synonymous with self-regulated learning and the achievement of learning outcomes within activities. In turn, this relationship between the motivation to learn, engagement responses and behaviours, and self-regulated learning appear to be both reciprocal and reinforcing (Marsh et al., 1998; Marsh and Craven, 2006; Marsh and Dowson, 2009; Marsh et al., 2007; Marsh and Martin, 2011; Marsh and O'Mara, 2008). The positive evolution of such reciprocal relationships is, in the main, informed by teacher support and competence-enhancing behaviours, which may be utilised by teachers as a means of improving the student's progress and associated achievement levels (Pelletier et al., 2002; Pelletier and Vallerand, 1996; Reeve, 2012; Reeve and Tseng, 2011; Skinner and Belmont, 1993). The quality of the interpersonal relationship between teacher and student has been posited as reciprocal in another way, in that the teacher is more likely to continue to respond to and support a student who has exhibited positive responses to the teacher's efforts and the subject(s) they teacher (Cole and Maxwell, 2003). A number of researchers have posited that behaviour in social settings, such as a classroom, is reciprocal, in that there is not a simple linear causal model whereby teacher attitudes and behaviours have a unidirectional influence upon student responses, outcomes and achievements (Ashton and Webb, 1986; Bronfenbrenner, 1976; Carew and Lightfoot, 1979; Cohen, 1972; Skinner and Belmont, 1993). They propose, that for a reciprocal socially mediated, interactive relationship to be positive, supportive learning contexts are essential, where teachers consistently place an emphasis upon students' motivation during learning activities through the satisfaction of basic psychological needs for positive relationships and to feel competent. In terms of the latter, there appears to be a reciprocal triadic relationship between perceived competence, self-efficacy and academic self-concept (Hughes et al., 2011, p. 288).

Further to the above, Marsh and Martin (2011) have proposed a reciprocal effects model (REM) of the motivational relationships between students' academic self-concept, engagement with learning, and their academic achievement. The reciprocal pattern of motivational relationships that Marsh and Martin (2011) posit between self-concept and performance within their REM both supports and is supported by similar self-attribute and self-belief research (for example, Bandura, 1997; Eccles and Wigfield, 2002; Harter, 1998; Hattie, 1992; Skaalvik et al, 1996; Valentine and DuBois, 2005; Wigfield and Eccles, 2002). Indeed, the findings of Valentine and DuBois (2005) support the conclusions and theories of Bandura (1997), Craver and Scheier (1981) and of Deci and Ryan (1985). All four studies argue that the self-concept has a causal influence upon academic self-concept and academic achievement, and the motivational relationships informing these are reciprocal in nature. This reciprocal relationship informs the cognitive and affective responses that have an impact upon how people decide upon their perceived competence and self-efficacy during current and future learning activities (Marsh and Craven, 2006; Marsh and Martin, 2011; Marsh and O'Mara, 2008).

The nature of the feedback that teachers give students has a significant impact on students' level of intrinsic motivation via the influence that such feedback has upon their perceived competence and resultant self-efficacy (Ryan et al., 1985; Ryan and Deci, 2009). Specifically, positive feedback that teachers give in response to students' performances results in increased perceptions of competence and a corresponding increase in intrinsic motivation. Similarly, informational feedback given in response to students' performance errors should be given in such a way that it results in an increase in students' perceptions that they themselves can control future performance outcomes which should then increase students' level of intrinsic motivation (Horn, 1987, 1992). In addition, Hughes et al. (2011) has stated that self-perceptions of academic competence and self-efficacy should each be regarded as reciprocally influential upon the other, as self-efficacy and self-concept arise from feelings of perceived competence (Bandura, 1990, 1997; Harter, 2012b; Marsh and Craven. 2006). Therefore, enhancing positive academic self-concept, perceived competence and self-efficacy is partially informed by teachers' feedback, which, in turn, has a reciprocal influence upon students' motivation for learning activities (Marsh et al., 2006; Marsh and Martin, 2011). These reciprocal influences have an impact upon sustained engagement with learning activities, which is predictive of subsequent achievement gains (Marsh and Craven, 1997, 2006; Skalvik and Hagvet, 1990). The motivation to engage with learning activities is both domain-specific and subject-specific (Valentine et al., 2004). The above mediating variables should have an impact upon the resultant nature of students' perceived competence and self-efficacy, and, therefore, influence the quality of competence motivation at an intrapersonal level (Bandura, 1997).

Finally, students' positive or negative experiences of prior achievement within specific areas will have an impact upon their self-efficacy, which, in turn, will influence their perceived chances of success during new learning activities (Bandura, 1997; Hattie, 1992; Harter, 1999; Marsh and Craven, 2006; Marsh et al., 1999; Reeve et al., 2008; Valentine et al., 2004). The impact of such perceptions appears to be the same regardless of the age, school level and type, and cultural background of students (Guay et al., 2003; Marsh and Craven, 2006). This matches the evidence from extensive SDT-based empirical research: that the satisfaction of the three SDT basic psychological needs in the classroom has a motivational impact upon students' engagement regardless of age, ability, SES and culture (Ryan and Deci, 2000, 2009).

2.7 The influence of teachers' autonomy-supportive behaviours upon students' engagement with learning activities

Students' receptiveness to a teacher's autonomy supportive behaviours has been directly linked to the quality of their perceived competence. This, in turn, appears to influence their motivation to be autonomous (Deci et al., 1981) In addition, the quality of a student's motivation to be engaged in learning activities has been asserted as being based upon the quality of intrinsic motivation and the degree of satisfaction of basic psychological needs for relatedness, competence and autonomy support (Reeve, 2002, 2012). These innate motivations are supplemented by evolving sources of motivation: such as personal aspirations, intrinsically motivated goals (that the student pursues for the sheer enjoyment of involvement and achievement), and perceived volitional causation. These lead to perceptions informed by and internalised through self-reflection and experiences within the learning environment. For example, a student's perceptions that are informed through prior experiences will influence his / her interpretations of the teacher's verbal and non-verbal responses to the student and the academic work that the latter has undertaken (Reeve, 2012). The persistent quality of student motivation is transformed into high-quality behaviours predictive of student engagement which are influenced by a variety of mediating variables within the learning environment. These mediating variables include the "… twin desires to interact effectively with the environment and to grow as a person and as a learner" (Reeve, 2012, p. 158).

A number of empirical studies have supported the view that a student's perceived competence acts as a motivating basis for receptiveness to a teacher's autonomy-supportive provision and behaviours (Grolnick and Ryan, 1987; Handre and Reeve, 2003; Ryan and Grolnick, 1986; Vallerand et al., 1997). For example, Grolnick and Ryan (1987) reported an association between the autonomy-supportive learning environment and the rapid development of both conceptual learning and enhanced interest. This led to enhanced feelings of competence through the students' perceived internal locus of causality. Where a teacher develops learning environments that afford opportunities for students to exercise their own autonomy within activities, higher achievement scores were found compared to an environment where the teacher exhibited mainly controlling behaviours. It has been proposed that a teacher's encouragement of students' autonomous behaviours has a positive effect upon students' sense of well-being and satisfaction within learning contexts (Jang et al., 2009).

Teachers' controlling behaviours are regarded as extrinsic motivation. Such behaviours include dictating the pace and direction of students' learning, giving frequent directives as to which learning strategies should be utilised, and not allowing students the opportunity present independent or critical opinions (Assor et al., 2002, 2005; Reeve, 2006). It was found that where students' perceived their teacher to be exhibiting direct controlling behaviours, the students responded negatively leading to emotions, such as anxiety and frustration. This often led to amotivation and a corresponding decrease in academic engagement and increase in disengagement with learning (Reeve, 2006). In addition, Reeve (2009) states that, further to the empirical investigation of the influence of the teacher-student relationship upon student engagement, the most important aspect of the teacher's approach to learning is whether s/he is autonomy-supportive or controlling within learning activities [supported by, for example, Reeve and Alusic (2009), and Vansteenkiste et al. (2004, 2005)].

The combined impetus for particular teacher behaviours in association with students' desired perceived competence and autonomy has been discussed within the majority of the aforementioned studies. This regularity of discussion points towards the potential interplay between each. This, in turn, led to the selection of a sociocultural motivational theory that not only encompasses the teacher-student relationship, competence and autonomy but also has an impact upon students' motivated engagement with learning activities (Reeve, 2012).

2.8 The selection of a social motivational theory that encompasses teacher behaviour influences upon students' engagement with learning

To investigate the motivational relationships between the impacts of teacher behaviours, the teacher-student relationship, perceived competence and autonomous motivation upon students' engagement with learning, a single motivational theory that encompasses them all has been selected. This theory may reveal if factors such as autonomy, competence and the teacher-student relationship have equal influence upon students' engagement with learning. The desire to choose a single theory rather than an emergent synthesis of numerous similar motivational theories was driven by the incentive of its potential ease of use by busy teachers within their own classrooms. That is, a theory that has a limited number of motivational constructs that teachers recognise as being central to engaging classroom learning. Such a theory would form the basis of evidence-informed practice within classrooms, in that the tenets of the theory may enhance teachers' understanding of which behaviours and methods are more likely to increase their students' engagement with learning, and, equally as important, why. In addition, teachers could use a single theory to inform research within the classroom that draws upon student responses.

This, therefore, involves the choice of a theory that can satisfy two important criteria. The first is that it should encompass both individual self-attributes and needs, such as competence, and teacher behaviour variables such as relatedness, in order to illuminate the relationships between motivation, self-regulated learning behaviours and engagement with learning. The second is that the student responses arising from theory-informed methods could be used by teachers within their own classrooms as a basis for informing and improving their professional practice, in that they become more confident in the use of pedagogical methods that enhance their students' motivated engagement with learning activities. Self-Determination Theory (SDT: Ryan and Deci, 2000) satisfies both criteria.

2.8.1 The central tenets of Self-Determination Theory

SDT presents itself as a viable theoretical framework for explaining motivation and associated engagement within a variety of social educational environments. SDT has been tested through inummerable experimental studies, observational research, and SDT-informed interventions predicted to enhance self-determined motivation within specific contexts (Reeve, 2002, 2012). For example, the extent to which school teachers responded either positively or negatively to their students' motivational needs were found to be predictive of the corresponding influence upon the students' competence- and autonomy-related motivation levels within the classroom (Reeve et al., 2004; Ryan, 1995). It is also a theory that integrates both basic psychological needs and social-cognitive constructs (Pintrich, 2003b). A clear distinction is made between the *quality* and *quantity* of motivation whereby the quality of motivation may be determined on a continuum where engagement behaviours are predictive of how motivated an individual is likely to be within a given context and activity therein. In addition, SDT specifies the factors and variables within the social learning environment that have both positive and negative affects upon human perceptions, the quality of motivation and, in turn, behavioural and emotional responses (Ryan and Deci, 2000, 2009).

SDT is a theory of human motivation and personality that encompasses a continuum from proactive intrinsic motivation via passive extrinsic motivation to inactive amotivation, and is both predictive and indicative of an individual's sense of relatedness, perceived competence and behavioural regulation within a specific sociocultural environment (Deci and Ryan, 2002). SDT involves the psychological and philosophical interplay of three basic psychological needs: relatedness, autonomy and competence. These have been described as specific nutriments that act as a basis for understanding the dynamics underlying the interpretations that students form within their social classroom environments, and may be utilised as predictors of motivation and engagement (Deci and Ryan, 2002).

SDT is an organismic, dialectical metatheory (Deci and Ryan, 2002, 2009). The term *organismic* is defined as the presence of innate, basic psychological needs: in the case of SDT, this relates to the innate, psychological need of an individual to be effective and to be able to enhance their potential. *Dialectical* is sociocultural gravitation towards teachers who provide a supportive learning environment where students perceive that their academic self-concept is being enhanced and promoted (Deci and Ryan, 2002). SDT is founded on the assumption that individuals are actively oriented towards personal growth and the need to be self-determining of their actions. However, individuals vary in the degree to which they are regarded as self-determined, and, by contrast, may equally be seen to reactive and passive within environments that do not satisfy their need for competence and autonomy (Ryan and Deci, 2002, 2009). The empirical testing of SDT within a variety of sociocultural domains has "… led to the explication of processes and conditions that promote effective functioning and psychological health, and in doing so have shed further light on the psychological nature of human freedom and connectedness" (Deci and Ryan, 2002, p. 433).

SDT differs from other sociocultural motivation theories in two distinct ways (Ryan and Deci, 2000). First, it considers the *quality* of the unseen motivational regulator as opposed to the *quantity* of the motivational regulator. A distinction is made between the different qualities of motivation, which range along a continuum from the most positive quality, fully self-determined motivation, to the most negative quality, amotivation (Ryan and Deci, 2009, p.173). Often, there is an interactive dynamic between intrinsically motivated learning behaviours and extrinsically motivated self-regulated learning behaviours (Ryan and Deci, 2009; Schunk and Zimmerman, 2008).

Second, it is the only motivational theory that centralises the importance of autonomy in the form of an individual's self-regulated, volitional and sustained engagement in an activity. The three different constructs of SDT – relatedness, competence and autonomy – centre upon the degree to which an individual perceives that their basic psychological needs are being satisfied or thwarted, and the influence that these perceptions have upon self-system processes such as self-efficacy, achievement and motivation for learning. In turn, these determine the extent to which these are predictive of regulated behaviours that are indicative of engagement within the classroom (Reeve, 2012; Ryan and Deci, 2009).

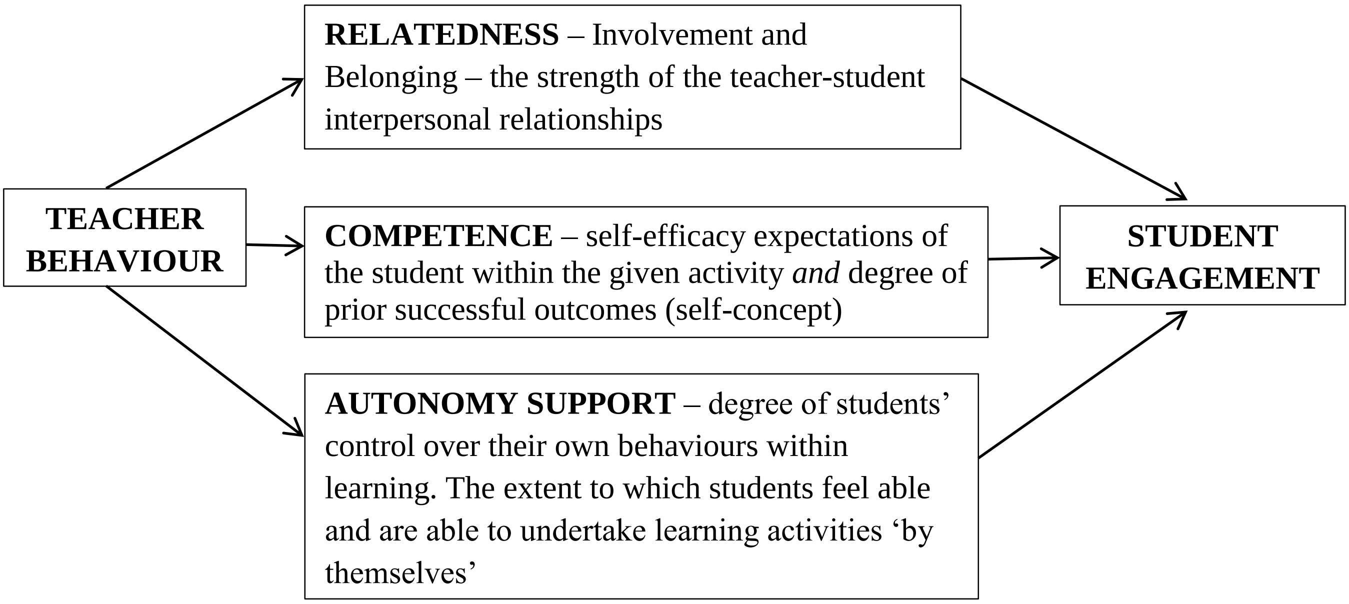
Where the three basic needs of SDT are perceived as being satisfied and sustained, it is predicted that this will result in an individual developing a more elaborate, informed self-concept and perceiving that they are more intrinsically self-determined. Within the classroom, this can be mediated by the relational and learning methods afforded by a teacher who provides clear, specifiable teacher behaviours that will support and enhance an individual's innate tendency to be self-determined and self-regulated (Ryan and Deci, 2002, p. 5). Self-regulated engagement has been asserted as indicative of a strong sense of self-determination which is, in turn, predictive of an individual's positive perceptions of autonomy, competence and relatedness (Deci and Ryan, 1991; Ryan and Deci, 2000). By contrast, where an individual perceives that their needs are being thwarted by, for instance, a teacher, or the learning activities are prescriptive and prevent study motivated by interest, this results in behaviours indicative of amotivation, disinterest and disengagement.

2.8.2. The three constructs of SDT

SDT proposes that the satisfaction of the three basic psychological needs promotes the internalisation of intrinsically and extrinsically motivated values, resulting in behaviours that predict engagement-indicative behaviours. Within the remainder of this section, the three SDT constructs are discussed in relation to classrooms and schools.

Central to SDT is the assertion that an individual will feel motivated to engage in learning when the three specific innate, basic psychological needs are satisfied through the provision of a supportive sociocultural environment (Ryan and Deci, 2000, p. 68). These basic needs are generally met in classrooms when three specific aspects of teacher support are in place (see Figure 2.1. below). These have been widely affirmed as having a positive impact upon student engagement with learning; competence, autonomy supported and relatedness (Deci and Ryan, 1985, 1991; Ryan and Deci, 2000, 2002, 2009; Skinner and Belmont, 1993).

Figure 2.1 *The motivational influence of the three SDT constructs upon student engagement within classrooms*



These specific needs have been defined as "… innate psychological nutriments that are essential for ongoing psychological growth, integrity, and well-being" (Ryan and Deci, 2000, p. 229), and are argued as being central to motivation being enacted as autonomous, engaged behaviours. The three basic psychological needs are regarded as highly interrelated, and in most contexts, at the global level, as only predictive through SDT (Baard et al., 2004; Weinstein and Ryan, 2010).

2.8.2.1 Competence

Competence is integral to many sociocultural motivational theories (Elliot et al., 2002; Spangler, 1992). Competence is, within the current research, defined as the psychological need to feel effective and confident within learning activities. That is, within the current research, the need for competence is regarded as a need to feel competent: for brevity, the term ‘perceived competence’ is used throughout this thesis. When students feel competent, they perceive that they are capable of successfully performing within and completing a learning task (Ryan and Deci, 2002). Competence involves being able to achieve effectively within activities that are valued by the student or within activities where success is required and determined by, for example, the teacher (Painter, 2011). Competence and the motivation to be competent are both context and domain-specific, especially motivation in relation to, for example, the achievement of proximal and distal goals (Skinner and Edge, 2002, p. 397). Perceived competence is informed by and is a cognitive informant of self-efficacy and self-concept, which combine to create motivational energy as a basis for self-regulated learning (Schunk and Zimmerman, 1989, 1998, 2008). Competence may be influenced both by perceptions of past performance and the desire to be effective in the future, with past and future reciprocally informing the other, and leading to further motivation to achieve, as “people’s *experiences* of effectance and autonomy are critical determinants of motivational processes …” (Deci and Ryan, 1992, p. 9: authors’ italic emphasis).

Competence is the only self-attribute of the three SDT basic needs, and is asserted as the basis of the motivation to acquire enhanced competence: competence motivation (Weiner, 2000, 2007). Competence motivation is defined as the need for mastery within contexts where the acquisition of knowledge and / or skills is regarded as important (Urdan and Turner, 2007, p. 297). It is manifested as the need to develop, demonstrate or attain competence. Such motivation appears to act as an inner drive that initiates and sustains behaviours oriented towards enhanced competence (Elliot et al., 2002, p. 361; Elliot and Dweck, 2005).

Levels of perceived competence are predicted by students’ self-reported confidence or anxiety together with the level of the challenge, relational support by the teacher and the degree of autonomy afforded when students have the free choice of selecting learning tasks (Harter, 2012a). For example, students who reported lower levels of confidence than other students revealed that they felt more anxious and worried when faced with new learning tasks, their perceptions therefore being mediated by affective responses. When these students were given a free choice of learning challenge, they, as predicted, chose the less challenging, easier tasks. When the students were asked why they had made these choices, their responses were indicative of lower self-efficacy and having a narrow comfort zone within learning activities (Harter, 2012a). By contrast, students who reported higher levels of confidence with their academic competence also reported affective responses indicative of their confidence. These students, again as predicted, selected more from the challenging, more difficult collection of learning tasks, and they also reported that they had chosen these based upon their confident self-efficacy. From this, it may be that perceived competence influences the extent to which a student feels self-efficacious and predicts the level and rate of progress in terms of academic achievement. The mediating variables throughout were affective as relatedness, competence and achievement influenced self-conscious and externally-directed emotions, and in turn influenced the self-efficacious drive for further achievement in a reciprocal effects cycle (Harter, 2012a).

The perceived competence levels of students are correlatively influenced by the frequency and types of feedback that they receive from their teachers. For example, students reported that they perceived greater levels of competence when their teachers gave positive feedback regarding their performance. When teachers gave positive feedback, this led to students' reporting enhanced levels of intrinsic motivation whilst negative feedback had a corresponding negative impact upon intrinsic motivation (Vallerand and Reid, 1984). In addition, students reported higher levels of intrinsic motivation when offered opportunities to make their own decisions within lessons (Goudas et al., 1994). Therefore, it appears that an individual's sense of control and self-efficacy is based on their perceived competence through social support within a positive sociocultural environment (Skinner and Edge, 2002).

The extent to which an individual's domain-specific competence is positive forms the motivational impetus for an individual to desire autonomy (Reeve, 2002). That is, the more positive an individual's perceived competence, the more positive will be their desire to be autonomous. By contrast, negative perceptions of competence are antecedents for an avoidance of the need to be autonomous: the student will be amotivated (Reeve, 2002, 2012; Ryan and Deci, 2009).

2.8.2.2 Autonomy

Autonomy is the psychological need to feel agentic through being able to exercise some freedom of choice and to make contributions to learning activities (Skinner and Edge, 2002). Autonomy refers to self-determined choices, rather than being based upon or driven by external controls, where choices are either limited or heavily directed by teachers' controlling behaviour (Hodgins et al., 2010; Sneddon, 2013). An individual's autonomy may be regarded as being autonomously motivated when involvement in an activity is both self-initiated and self-regulated, and that the more autonomously motivated a person regards themselves as being, the more intrinsically motivated they will be to engage an activity (Ryan et al., 1995). However, autonomy is not the same as independence: the latter being the ability to undertake and potentially complete a task or activity without external help from, for example, a teacher.

Within the classroom, autonomous motivation is the specific desire to be autonomous when afforded opportunities by the teacher during learning activities, and is a potential pre-cursor to self-determined motivation (Standage et al., 2003). Autonomous motivation can be domain-, subject- and task-specific, and depends upon informing perceptions within a context: these include perceptions of competence, particularly self-efficacy, the teacher (including the quality of the teacher-student relationship and the student's expectations that concepts will be taught effectively), and the relation of learning goals to the student's personal academic achievement goals (Koestner et al., 2008). Ntoumanis (2005) suggests that autonomous motivation is composed of the combined influence of intrinsic motivation and identified regulation. The latter is defined as representing "behaviors with high degree of self-determined motivation … Individuals with high identified regulation have internalised the value of certain behaviors that they perform out of choice but without necessarily enjoying them" (p. 444).

When a teacher provides learning activities within an autonomy supportive learning environment, students' needs for autonomy are satisfied, which, in turn, can lead to engagement with learning through self-regulatory learning strategies, mastery of the concepts encountered, and enhanced academic learning and achievement (Assor et al., 2002, 2009; Reeve, 2009b; Reeve et al., 2014; Ryan and Deci, 2009, p. 175; Schunk and Zimmerman, 2008; Vansteenkiste et al., 2004). Teachers who are regarded as autonomy supportive "… tend to adopt their students' perspectives, welcome their students' thoughts, feelings and actions into the flow of the lesson, and support their students' developing capacity for autonomous self-regulation" (Reeve et al., 2014, p. 94). This should result in the self-determined motivation of students to engage with learning activities through self-sustained persistence and efforts, and includes offering explanations, using concept-based, subject-specific language, and being prepared to reassess and use alternative strategies when investigations and ideas do not meet their initial predictions (Reeve, 2009b; Reeve et al., 2014).

A teacher's autonomy-supportive behaviours include "… to listen more, made fewer directives, responded more to students' questions, attended more to students' wants, resisted giving problem solutions to students, made more statements that implied perspective taking, and were generally more supportive of the students' initiatives" (Ryan and Deci, 2009, p. 184). Indicators of a teacher who is autonomy supportive as opposed to controlling include an afforded learning environment where "teachers and students interact freely and respectfully, students spend time focused on their own work in an interested way; students take initiative, and teachers respond to students' initiations. In short, the classroom climate feels accepting, supportive, and encouraging, and students respond positively" (Ryan and Deci, 2009, p. 183).

Conversely, teachers who have a controlling motivating style "… tend to adopt only their own perspective, intrude into their students' thoughts, feelings and actions, and pressure their students to think, feel, and behave in a teacher-prescribed way …" (Reeve et al., 2014, p. 94) Numerous studies have shown that "… being more controlling with externally regulated students has been found to only further undermine their self-motivation ….adding salience to extrinsic goals in the teaching extrinsically oriented students only further takes them away from being personally engaged in learning" (Ryan and Deci, 2009, p. 183). These controlling behaviours include actions such as the use of external rewards and incentives to work or behave in a teacher-desired way, the use of controlling language that the student may regard as restrictive or offering no opportunity to make a constructive contribution, and showing impatience when students do not work at the pace expected of them or wish to work in a way that is an alternative to the teacher's preference (Reeve, 2009b; Reeve et al., 2014).

2.8.2.3 Relatedness: Teacher-Student Relationship Quality

For the purposes of the current research, relatedness is defined as the quality of the teacher-student relationship as perceived by the student (Hughes et al., 2008; Painter, 2011). A positive teacher-student relationship is likely to enhance an individual's capacity, desire and fundamental need to seek, initiate, sustain and gain affective satisfaction, such as pleasure, from interactions with teachers within a supportive sociocultural learning environment (Ainsworth, 1979; Bretherton, 1985; Skinner and Edge, 2002). The satisfaction of the posited need for such relatedness relies upon the extent to which an individual perceives a sense of belonging and connection with teachers and peers within formal learning settings (Ryan and Deci, 2009). Relatedness is the only non-instructional construct of the three within SDT but may, equally, be the most important, in that without a positive teacher-student relationship, including trust and perceived worth of the relationship, students are less likely to be receptive to support and the learning activities in place within a specific context (Birch and Ladd, 1996; Connell and Wellborn, 1994; Ladd et al, 1999; Pianta, 1992; Skinner and Belmont, 1993; Wentzel and Asher, 1995). For example, Reeve (2012) states that the "… student-teacher dialectical framework within SDT [can be used] to explain how classroom conditions sometimes support but other times neglect and frustrate students' motivation, engagement, and positive classroom functioning" (p. 149). Zhang et al. (2012) argue that "… teachers can play an important role in shaping and promoting students' self-determined motivation and achievement outcomes by providing support that satisfies these three innate needs." (p. 332), a view shared by Standage et al. (2005) and Shen et al. (2010). It has been argued, further to the study by Deci et al. (1992), that the teacher has a stronger influence upon students' engagement with learning than parents: "… teacher variables tended to be stronger than mother variables in predicting motivation and well-being of junior and senior high school students." (p. 181)

Ryan and Deci (2009) assert the influence of teacher variables as the basis for predicting students' motivation and well-being: "…both the social-contextual and personal motivation variables central to SDT have been found to predict engagement, performance and well-being" (p. 181). A variety of studies have considered and drawn the same conclusion: that the teacher plays the central, pivotal role in providing and developing supportive learning environments, and activities therein, which nurture students' self-determination to master and understand knowledge through a combination of interest, enjoyment and engaged effort (for example, Cox and Williams, 2008; Linkonnen et al., 2010; Zhang et al., 2012). The extent to which the teacher-student relationship quality is perceived as positive by the student has an impact upon their effortful engagement with learning activities (Hughes et al., 2008, p. 2). This view evolved from research stating that the teacher-student relationship quality is the key factor central to students' prosocial and academic behaviour (Birch and Ladd, 1997, 1998; Hamre and Pianta, 2001; Howes, Hamilton and Matheson, 1994; Hughes et al., 2008; Pianta, Steinberg and Rollins, 1995).

Skinner and Edge (2002) brought the reciprocal influences of relatedness and competence together in such a way that relatedness and competence are the basis of intrinsic motivation and the efficacy-informed desire and capacity to be autonomous. That is, the extent to which an individual perceives that s/he is both emotionally involved in a positive teacher-student relationship and that they have the self-efficacious competence to succeed and achieve within further learning activities will influence the extent to which autonomous motivations and actions are energised and sustained. Therefore, autonomy was posited as a potential outcome of relatedness and competence, which, in turn, may be the basis of intrinsic motivation and the efficacy-informed desire to be autonomous (Skinner and Edge, 2002).

Social contexts, where the behaviours of a supportive teacher afford a positive classroom environment, are, therefore, strongly asserted, within the substantive research, as the basis of sustained engagement (Connell and Wellborn, 1991; Guay et al., 2013; Skinner and Edge, 2002). For example, where a student perceives a strong, trusting relationship with their teacher, this has a corresponding predictive influence upon their perceived competence. Conversely, if the student perceives a negative teacher-student relationship, the student self-reports a corresponding sense of incompetence within subjects taught by that teacher (Skinner and Edge, 2002). On this theme, a number of established SDT researchers have proposed that the relationship between motivation and engagement is a reciprocal one (Reeve, 2002, 2012; Marsh and Martin, 2011; Reeve, 2012).

It may be that the student internalises values, goals and behaviours which combine and manifest as self-regulated learning behaviours on the basis of the extent to which the relationship with the teacher is regarded as positive or negative. Where the student regards the teacher-student relationship as negative, this internalisation appears to form the basis of extrinsically regulated learning behaviours, and may be more strongly influenced by peers (Reeve, 2002). The balance between intrinsically and extrinsically motivating learning activities has been shown to have implications for students' self-determined engagement with learning (Ryan and Deci, 2009). However, the findings reported by Ryan and Deci (2009) have been based mainly upon survey responses alone, and have left a potential gap in terms of defining and understanding the potential links between teachers' relational behaviours and supportive methods that enhance students' motivation to learn and to persistent in their engagement within learning activities (Deci et al., 1991; Patrick et al., 2005; Tessier et al., 2010; Urdan and Turner, 2007).

In summary, SDT is a theory that combines the three elements of autonomy, competence and the quality of interpersonal relationships within the classroom in such a way that may prove attractive to teachers, as it has the potential to inform teachers' and researchers' understanding of the behaviours and methods that they can implement to enhance students' motivation for and engagement with learning processes and activities. This is further to the gap for further investigation, as Black and Deci (2000) have asserted, that a student's perception of a positive teacher-student relationship, competence and autonomous motivation have a positive predictive influence upon engagement and achievement outcomes.

2.8.2.4 Types of extrinsically motivated regulation within the SDT continuum

In developing SDT, the authors were keen to define the optimal psychological and sociocultural factors which could promote internalisation of the motivational mechanisms leading to self-regulated behaviours such as persistence, effort, resilience and other similar behaviours that are indicative of engagement (Ryan and Deci, 2000). In consequence, it was proposed that different forms of engagement, including the intensity and sustained nature of engagement, were indicative of and could be used to predict the specific form of motivation leading to self-determined motivation. As stated, unlike other sociocultural motivation theories, the quality and type of motivation is asserted within SDT as being more important than the quantity of motivation, through a continuum of motivation from positive intrinsic motivation, autonomous motivation, controlled motivation and extrinsic motivation, through to negative amotivation. The continuum from external regulation to integrated regulation was originally developed within organismic integration theory (OIT: Ryan and Connell, 1989). While cognitive evaluation theory (CET: Deci, 1975) focused on the effects of identified mediating sociocultural variables upon intrinsic motivation, OIT is based upon the theoretical viewpoint that perceptions informing motivation and engagement arise from the assimilation of past experiences and views based upon expectations.

Different forms of extrinsic motivation embrace a wide range of external behavioural and cognitive regulations (Reeve, 2012; Ryan and Deci, 2000, 2009). Extrinsic, or non-intrinsic, motivation is "… the performance of an activity in order to attain some separable outcome, and, thus, contrasts with intrinsic motivation, which refers to doing an activity for the inherent satisfaction of the activity itself" (Ryan and Deci, 2000, p. 71). Extrinsic motivation has been presented as indicative of the degree of relative autonomy that an individual perceives him or herself as having (Ryan and Connell, 1989; Vallerand, 1997).

Specific to SDT, there are four forms of external regulation situated on a continuum between fully self-determined (intrinsic motivation) at one end and amotivation, which is a complete lack of motivation, intention or engagement, and at the other (Ryan and Deci, 2009, p. 177), summarised as "external (partaking in an activity because of external pressures or incentives, such as rewards, threats or punishment), introjected (doing an activity because of internal pressures such as guilt or shame), identified (pursuing an activity because one finds it important and useful) and integrated[1] (undertaking an activity because it is congruent with one's set of core goals and values)" (Tessier et al., 2010, p. 243) (see Figure 2.3 below).

The quality and type of motivation may be inferred from the engagement-indicative behaviours that are manifested: that is, by knowing which behaviours are associated with which type of motivation, researchers and teachers should be able to use this to infer unseen motivational processes. It is such that, further to similar conclusions drawn by, for example, Ryan and Grolnick (1986), Tsai et al. (2008), Pelletier et al. (2002), and Roth et al. (2007), Ryan and Deci (2009) have suggested that "… intrinsic motivation is not just a person variable but also a response to what the social environment affords" (p. 175).

It is still possible for extrinsically motivated behaviours to be autonomous (Ryan and Deci, 2009, p. 176) as values and needs regarding competence and achievement become internalised (Ryan et al., 1985). That is, that within many areas of achievement motivation and engagement, such as school-based learning, activities will not always be regarded as intrinsically motivating by students, in terms of being enjoyable or interesting, for example (Ryan and Deci, 2000, 2009). The degree to which extrinsically motivated regulated learning is internalised acts as the basis for autonomous self-regulated learning behaviours (Zimmerman and Schunk, 2001). As a means of addressing variance in motivation for learning activities and their associated competence-based outcomes, SDT states that intrinsic motivation should not be regarded as the only form of self-determined motivation (Deci and Ryan, 1985; Ryan and Deci, 2000, p. 71).

The least autonomous form of extrinsic motivation is external regulation, which is based upon the individual's desire to gain a reward offered by the teacher or to avoid punishment. Learning is experienced as controlled, and is the least internalised form of cognitive regulation in relation to motivation to learn. Behaviours indicative of both amotivation and external regulation include responses such as an unwillingness to participate in learning activities, and non-compliance with instructions from the teacher or the student's peers. Affective responses include boredom, anger, anxiety, and guilt. As one seeks behaviours that are more predictive of the positive end of the self-determined continuum, one would expect to see increased incidences of positive affect and engagement behaviours such as persistence, effort and resilience in the face of learning challenge (Ryan and Deci, 2000, 2009). Next in the continuum is introjected regulation, which is partially internalised but involves an individual's regulation of motivation on the basis of anxiety and the avoidance of affective responses such as guilt and shame. This has been labelled as ego-involvement (Nicholls, 1984; Ryan, 1982), and involves the seeking of responses from the teacher that result in the student's sense of pride and ego-enhancement.

Identified regulation of learning is based upon the recognition of the utility value of the learning activity, and is internalised as motivated approaches to either performance or mastery goals, or, indeed, a combination of the two. This form of extrinsically motivated regulation has been described as "… a relatively autonomous form of regulation, because people feel volition and self-endorsement when acting in accord with identified behaviors or values" (Ryan and Deci, 2009, p. 176).

Integrated regulation is the most autonomous form of extrinsic motivation. This involves the combination of identity with the value of the learning activity, in terms of contribution to progress and enhanced competence, and the behaviours that will be needed to undertake and complete the task successfully. This form of regulation shares common features of intrinsic motivation, "… for people experience both as freely chosen, volitional, and engaging" (Ryan and Deci, 2009, pp. 176 – 177). This most positive form of extrinsic motivation is predictive of needs to participate and invest effort in a learning activity relies upon the student's view that to do so is based upon the utility value of the task. These identified utility task values include the likelihood of achievement and making progress, and the mastery and understanding of concepts.

The difference between integrated regulation and intrinsic motivation is that the latter is based upon behaviours relating to interest and enjoyment: that is, "… people do these behaviours because they are engaging and fascinating – whereas with integrated extrinsic motivation people do the behaviors because they are *valued*, or viewed as personally important and relevant to attaining self-selected goals" (Ryan and Deci, 2009, p. 177). Indeed, Blumenfeld and Meece (1988) argued that students that are seemingly interested and fully engaged may not be cognitively engaged with the learning activities in question. Similarly, Bergin (1999) suggests that interest enhancement does not necessarily lead to learning enhancement. That is, that students can conversely be cognitively engaged without necessarily being interested in the task at hand: that is, extrinsic motivation such as identified and introjected regulation (Ryan and Deci, 2009). Therefore, within the SDT extrinsic continuum, engagement is based upon the recognition of the utility value of the learning activity, and is internalised as motivated approaches to either performance or mastery goals, or, indeed, a combination of the two. Further to the point by Bergin (1999), that interest enhancement does not necessarily lead to learning enhancement (p. 96) is acknowledged. Indeed, within SDT, interest is not regarded as a key motivator in all cases of the motivation to engage with learning activities. The central point made, through the SDT extrinsic motivation continuum, is that engagement with learning is more likely to lead to learning enhancement, including achievement. As previously discussed (for example, sections 2.2 and 2.6.1) interest is presented with SDT as more indicative of intrinsic motivation.

It may be that the student takes on and internalises values, goals and behaviours which combine and manifest as self-regulated learning behaviours on the basis of the extent to which the relationship with the teacher is regarded as positive or negative. Where the student regards the teacher-student relationship as negative, this internalisation will form the basis of extrinsically regulated learning behaviours, and may be more strongly influenced by peers (Reeve, 2002). The balance between intrinsically motivating and extrinsically motivating learning activities has been shown to have implications for students' self-determined engagement with learning (Ryan and Deci, 2009). However, the findings reported by Ryan and Deci (2009) have been based mainly upon survey responses alone, and have left a potential gap in terms of defining and understanding the potential links between teachers' relational behaviours and supportive methods that enhance students' motivation to learn and to persistent in their engagement within learning activities (Deci et al., 1991; Patrick et al., 2005; Tessier et al., 2010; Urdan and Turner, 2007).

2.9 Criticisms of SDT that have informed the current research

When SDT was first proposed as a social motivational meta-theory, its' authors acknowledged that research would be needed to develop the theory so that teachers and researchers could understand, within specific settings, the "… environmental factors that hinder or undermine self-motivation, social functioning, and personal well-being" (Ryan and Deci, 2000, p. 69). To date, SDT-embedded research investigating motivational variables that have a positive impact upon students' engagement has primarily pinpointed three key factors that inform students' sustained engagement with learning activities. One of these is students' enjoyment of learning within a learning environment, where they are able to perceive their own competence. This becomes the motivational drive for the making of volitional choices that enable them to exercise their own autonomy. The second factor involves being in receipt of feedback by a teacher that gives the student a sense of their current competence and strategies for achieving continued success within learning. Whilst autonomy and competence-informed motivational drives may be cumulative, SDT has highlighted the important motivational influence of the teacher upon student engagement. The role of the teacher has been increasingly located centrally to the motivation that stems from the enhancement and progression of feelings of autonomy and competence (Reeve, 2012; Ryan and Deci, 2009). For example, Weinstein (2002) notes that the teacher plays a crucial role in helping children to construe and act upon feelings of competence, confidence, self-efficacy and self-determined motivation to learn, as:

> "… children rarely look to themselves or the qualities of the task in which they are engaged for information about how they are doing – a fact that emphasizes …the dependent role in which we place students in classroom settings. That we do not foster self-monitoring of their work and their accomplishments as a primary source of feedback about capability is perhaps our downfall, given the growing evidence about the important role of self-efficacy in human development…"
>
> (p. 113)

During the first part of the review of student engagement, when viewed through the theoretical lens of SDT, the question arose as to whether there may be a hierarchy amongst the three SDT constructs / needs in terms of their impact upon each other and, as an outcome, engagement. The possibility of a hierarchy of influence and impact was an unconsidered or unaddressed possibility across the encountered SDT research literature. However, such a hierarchy amongst variables informing different forms of engagement has been proposed by Reschly and Christenson (2006, 2012). They argue that cognitive and emotional engagement precede and inform the quality and persistence of behavioural engagement. Fredricks et al. (2004) felt that research was needed to investigate the interplay between different variables informing engagement as a multidimensional concept, as many studies, including SDT-embedded engagement studies, had not considered how cognitive factors interplay with affect and behavioural outcomes to inform students' motivation to engage with learning activities. In addition, although the reciprocal relations between social contextual factors, academic perceptions and engagement have been investigated (Skinner and Belmont, 1993), this has not been fully considered within SDT-embedded research. Finally, as has been discussed within the current research (see sections 1.5), how the three SDT needs potentially mediate between sociocultural factors and engagement had not been investigated by most studies seeking to understand engagement. Least studied are the motivational relationships between perceived competence and students' engagement with learning. Indeed, when considering prior research, it has been difficult to envisage the potential 'route map' of the interplay between the three constructs of SDT and their motivational impact upon engagement with learning activities, as all three constructs have been presented as being simultaneous in their influence. This was true of, where included, both written described pathways and proposed pathways as diagrammatic models within published research.

Therefore, it may be that, contrary to published SDT models, that some of the proposed needs and components informing motivation and engagement have a greater impact comparative to others, that some needs are required as the threshold for other needs to be motivated, and that a larger amount of one component is sufficient to compensate for less of another. As SDT focuses upon only the three specific basic psychological needs, this may result in stifled discussions regarding the inclusion and consideration of other motivational variables that need to be considered if one is to develop a more informed picture of the motivational 'pathways' between classroom-based variables and student engagement with learning activities. Such criticisms of SDT have been placed central to the current research: this included a focus upon investigating the potential interplay between how the satisfaction of basic psychological needs and contextual variables influence engagement across different developmental stages, as "students may not become deeply invested in learning until they have the intellectual capacity to self-regulate and become intentional learners, which tends to occur at later ages" (Fredricks et al, 2004, p. 84). This was further to the observation that 'The presumption is that support from the teacher meets an individual's need for relatedness; but, for the most part, the mediation assumption has not been tested' (Fredricks et al, 2004, p. 86).

As it may be that engagement is an outcome in response to the motivational energy that students gain from the teacher satisfying the need for competence or autonomy, or both, the first research question centred upon defining the potential hierarchical relationship between students' self-determined motivation and their sustained engagement with learning activities within lessons, including the mediating variables that influence motivation and engagement within learning contexts: that is, what does SDT-embedded evidence reveal to be the strongest teacher behaviours that have motivational influences upon students' engagement with learning? This has been investigated through an MER (next section).

2.10 Using Meta-Ethnographic Review and Best Evidence Synthesis protocols to address the two research questions

Further to the criticism discussed in section 2.9, the two research questions have been utilised to enable the investigation of the potential interplay between SDT-informed motivational variables and students' engagement with learning. This was achieved through a research protocol called meta-ethnographic review (MER; Noblit and Hare, 1988). The MER enabled the synthesis and translation of numerous research studies in order to find common SDT-based motivational patterns of influence upon academic engagement in learning activities. This led to a more informed understanding of the potential hierarchical impact of SDT constructs and other emergent motivational variables upon student engagement. This included an understanding of the influence and impact that the three SDT constructs have upon student engagement by identifying and evaluating evidence through the aforementioned research questions (see section 1.1). Within the boundaries of the MER, 'influence' refers to the resulting quality of motivation and 'impact' refers to actual outcomes in the form of self-reported and / or observed engagement within learning activities. 'Needs' refer to the three basic psychological needs central to SDT (see Glossary). A subsidiary objective of the MER was to see if one of the three constructs of SDT has a more significant influence upon students' motivation for and engagement with learning than the other two constructs, such as in the form of a 'motivational pathway' whereby the influence of each SDT construct upon motivated engagement may be made more apparent.

MERs are research syntheses that through the "comparative textual analysis" of research studies have been asserted as an effective means of gaining an informed understanding of the findings of individual studies, and their potential transferability to other settings (Noblit and Hare, 1988, p. 5). The decision to conduct a MER was taken on the grounds that all of the included studies utilised qualitative means of analysing and interpreting evidence through inductive, interpretive approaches that lead to SDT-informed inferences for further investigation and testing. Qualitative interpretations more often focus upon understanding than knowledge (Noblit and Hare, 1988, p. 24; Savin-Baden and Major, 2013). The research questions herein focus upon understanding social phenomena within several real-life educational contexts, where possible through the self-reported perceptions of students. Specifically, MER procedures have been used herein to enable the systematic comparison of studies to draw cross-study conclusions about potential common motivational factors that have an impact upon engagement. Whilst an MER does not yield knowledge and outcomes of the same type as quantitative research, an inductive, interpretive approach remains viable because it brings to light an underlying coherence through an increased awareness of emergent, significant patterns that are common across numerous similar studies, by interpreting, examining and analysing the conclusions that researchers draw from the evidence within their own studies.

The main advantage of an MER is that it can lead to greater insights than would be possible through, for example, the consideration of research within a single social context, as results may be confirmed or adapted as each new study is analysed. In addition, an MER is more appropriate when synthesising outcomes and interpretations to find common outcomes and influences. It is also an efficient method for answering etiological questions such as "Does a teacher's behaviours towards a student directly influence the student's feelings of motivation?" and "Do students report that the extent of their positive engagement with learning is due to motivational influenced by their teacher?" The answering of such questions relies upon the collection of data through prospective and retrospective study designs (Petticrew and Roberts, 2006).

The MER within the remainder of this chapter has utilised the two research questions (section 1.1) as the basis for guiding the synthesis and interpretation of numerous similar studies (Noblit and Hare, 1988). Similar to a structured review, inclusion and exclusion criteria are used as the basis for determining the MER membership studies. The key findings in the form of explanations, descriptions and interpretations are extracted, and are then compared and developed conceptually to by extraction and third-order analysis of common and divergent conclusions: that is, "… the systematic identification and charting of the key concepts in the papers being synthesised" (Britten et al., 2002, p. 214).

The method of synthesis selected for this purpose was Best Evidence Synthesis (BES; Slavin, 1985, 1987), as the protocols therein ensured that "the method of synthesis [is] appropriate to the research being synthesised" (Britten al al, 2002, p. 214). BES is one means of extracting outcomes and findings, together with the meanings that have been assigned by either respondents and / or researchers as a method for acquiring an understanding of others' perceptions and responses. This has the benefit of determining how the study outcomes are related in terms of common key conceptual understandings (Noblit and Hare, 1988). One advantage of a synthesis methodology, such as through BES, within an MER, is that such an interpretative endeavour which enables the support and refutation of theories and their constituent parts, as well as tying together similar cumulative results to build upon the common findings and arising conceptual understandings. This, thereby, facilitates the forming of a whole from something more than the constituent parts (the emergent findings that encompass the majority of the conclusions from the synthesised studies): thereby enabling a "… focus on translation … for the purpose of enabling an audience to stretch and see the phenomena in terms of others' interpretations and perspectives" (Noblit and Hare, 1988, p. 29).

Finally, although there is a plethora of research relating to science education in general, there is a dearth of research grounding SDT within science education. The literature database search (see section 2.12) revealed only five such studies, none of which were set within British schools. The majority of SDT-grounded research within education has investigated physical education, sport, reading and maths. Ongoing searches of the literature databases between September 2012 and February 2015 revealed that there were no MERs of the grounding of SDT in the study of students' engagement with learning either in schools, general education or science education. The MER within this thesis therefore makes an original contribution to knowledge in that there are no MERs which have evaluated the effects of SDT-grounded interventions upon students' engagement with learning.

2.11 The Method for the Meta-Ethnographic Review: Search Strategy

Given the similarity of the protocols for both structured reviews and MERs, in order to ensure rigour during the MER process, the protocol used as the basis for the search strategy and synthesis of data has been developed from Noblit and Hare (1988) and Petticrew and Roberts (2006). Both were the main sources used for the MER protocol due to the authors' emphases upon research reviews within the social sciences. The protocol involved seven stages (taken from Petticrew and Roberts, 2006, p. 27):

1. Defining the research questions that the MER is setting out to answer (see section 2.10)
2. Determination of the types of studies that will need to be located (see section 2.11.2)
3. A comprehensive search of ten published research literature databases to locate potential studies for inclusion (see Table 2.1, and section 2.12)
4. Screening of the results of the search to determine which studies fully meet the inclusion criteria (see Figures 2.5 and 2.6)

5. Critical appraisal of the studies, including bias within the studies (see sections 2.14. and 2.14.1)
6. Synthesis of the studies, including determining the homogeneity and heterogeneity amongst the emerging evidence (see sections 2.15 and 2.16)
7. Discussion and summarising the key findings, including, where available, the effectiveness of interventions (see sections 2.17, 2.18 and 2.19)

2.11.1 The Search Strategy

An extensive search strategy was used to identify studies that should be included in MER and those that should be excluded. The first stage involved the identification of the inclusion and exclusion criteria for studies to be extracted from the database search (see section 2.11.2). These are the criteria for considering studies for this review. The second stage was to select the search terms (key words) to be used to interrogate the ten electronic literature databases. This selection process focused upon the dependent and independent variables that prior classroom / school-based research focusing upon the application of SDT had identified as key influences upon the optimal development of student's self-determined, self-regulated learning engagement behaviours, as summarised in Figures 2.3 and 2.4 below. The third stage involved performing an extensive search of bibliographic and citation databases using the inclusion criteria to enable access to published (peer-reviewed) and unpublished (doctoral theses and masters' dissertations) research studies. The boundaries of the search were limited to peer-reviewed research articles, statistical data reports and doctoral theses written in English.

Ten databases were identified and selected for interrogation through ERIC (ProQuest); seven databases summarised peer-reviewed journals and books, and three databases summarised unpublished research such as doctoral theses (see Table 2.1). The searches of the databases were undertaken at monthly intervals between September 2012 and February 2015 to ensure that appropriate studies were not inadvertently omitted. A cross-check was undertaken of research studies undertaken in relation to education and schools published on the official self-determination theory website [http://www.selfdeterminationtheory.org/ last accessed 11th May 2015]. This included a full review of the sections titled 'Applications of SDT – Education', 'Self and Self-Esteem' and 'Vitality and Energy'. The literature review articles by Chatzisarantis et al. (2003) and Ryan and Deci (2009) were also used to locate any articles that might not have emerged from the searches of the databases.

Figure 2.2 *The assumed relationships between SDT variables and engagement (consequences) (From Sas-Nowosielski, 2008, p. 138)*

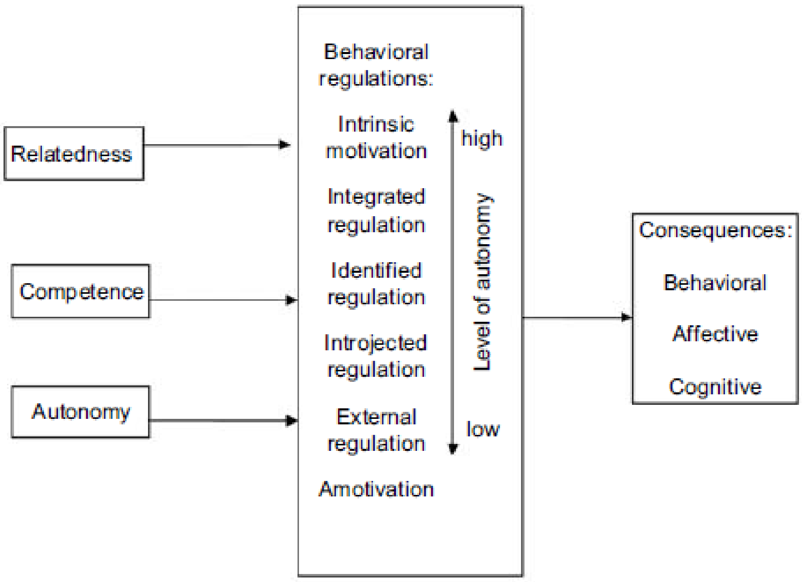


Table 2.1 *Summary of Research Bibliographic and Citation Databases searched*

Published (peer-reviewed journals and books)

1. ERIC – ProQuest AND ERIC (Dialog) – ProQuest
2. PsycARTICLES (Ovid)
3. British Education Index (Dialog) – ProQuest
4. Australian Education Index – ProQuest
5. Applied Social Sciences Index and Abstracts – ProQuest
6. Via the Self-Determination Theory website; selfdeterminationtheory.org
7. Social Sciences Citation Index (ISI Web of Knowledge)

Unpublished (theses and dissertations)

1. EThOS – unpublished British theses – available for download
2. ProQuest – Dissertations & Theses
3. Index to Theses

Ensuring the similarity of the included studies was carefully controlled: all such included studies had investigated the influence of at least one, if not all three, of the SDT constructs upon engagement-indicative operational variables, and that all had been undertaken within one or more schools.

2.11.2 Criteria for including studies in the review

Studies that satisfied all of the following inclusion criteria were synthesised and analysed within the MER:

1. The study had utilised SDT as the theoretical basis for the engagement outcome variables being measured;
2. The study had sought to establish associative relationships between academic / learning engagement and one or more of the three constructs central to SDT; relatedness, autonomy / autonomy support and competence;
3. The study had harvested data from students; that is, the studies are undertaken within school settings, and data are based upon students' self-reported perceptions rather than those of their teachers;
4. The study had included an SDT-grounded intervention, implemented within a student age range including 8 to 13 years old, and;
5. The study was written in English.

The age group of 8 to 13 year-olds was selected as the target population for this study because of my professional interest in enhancing and improving the learning experiences of my own students of the same age (see section 1.3). As discussed, I was keen to understand why students choose to be intrinsically and extrinsically engaged in their own learning. This includes an understanding of the teacher-reliant motivating experiences informing students' self-reported views as to why they become engaged in learning activities during science lessons. Therefore, the three essential elements that had to be present for a study to be included in the MER were:

1. The use of SDT as the means of explaining / interpreting the factors that enhance children's motivation for and engagement with learning in the classroom;
2. The inclusion of children aged between 8 and 13 amongst the participants, and;
3. The use of at least one intervention which is designed to have an effect upon an operational variable of engagement with learning (within the boundaries of the three SDT constructs).

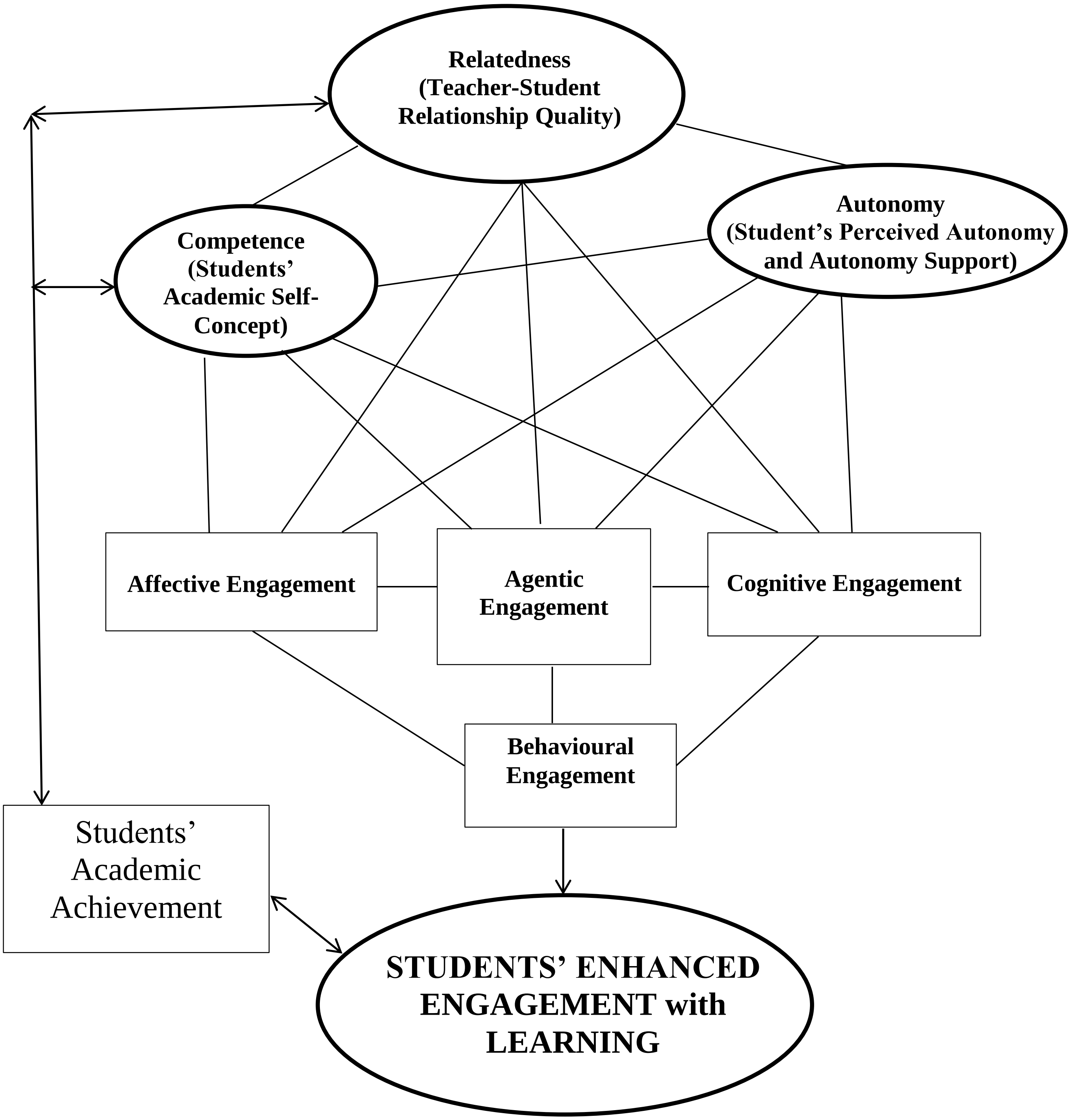
In consequence, studies were excluded if they did not utilise SDT as the theoretical framework, they did not include or partially include students within the 8 to 13 age range, if they were not set within a school setting, or they did not have student engagement variables as outcomes. In addition, studies were excluded if it was not possible to access the full electronic text of the study.

2.11.2.1 Keywords used during the Literature Database Search

Key Search Terms:

1. Self-Determination Theory AND Education
2. Self-Determination Theory AND Student Engagement (Academic, Learning)
3. Student Autonomous Motivation
4. Self-Determined Learning
5. Self-Regulated Learning
6. Science Education
7. Self-determination theory AND teacher-student relatedness AND education / school
8. Self-determination theory AND student autonomy support AND education / school
9. Self-determination theory AND student competence AND education / school
10. Teacher-student interpersonal relationships AND engagement
11. Student engagement AND teacher relational behaviours
12. Student engagement AND self-regulated learning AND teacher-student interpersonal relationship

Figure 2.3 *The Conceptual Framework for the MER (based upon the review of the student engagement literature: sections 2.1 to 2.8)*



2.12 Results of the Literature Database Search

The identification of potential studies took place during numerous electronic literature database searches between September 2012 and November 2013. The searches revealed 134 possible studies for inclusion in the structured review. Of these, a number of electronic 'barriers' prevented full access to some of the doctoral theses, including three of the four doctoral theses within the search term 'self-determination theory AND teacher-student relationships'. 69 studies with potentially usable data sets were accessed (see Appendix 2.3). Further screening resulted in a total of 32 studies being included in the MER (see Appendices 2.1 and 2.2).

Table 2.2

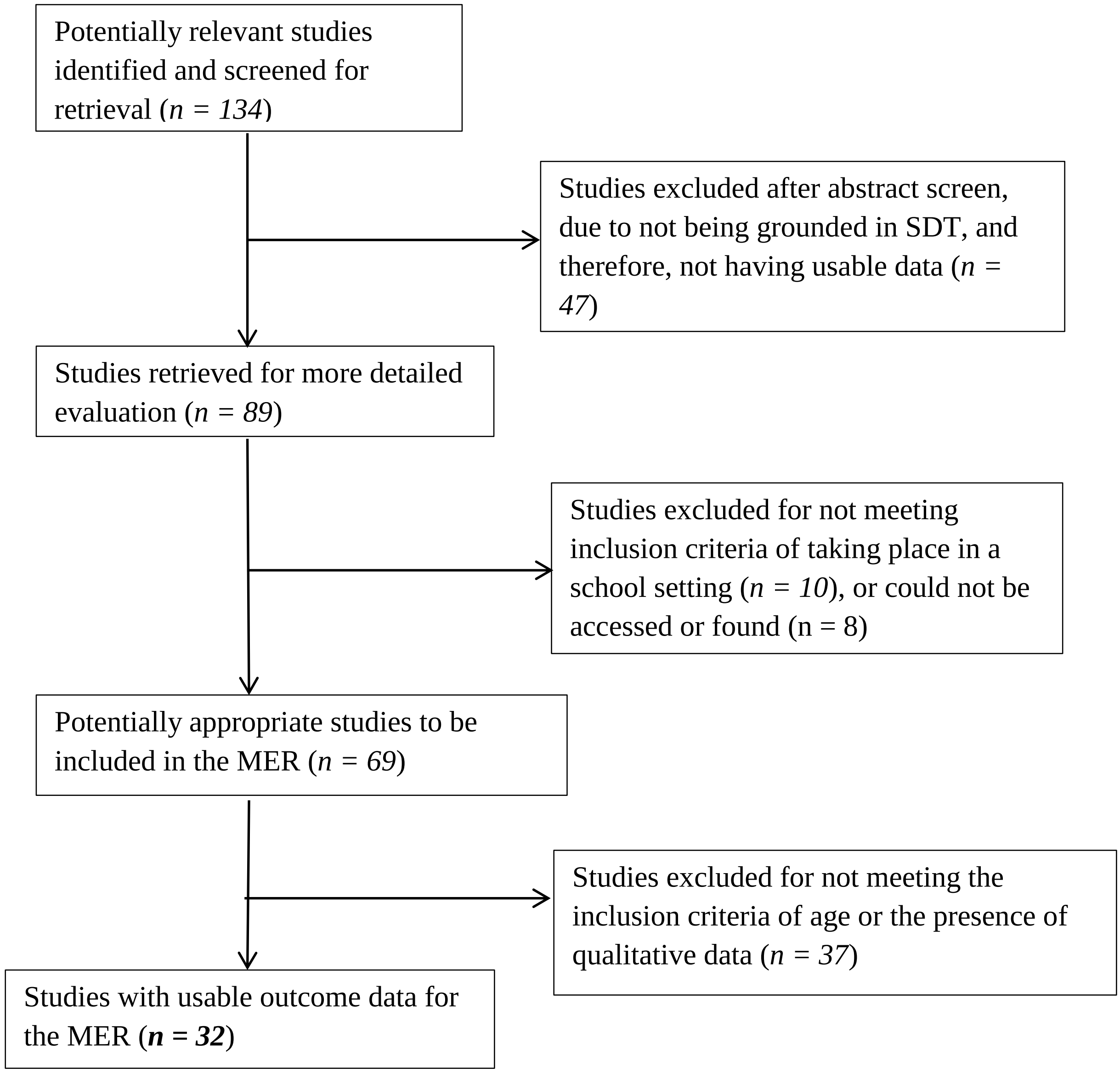
Summary of the accessed research studies with usable reported outcomes

Type of publication	Accessed and with potentially usable data	Accessed but without usable data	Could not be accessed or found	Data collected not on relevant SDT constructs	Data not related to school contexts
Journal article	**63**	30	4	8	8
Doctoral theses	**6**	7 (Note 1)	4	2	2
Totals	**69**	37	8	10	10

Notes:

1 – only previews of the doctoral thesis could be found; there was no access to the data set.

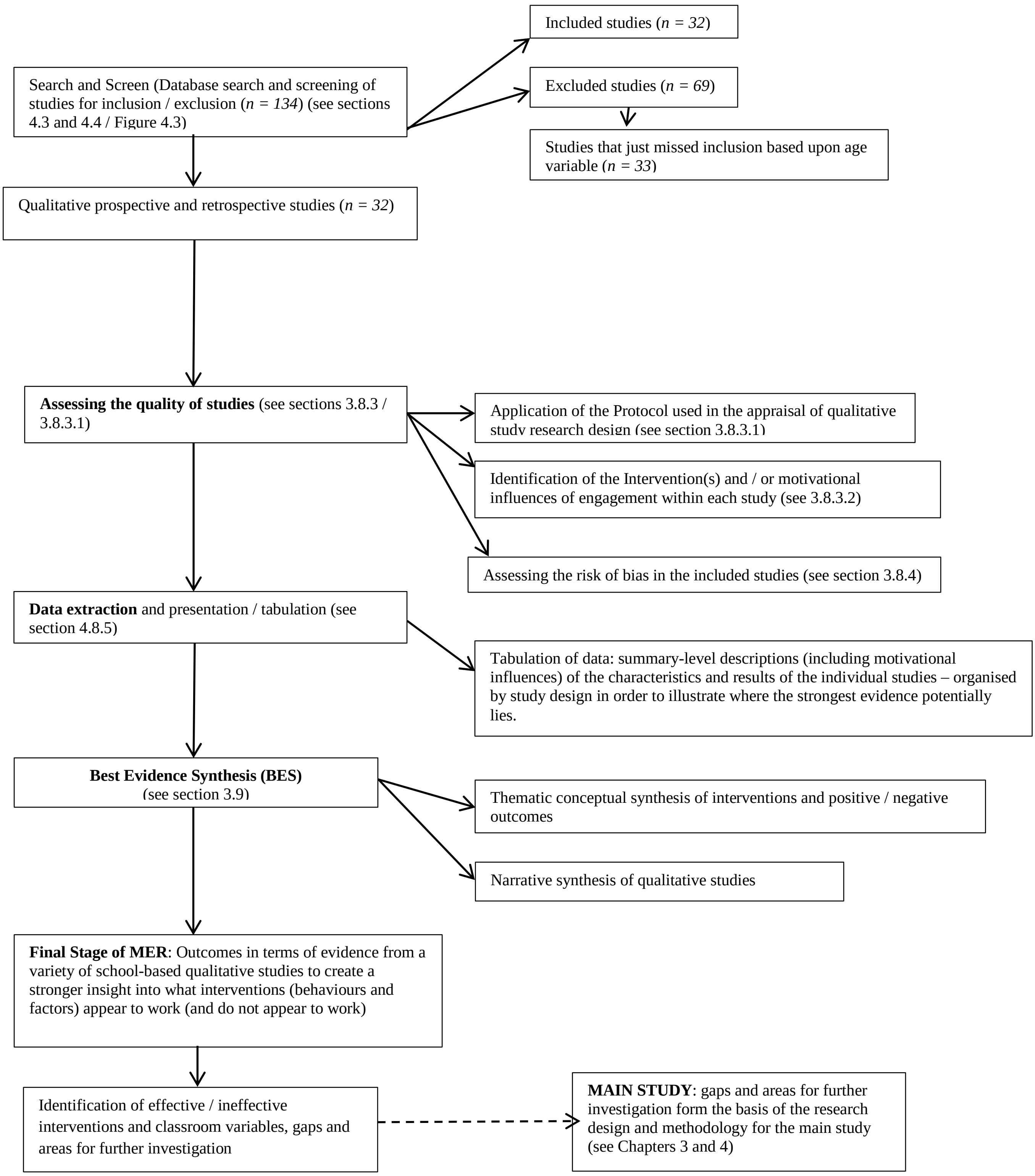
Figure 2.4 *Search and screen diagram: Meta-Ethnographic Review (format based upon De La Rue et al. (2014) p. 31)*



2.13 Data Collection, Presentation and Analysis

The stages of the protocol for the MER are summarised diagrammatically in Figure 2.6.

Figure 2.5 *Meta-Ethnographic Review Protocol: visual representation*



Assessing the quality of each study relied upon determining if there was enough information provided about the context, methods for collecting data, means of analysing and presenting the data, and the background to the study (such as recruitment and selection of participants, and the number of participants) provided in such a way that the data may be interpreted meaningfully (Gorard, 2014; O'Brien et al., 2014; Petticrew and Roberts, 2006, p. 126; Santoro, 2014; Spencer et al., 2003; Thomas and Gorard, 2007). When judging the quality of the research process and the resultant findings, there was a need for clear criteria, including significance, rigour of data collection and the appropriateness of methods, the adherence to due process, and the potential impact in terms of the generalisability of the synthesised findings (Spencer et al., 2003; Thomas and Gorard, 2007). In all cases, each of the studies was analysed and accepted on the basis of the criteria given in Table 2.3 (above).

Table 2.3 *Criteria used for assessing the quality of a study*

1. Are the research questions clearly stated?
2. The relevance of the research question to the study design and outcomes / understanding sought by undertaking the study;
3. Is the method of data collection clearly described?
4. Internal validity: the degree to which the study design, intervention, conduct of the study, analysis and conclusions drawn have been able to answer the research question;
5. The minimisation of bias: methodological, selection, response, attrition and observer biases;
6. External validity: the extent to which the findings are generalisable to similar settings;
7. Is the method of analysis clearly described?
8. The appropriateness of data analysis and presentation;
9. The extent to which the links between data, interpretations and conclusions are made clear, and;
10. Are the claims made supported by the evidence?

(Adapted from Atkins et al., 2008, p. 25 and Petticrew and Robert, 2006, p. 127)

2.14 The acknowledgement of bias within the included studies

The purpose of the MER was to identify cross-study patterns in the influence of each of the SDT constructs upon each other, and to consequently form a generalised understanding of their potential hierarchical influence upon the optimal enhancement of students' engagement with learning. Throughout, there was an understanding that bias is an unavoidable component of qualitative research especially when such studies are reliant upon harvesting others' self-reported views. For example, one would expect within studies that harvest self-reported perceptions, a high risk of respondent bias (Sackett, 1979). For example, students had not been randomly selected but were drawn, for example, from a larger available population within a school or group of schools. The participation of students was dependent upon, in the majority of studies, the informed consent of both the students and their parents, given that the majority of students were under 18 years old. In a small number of studies, informed consent was given by the headteacher of a school, but it is not recognised in any of the studies that where the students were compelled to participate, they may have done so unwillingly. Such unwillingness may result in skewed responses that undermine the validity of the analysed evidence. In addition, the depth and nature of the motivational and engagement-predictive variables being explored depended upon the survey instruments selected to investigate the variables under scrutiny, and the study-defining research questions. Finally, the response bias was a factor within all of the studies in terms of the extent to which individual students understood the wording of survey questions, the extent to which it could be categorically stated that all questionnaires were completed in full by all students at each data point, and the full cooperation of participants in giving truthful, considered responses to the potentially intrusive psychological insights being sought (Furnham, 1986). In addition to the different forms of bias that invariably emerge within educational research that involves people within contextual settings, the choice of one theoretical lens over innumerable similar theories creates an epistemological bias (Gorard, 2013; Thomas, 2007).

To dismiss studies on the basis of bias that is clearly unavoidable when it comes to, for example, research questions, selecting a theoretical lens, research design, research methods and instruments, research setting and participants therein, the nature and extent of insights allowed by participants' willingness to share personal information and their ability to articulate their ideas, would lead to all being dismissed on the grounds of a lack of internal validity (Gorard and Taylor, 2004; Sackett, 1979). Thus, studies have been included and assessed in terms of their external validity for use by teachers within their own classrooms as a basis for pinpointing teacher behaviours and classroom social-contextual factors that have the potential to enhance students' motivation, engagement and achievement within learning activities (further to Gorard, 2013; Gorard and Taylor, 2004; Thomas and Gorard, 2007; Thomas and Pring, 2004). The quality and significance of educational research is often assessed based upon the external validity and impact of the research outcomes (Research Excellence Framework, 2014 – see http://www.ref.ac.uk/): that is, the extent to which students' self-reported perceptions, motivations and future intentions may be predicted across different contexts and life domains. The alternative is that educational research without significance or impact may be regarded as fragmented and potentially worthless, as such research is "… often addressing similar questions, start from different positions or use different sample" (Pring, 2000, p. 2). Education and educational research are concerned with life chances and the positive optimisation of such chances for the benefit of students and teachers: therefore, a disadvantage of "… steering research in the direction of experimental trials … means that 'qualitative' evidence is largely ignored, which is particularly wasteful" (Gorard and Taylor, 2004, p. 49).

As a consequence of such thinking, the central focus throughout the BES of the included studies was to summarise and present the findings and potential underlying motivational pathways, whatever they emerged as, in such a way that they could be used as the basis for testing their generalisability (external validity). That is, the informed application of the findings of others' SDT-embedded research to similar school populations or classroom settings (Hammersley, 1993). Therefore, the key study within this thesis has applied the cumulative findings of the MER. In addition, the central objective was that the evidence to answer the research questions within the MER and central study was of sufficient depth and richness to postulate probabilistic motivational pathways informing students' motivated engagement with learning (de Vaus, 2001; Denscombe, 2010; Hage and Meeker, 1993; Morrison, 2009).

The 32 included studies draw upon the students' self-reported perceptions of the SDT-grounded influences that have both positive and negative influences upon their initial and sustained motivation for and engagement with learning in formal learning contexts. In the case of the current research, the choice of a motivational theory that may be generalised across schools and classroom settings can be of use to teachers as it may provide "… relevant predictions, explanations, interpretations and application" (Glaser and Strauss, 1967, p. 1). However, seeking to establish criteria for defining quality and diminishing bias is almost impossible, not least because of the difficulty of applying them consistently across all areas of research involving qualitative methods within education (Spencer et al., 2003; Thomas and Gorard, 2007; Thomas and James, 2006).

2.15 Synthesising the evidence

The challenge with presenting and analysing the emergent findings of the MER was to assemble the large amount of evidence in such a way that a more meaningful picture could be formed in terms of what the evidence is saying (Atkins et al., 2008). This includes, where used, the effectiveness of interventions, and, in particular, the impact of SDT constructs (isolated and cumulative) upon students' engagement with learning.

Synthesising the evidence involves logically organising and presenting the evidence emerging from the included studies. The first stage of the synthesis was to present a within-study summary of each of the 32 studies, where the characteristics and results of the individual studies are described (Appendix 2.1). This included the authors and year of publication, the type of publication (published peer-reviewed journal article or unpublished doctoral thesis), the type of study design and context (curriculum subject, country), the age range and number of students, gender (male and female in the case of all studies: mixed), and the SDT construct outcomes. Appendix 2.2 summarises the critical appraisal of each study on the basis of the SDT-informed focus, and the outcome(s), including intervention(s), where used. This summary revealed that the studies were not homogenous, in the way that may be found, for instance, with randomised controlled trials investigating the same intervention with similar populations. Instead, the included studies were a heterogeneous set as, although they were mainly survey-based, prospective study designs, they drew primarily upon the self-reported perceptions of a wide and diverse range of cohorts. This emphasis upon qualitative, survey-based methods and analysis should not be regarded as prohibitive if the approach of reviewing on the basis of both internal and external validity of the studies, as opposed to internal validity alone (Noblit and Hare, 1988).

2.16 The review of mixed methods research through Best Evidence Synthesis (BES)

Research encompasses a range of mixed methods, including interviews, focus groups, observations and surveys, operating within a paradigm of analytic induction (Sterne et al., 2001). The synthesis of the 32 studies centred upon reported outcomes, taken from students' self-reported perceptions of the impact of specific SDT-informed teacher and contextual variables upon the perceived enhancement of their engagement with learning. The synthesis of the data has also relied upon a narrative approach (Boud and Miller, 1996), which, true to the MER method, led to the thematic categories beginning to inductively emerge on the basis of the primary data rather than prior knowledge (Atkins et al., 2008).

The information summarised within the tables do not constitute a synthesised review of the studies at this stage (Petticrew and Roberts, 2003, 2006). This is achieved within the next and final stage of the MER: a Best Evidence Synthesis (BES: Slavin, 1986, 1995). BES has most frequently been used to explore educational phenomena, is not prescriptive about the types of study designs that should be included or excluded, and has a standardised protocol used to identify and extract the same information from each study in the MER. The ideal outcome of the BES approach will be useful, generalisable information regarding where the interventions were used, which interventions worked, how they worked, who they worked with, and, equally importantly, why they worked in the given contexts. In addition, BES can reveal evidence that answers important questions regarding underlying, and potentially invisible, variable pathways that will not or cannot be illuminated through experimental / controlled trials (Egger et al., 1998, 2002). Throughout, BES has been approached as one means of enabling a form of illuminative analysis, adopting the assumptions of interpretivism (Thomas, 2009, p. 198). Interpretivism is central to the discussions within all of the MER studies as the researchers' have sought to make sense of human behaviour, motivation and responses through the lens of SDT.

Whilst other methods of synthesising qualitative evidence within MERs exist, a major advantage of BES is that its protocol facilitates the meaningful gathering of evidence from a variety of school-based qualitative studies to create not only a stronger insight into what appears to work (and does not work) but also for identifying gaps and areas for further investigation (Slavin, 1986, 1987, 1990). It also enables insights into how into how teachers' professional practice can be improved by knowing what the available evidence suggests are the best means of embedding SDT within their classrooms for the basis for students' sustained engagement, whilst being aware that the evidence base will be far from definitive or flawless (Slavin, 1986; Slavin et al., 2014).

The BES synthesis process was approached as a "reciprocal translation by … comparing the themes and concepts from paper 1 with paper 2, and the synthesis of these two papers with paper 3, and so on, beginning from [pre-determined] categories … but keeping an open mind for emerging ones" (Atkins et al., 2008, p. 27). These categories, in the form of emergent themes, have been presented (see Table 3.8) as first, second and third order interpretations (Atkins et al., 2008; Britten et al., 2002): themes highlighting the most frequent SDT-related motivational variables, and the most common mediating variables and classroom social contextual factors which were repeatedly asserted to have an influence upon students' engagement intentions and behaviours. The third-order interpretations relate to how student engagement might be improved. These, in turn, became interpretations that formed the starting point for further investigation within the main study (Chapter 3). The outcomes of the MER are summarised in Appendices 2.1 and 2.2, and are discussed within the remainder of this chapter.

2.17 Moving from descriptive first-order constructs through translation to third-order interpretations

The objective of the interpretations formed through the BES (Table 2.4) was to reveal outcomes that consistently emerged regarding the potential impact and motivational influence of each of the three SDT constructs upon students' self-reported engagement with learning, and how these are potentially interlinked. The objective for using the outcomes that emerged across the majority, if not all, of the studies was to form second- and third-order interpretations as the basis for the formation of a proposed motivational pathway model that illustrates some of the key interlinks between the SDT constructs, different motivational types, and students' motivated engagement with learning (see Table 2.4). First-order constructs are direct responses acquired from participants, which can only be compared at the descriptive level at which they are made available to the researcher (Burns et al., 2010). The next stage consists of second-order interpretations, which are the researcher's initial interpretations of the findings. These lead to third-order interpretations which represent the researcher's integrated interpretive conclusions (Britten et al., 2002; Noblit and Hare; 1988). These consist of the translation of the primary findings by drawing inferred conclusion from more than what the parts alone imply at the surface level, thereby taking the findings from descriptive to interpretive (Burns et al., 2010; Walsh and Downe, 2005). These inferred conclusions led to interpretations that highlight and explain the psychological interplay and strategies that have been found to have a positive impact upon enhanced student engagement. These interpretations are tested and explored through the two research questions within the two parts of the main study (Chapters 3 and 4).

Table 2.4 summarises the first-order constructs, and second- and third-order interpretations drawn from the synthesis and translation of the 32 studies. These interpretations should be considered alongside sections 2.18 and 2.19, where these are unravelled and discussed in more detail.

Table 2.4 *Best Evidence Synthesis, encompassing concepts (first-order constructs), second- and third-order interpretations*

Concepts (First-order interpretations)	**Second-order interpretations**	**Third-order interpretations**
Satisfaction of SDT basic needs leads to enhanced engagement through the cumulative quality of the teacher-student relationship, perceived competence, and autonomy	Students' optimum engagement within learning activities is due to the cumulative influence of all three SDT psychological needs being satisfied	Within their professional practices, teachers need to ensure a focus upon strategies that lead to the satisfaction of all three needs
The central importance of relatedness – the quality of the teacher-student relationship – upon context- and subject-specific student engagement	The strength of the interpersonal relationship with the teacher is more influential upon students' motivation for and engagement with learning, comparative to the students' perceptions of autonomy and competence	Teachers should emphasise the centrality of the quality of their relationship with their students as this has a stronger impact upon engagement comparative to the need for competence and autonomy
The quality of the teacher-student relationship (relatedness) influences the students' perceived competence	The perceived teacher-student relationship quality is the basis for a student being more receptive to the performance-related feedback from the teacher	The more positive the teacher-student relationship, the more positive a student's perceived competence will be
Students' perceived competence is enhanced by their teachers' performance-related feedback	The nature of the teacher's feedback to a student regarding performance and progress is central to the students' perceived competence	Teacher feedback has an impact upon the students' perceived competence, which in turn influences academic self-efficacy and self-concept
Competence support by the teacher is central to students' self-efficacious beliefs	Perceived competence has the potential to inform students' self-efficacy, and, in consequence, impact upon their engagement within learning activities	When utilising competence feedback strategies, teachers need to be aware of the current and future impacts of such feedback, in terms of the impact it will have upon self-efficacy the motivated desire to be more competent
There is a reported association between perceived competence, self-efficacy, academic self-concept and competence need satisfaction	Perceived competence is an overarching concept composed of and influenced by several competence-based psychological responses	When seeking to enhance students' perceived competence, teachers should consider the current and future impacts of their feedback, in terms of the impact upon self-efficacy and the motivated desire to be more competent

Concepts (First-order interpretations)	Second-order interpretations	Third-order interpretations
Perceived competence informs students' autonomous motivation	The more competent an individual perceives him/herself to be, the greater will be their self-efficacy, which, in turn, will inform the extent and nature of their motivated desire to be autonomous within learning activities	Students will only perceive autonomous motivation and exercise it in situations where prior feedback has enhanced their perceived competence and resultant self-efficacy
Relatedness and competence, but not autonomy, mediate the effect of feedback upon students' motivation	Feedback is regarded as either positive or negative based upon the perceived quality of the interpersonal relationship with the teacher and the extent to which feedback informs perceived competence	Relatedness and competence have a mediational influence upon students' motivational perceptions and responses predictive of engagement
There are positive associations between teacher support, enhanced feelings of relatedness towards the teacher, and students' feelings of self-determined motivation	Engagement may be enhanced over time, mediated by relatedness manifested as teacher feedback and support.	Reciprocal effects may exist between prior and later perceptions of engagement, and the motivating and engaging nature of the classroom

(*Format of the table based upon Britten et al., 2012, p. 213*)

N.B. Within the following sections of this chapter, relatedness refers to the students' perceptions of the teacher-student relationship quality and the behaviours / methods that have an impact upon its quality. Competence refers to the basic psychological need to feel competent or achieve further competence. Autonomy includes the motivation to be autonomous or to exercise opportunities to be autonomous during learning activities.

2.18 Identifying specific classroom practices that motivate students' engagement with learning

Savard (2012: Study 1) investigated the motivational interplay between relatedness (in the form of teacher care), perceived autonomy support and competence support by the teacher upon the satisfaction of students' basic needs, their affective motivational responses to learning, and their intention to engage within further learning activities. The intervention involved teachers increasing the frequency of positive behaviours regarded as central to the three SDT constructs, in order to determine if there was an associated enhancement of students' perceptions of the quality (as opposed to amount) of motivation and subsequent wish to engage further in learning. 115 students, aged 12 to 17, within Canadian social rehabilitation schools were surveyed pre- and post-intervention. It was found that a teacher's interpersonal style and associated interpersonal behaviours had a long-term impact upon students' SDT basic need satisfaction, adjustment to learning within a formal context, and an enhanced motivation to engage in learning. Specifically, relatedness and autonomy support, but not competence, led to students' enhanced positive perceptions of higher need satisfaction, self-determined motivation and engagement. Supportive teacher-initiated behaviours include; that the teacher discusses the relevance and connections between learning activities and their relevance within real-world contexts; empathy towards the students' needs within a learning activity; enabling choice within learning activities; setting clear expectations as to potential approaches to learning during specific activities, and; providing regular and informative feedback regarding performance and next stages within learning activities.

Hagenauer and Hascher (2010) also identified specific classroom practices that were the source of the students' enjoyment of learning, with self-efficacy acting as a partial mediator. When teachers neglected students' need for a positive teacher-student relationship (relatedness) and to feel competent (competence), this was a significant indicator of impeded learning enjoyment. Specific classroom practices that were predictive of students' sustained enjoyment of learning included, in order of descending correlative association, teachers' care, instructional quality, an autonomy supportive learning environment and self-efficacy (p. 505). Students associated all of these factors with the satisfied need for competence and relatedness. Where students felt competent duringlearning tasks, they reported that they had a more positive relationship with the teacher and that they enjoyed learning within lessons taught by that teacher. Conversely, where the need to feel competent was thwarted, learning was not regarded as worthy of engagement and the students reported a negative / poor relationship with the teacher (Hagenauer and Hascher, 2003, p. 506). The study confirmed that teachers' classroom practices and afforded learning methods are the key sources of students' enjoyment of learning activities. That is, the teacher's support and encouragement of students' needs for a positive teacher-student relationship and to feel competent were significant predictors of enhanced enjoyment of and engagement with learning. Conversely, a teacher's neglect of students' needs for relatedness and competence were significant predictors of both decreased and declining enjoyment of and engagement with learning (Hagenauer and Hascher, 2010, p. 510). The study recognises, amongst its limitations, the need to take prior experiences into account, such as prior achievement within specific subjects and the quality of the relationship with a specific teacher, in the form of affect-driven cognition, is necessary when seeking to understand enjoyment of learning.

2.18.1 The impact the teacher-student relationship quality (relatedness) upon students’ engagement with learning

The impact of relatedness (the quality of teacher-student relationships) upon students’ intrinsic motivation for learning was the focus of the study by Cox and Williams (2008). The three SDT constructs were applied in order to further understand their mediating influence upon the sustaining an engaging formal learning motivational climate. It was revealed that the strength of the interpersonal relationship with the teacher was more important than the students’ perceptions of autonomy and competence. Variables relating to all three SDT constructs were found to partially mediate self-determined engagement with learning. However, all such perceptions were directly influenced by the quality of the teacher-student relationship. Although there were no definitive conclusions about the comparative strengths of the three constructs relative to each other, the strongest association was between teacher support, which enhanced students’ feelings of relatedness towards the teacher, and students’ feelings of self-determined motivation. Conversely, a weak association was found between students’ motivation to be autonomous and their self-determined motivation.

In contrast to the study by Hagenauer and Hascher (2010), Liu et al. (2009) investigated the influence of affect-driven cognition upon actual achievement and the perceived self-efficacious ability to achieve further competence. Affect-driven cognition was defined, within the study, as students’ perceptions of the degree to which they were able to self-determine the direction that learning should take. It was found that students who perceived a higher level of autonomous self-determination, as opposed to feeling controlled by their teacher, were more likely to feel that all of their SDT basic needs had and were being satisfied. This was comparative to students who felt that their SDT basic needs were not being satisfied because they regarded their teacher as controlling during learning activities. As a consequence, students reported correspondingly lower levels of autonomous motivation.

Further to the above findings, Pat El Tellima and Van Koppen (2012) found that teachers’ performance feedback had an impact upon students’ sense of relatedness and intrinsic motivation for engaging in learning activities. Two key mediating variables that had an impact upon intrinsic motivation and subsequent engagement were the teachers’ interpersonal style and instructional behaviours during lessons. The forms of feedback that were used had an optimal effect upon students’ positive perceptions were that their teacher had a positive interpersonal style and taught using instructional behaviours that enhanced students’ autonomy supportive self-perceived competence: the modes of feedback and teachers' interpersonal behaviours were predictive of student motivation and engagement in project work. It was concluded that both relatedness and competence, but not autonomy, directly mediated the effect of performance feedback upon students' motivation: that is, the extent to which a student regarded feedback as either positive or negative was dependent upon the perceived quality of the interpersonal relationship with the teacher and the extent to which the teacher's feedback informs a student's positive perceived competence, even when the feedback was always positive. The influence of the basic psychological need to feel competent upon engagement was further reinforced within Soric (2009), who found that causal attributions of self-determination and control over the self-direction of learning impacted upon feelings of engagement and subsequent measurable academic achievement. It is noted that "… results showed that intrinsically motivated successful students, who feel autonomous and self-determined rather than controlled by others, attributed their success to more internal and controllable causes" (Soric, 2009, p. 403). The motivation to be autonomous, once again, appears to be an outcome, the nature of which is based upon a combination of teachers' relational-enhancing behaviours and the extent to which teachers' competence-based feedback enhances students' perceived competence. This suggests that there is a chain of events informing motivation and engagement with learning, that are dependent upon students' perceptions that they have the competence (based, possibly, upon prior achievement informing self-efficacy) allied with teachers' positive feedback and interpersonal support to achieve within specific subjects. This supported the potential interplay between relatedness and competence proposed by Deci and Ryan (2002).

Similar to Soric (2009), Standage et al. (2012) undertook a study involving 394 students aged between 11 and 14 within PE lessons in British schools, examining the relationship between students' motivational processes and their engagement during PE activities. The evidence revealed that students who perceived that their classroom was an autonomy supportive environment also self-reported correspondingly greater levels of relatedness, competence and autonomy than other students who perceived their learning environment to be controlling and thwarting of self-direction. A key point was that autonomy perceptions were revealed as motivational outcomes based upon the students' perceptions of relatedness and competence, both of which were enhanced by their teachers' behaviours. Such motivational outcomes were optimised in contexts where the teacher provided them with choices and options, that they felt understood by their teacher, that the teacher exhibited confidence in the students' abilities to do well in PE, that students were encouraged by the teacher to ask questions, that the teacher sought students' opinions as to how learning activities should be undertaken, and that the teacher would try to understand the students' perspectives when suggesting new learning strategies (p. 110). Therefore, autonomous motivation was asserted as being based upon the strength and sustainability of specific teacher relatedness / interpersonal behaviours: including the perception that the teacher is supportive, understanding, a good listener, one who explicitly values the students, and one who provides a learning environment where students feel secure in their ability to achieve and progress.

Zhang et al. (2012) reported similar results from their study of 273 11-14 year-olds in PE lessons in an American school. Their examination of the teachers' behaviours that are predictive of students' motivation and achievement within the subject-specific domain of PE revealed the important influence that teachers' competence supportive and autonomy supportive behaviours can have upon the formation and reinforcement of students' motivational constructs, and subsequent engagement and achievement. The study's conclusions indicate that a supportive learning environment and high levels of expectancy-related beliefs, communicated by the teacher and attributed by the student, are positively associated with positive engagement outcomes. The key factors asserted as mediating between social contextual factors provided by the teacher and the students' sustained motivation to engage with learning activities had an impact upon students' positive perceptions of competence and self-efficacy. These factors included the affordance of activities that students regard as important and interesting due to a strong subjective task value, and the importance of the teacher's role in ensuring that all of these factors are sustained through their interpersonal and instructional styles (p. 341). Competence support by the teacher was central to the positive development of students' expectancy-related and self-efficacious beliefs, whilst both competence support and autonomy support are central to students' subjective intrinsic and utility task values (p. 338). Interest and motivation are different in that interest is related to preferences for activities or knowledge domains, with the magnitude and type of interest acting as predictive of motivation to engage with learning activities (Abrahams, 2011, pp. 26 – 27).

2.18.2 The influence of teachers' competence-related feedback upon students' engagement

Kaplan and Assor (2012) investigated the impact of positive competence-related performance feedback from the teacher upon students' affective engagement with learning activities. The intervention utilised I-Thou autonomy supportive dialogue by teachers during a longitudinal study over the course of two years with 420 children aged 12 to 13 years. The principle of I-Thou (Buber, 1959, 1960) is that individuals form perceptions through supportive and meaningful transactional constructivism. Kaplan and Assor (2012) investigated the impact of teacher-student interactive dialogue that supports adolescent students' sense of autonomy and competence, and in turn, their enjoyment of and motivation for learning within learning environments that the students regard as secure. The I-Thou, programme was formed based upon the view that when:

> "… human beings are in dialogue with one another, each of them relates to the other as a unique individual, thus achieving genuine communication. Moreover, dialogue is actually a creation of a new meaning, a meaning that did not exist before and that is created within the domain of interpersonal human relations."
>
> (Kaplan and Assor, 2012, p. 252)

This transactional constructivism programme bears a strong similarity to SDT, in that both have similar organismic dialectical perspectives, asserting that, when basic psychological needs are met, "… people thrive, feel well and show consideration for others when the environment enables them to satisfy their basic needs for autonomy, relatedness and competence" (p. 253). The outcomes of the study indicate that when adolescent students feel that their basic psychological need for autonomy is supported through meaningful teacher-student dialogue, the students are more inclined to feel happy and satisfied, as opposed to feeling frustrated or angry within contexts where the teacher is regarded as more controlling in terms of preventing students' volition within learning activities (p. 262). Optimum dialogue, in terms of enhancing students' self-perceived autonomy, allowed students opportunities to make volitional choices of activities and / or the direction of learning therein, as a basis of enhancing social connections with teachers (p. 262). Specific teacher-initiated support included:

1. The teacher asked students which topic areas they wished to discuss in more or lesser detail;
2. The teacher sought opinions as to how a specific subject / topic should be studied, in terms of the learning style to be used;
3. The teacher provides guidance about the different ways in which students may make better, informed choices about learning styles and depth of study;

4. That the teacher and student discuss the relevance and connections between learning activities and their relevance within real-world contexts;
5. That the teacher discusses students' perceptions and affective reactions with them;
6. The teacher listens to the student's ideas and opinions in class;
7. The teacher welcomes and is willing to discuss ideas that are contrary to those held by the teacher or knowledge that is presented as part of the learning activity, and;
8. The teacher is willing to listen to, acknowledge and discuss students' opinions about the level of motivation, interest and enjoyment during lessons.

(Kaplan and Assor, 2012, pp. 265-266)

One limitation of their study was that the focus was upon autonomy only, without taking into account the potential informing interplay between students' feelings regarding the quality of the teacher-student interpersonal relationship and perceived competence. A second limitation of the study, acknowledged by the study authors, is that the interventions did not investigate the specific influence of relatedness and competence mediating students' perceptions and reactions (p. 264).

2.19 The combined motivational impact of the three SDT constructs upon students' engagement with learning

Within these next three sub-sections, a BES approach has sought to identify and determine the motivational influence of each SDT construct upon the other two, their interplay, and the potential mediating impact that each basic psychological need has upon students' perceptions of self-determined motivation and engagement.

2.19.1 Studies primarily focusing upon Relatedness (Teacher-Student Relationship Quality)

Assor et al. (2005) investigated the influence of relatedness in the form of directly controlling teacher behaviours (DCTB) upon academic engagement. Students self-reported that teachers who were perceived to use DCTB resulted in students' restricted academic engagement with learning activities. By contrast, students who regarded their teacher as autonomy-supportive reported comparatively enhanced feelings of intensive academic engagement. Teacher control had a negative impact upon students' affect, and was more likely to result in student amotivation and disengagement. Affective responses included anger and anxiety, which often resulted in amotivation and the unwillingness of students to find means of adapting to environments where teachers exhibited DCTB. This led to negative responses by the teacher, such as attempting to be more controlling as a means of curbing, for example, unruly behaviour within the classroom, completly withdrawing support from the student as the teacher perceives that the student is not interested in or motivated by their subject (p. 410).

Hardre et al. (2006) focused upon this emerging important relationship in terms of the influence that relatedness (teachers' support behaviours) has upon students' perceived competence, intrinsic motivation, and motivation for engagement and achievement. Students' perceptions of the quality of teacher support had an impact upon perceived competence, with both being cumulatively predictive of their motivation to engage in learning. The evidence suggested that a student's individual affect-driven motivation to engage with learning activities is based upon his/her perceptions of the classroom environment. Key motivating factors within the classroom were a learning goal orientation (as opposed to a performance goal orientation), the enhancement of students' perceived competence within a specific subject / domain, and relatedness through teacher support. Each had a positive impact upon students' intrinsic motivation. Consequently, if teachers are to enhance and promote students' motivation for learning, they need to focus upon learning goals, the active promotion of students' perceived competence, and the development of students' self-determined motivation learning environment through teacher support (p. 204). In all investigated cases, the central importance of the teacher-student relationship was affirmed, whether through the provision of a supportive learning environment by the individual teacher or positive interpersonal relationships (p. 202). Gillet et al. (2012), however, noted declines in students' self-determined motivation perceptions which may be due to negative changes in the teacher-student relationships between the ages of 12 and 15, and Hardre et al. (2006) reported that, "While high school students are very peer conscious, teachers rather than peers can have the greatest effect on high school students' school-related motivation" (p. 202). As would logically be expected, differences in perception tend to vary from one student to another: for example, the "… need for cognition is the desire to think and know, not simply but deeply, and a student with a high need for cognition sees teacher support differently from a student who wants simple questions and easy or "right" answers" (p. 200). Such differences in the motivational need to be autonomous or to be controlled during learning activities depends upon the differences in students' perception of their subject-specific competence, and the perceived range and quality of support provided by a teacher. These differences may predict student motivation, in that a student who has more positive perceptions of relatedness, and its positive impact upon competence, are more likely to display typical autonomy behaviours, such as asking questions to gain mastery of concepts, asking questions to clarify the suitability of actions, and making self-determined choices as learning activities evolve.

Similar to Standage et al. (2006) and Zhang et al. (2012), Koka and Hagger (2010) investigated the impact of perceived teacher behaviours, such as care and support, upon students', aged 12 to 17, self-reported self-determined motivation and engagement during PE lessons. Teacher care and support that had a positive impact included monitoring progress, providing appropriate performance feedback and positive general feedback, giving praise, encouragement, guidance and helping student to work towards agreed targets, and scaffolding within learning activities to ensure competence-based achievement. The results suggest that both the quality of the teacher-student relationship and perceived satisfaction of the need for competence have significant positive effects on students' self-determined motivation (p. 82). This may vary with the age of the respondents, in that younger children (below the age of 11) may rely more heavily upon their teachers' feedback when forming opinions regarding competence. By contrast, older students may still perceive strong interpersonal relationships with their teachers but have formed cognitive benchmarks which they use to develop as the basis for more accurately perceiving their competence and self-efficacy. However, regardless of age, perceived competence was the strongest mediator between the teacher-student relationship and self-determined, motivated engagement with learning. Perceived competence was based upon performance feedback provided by the teacher, which, in turn, informed students' motivation to be autonomous (p. 81). As part of their findings, Koka and Hagger (2010) conversely found that perceived negative verbal and nonverbal feedback from the teacher had a significant effect on students' perceived competence, and, as a consequence, their self-determined motivation (p. 82). However, the study found that "… satisfying the psychological needs for competence and relatedness, but not autonomy, were related to students' self-determined motivation … the lack of a significant relationship between autonomy and self-determined motivation …" (p. 82).

The study concluded with a puzzle that may prove an impetus to find answers through further research: that is, "… to identify the general feedback components that contribute specifically to autonomy need support" (p. 83). One such component may be the impact of affective engagement as the basis for enhancing adolescents' academic performance and overall well-being in the classroom (Park et al., 2012). This three-year longitudinal study involved 94 students, aged 13 to 15, whose SDT need satisfaction was surveyed as a means of illuminating the motivational relationships between relatedness, in particular, and academic engagement. This was considered important for investigation as positive academic engagement appears to be a primary predictor of enhanced achievement in schools (p. 390). For the purposes of their study, affective engagement was defined as "students' affective response (e.g., happiness, anxiety, interest) to learning activities and to the people involved in those activities" (p. 390: based upon Appleton et al., 2008). Their findings revealed that students who self-report a greater sense of affective engagement within the classroom, both with their teachers and the afforded learning activities, were more likely to report greater well-being comparative to those with decreased or declining affective engagement. With the latter, such affective disengagement was predictive in that such students were more likely to self-report feeling amotivated, anxious or bored during learning activities. It was argued that SDT basic need fulfilment and the resultant perceptions of affective engagement fluctuate both temporally and across contexts, with fulfilment being directly related to affective engagement within specific contexts. It was asserted that the factor having the key motivational influence upon students is the teacher, who, by their methods, behaviours and responses, has the strongest impact upon the satisfaction of students' SDT basic needs and the resulting sense of affective engagement. Whilst the satisfaction of the needs for relatedness and competence both emerged as having correlative associations with affective engagement, this was fluid across time and context for individual students (p. 398). In common with other reviewed studies, relatedness and competence were predictive of students' motivation and the desire to engage with learning, with autonomy being a motivational need directly related to the students' perceptions and intentions to engage in learning: in particular, "… perceived opportunity for relatedness was more strongly associated with engagement for higher achieving students than for their lower achieving counterparts" (p. 398). It was found that gender (girls being slightly more, but not significantly, affectively engaged than boys) and ethnicity (black and Latino students being more emotionally engaged than white students) are moderating variables. Whilst gender and ethnicity influenced such perceptions within their study, prior achievement and socioeconomic status did not (pp. 395-396).

Whilst other studies had considered the impact of relatedness, through the teacher-student relationship quality, including teacher care and support, upon students' perceived competence and the motivation to be autonomous, Sakiz et al. (2012) specifically investigated affective support by teachers as the basis for enhancing students' feelings of belonging, academic enjoyment, academic optimism and self-efficacy / perceived competence and engagement. The study harvested students' perceptions during a single data point. Significant associations were reported between perceived teacher affective support and students' motivational, affective and engagement behaviour outcomes. The findings of this study bears similarities to Gillet et al. (2012), in that it recognises a decline in students' self-determined motivation and engagement with learning during early adolescence. Whilst Gillet et al. (2012) does not go much further than recognising this decline and stabilisation, Sakiz et al. (2012) states that this decline may be, as revealed by students' self-reports, for two reasons. The first is a perceived decline in teacher support across the middle school years. The second is a declining sense of belonging and relatedness through less positive teacher-student relationships at a time (early adolescence) when students' needs for higher quality interactions with their teachers and a sense of belonging increase (p. 236).

Teachers' behaviours that had an impact upon students' perceived positive affective support include caring for and interest in students, demonstrating respect and concern as appropriate, listening and responding to students' ideas, recognition of effort, and fair treatment. These were argued to be positive predictors of students' positive self-concept, academic effort, academic achievement, and the pursuit and practise of prosocial behaviours (Tharp and Gallimore, 2008). Such relatedness-enhancing behaviours were the basis of the development of higher expectations of students, and were associated together. That is, a teacher who had a stronger affective and relational bond with a student had higher expectations of the student than, conversely, where the bond was weaker. In the latter case, the teacher was perceived to have lower expectations of the student. This sense of relatedness combined with the teacher's expectations of the individual student had a predictive impact upon the student's perceived self-concept (such as competence, academic enjoyment and self-efficacy). For example, teacher affective support had significant associations with students' sense of belonging (065: $p = <0.001$), academic enjoyment (0.62: $p = <0.001$), and self-efficacy (0.55: $p = <0.001$). These student perceptions were significant mediators of academic engagement.

The theme of enhancing students' sense of relatedness within individual classrooms through teacher support is common to both Shih (2008) and Shih (2009). Both studies focused upon autonomy support by teachers, which, it was argued, will only be regarded as positive by students when certain motivational characteristics are in place. These characteristics should promote and predict students' academic engagement. That is, when students are more fully affectively and behaviourally engaged with learning, this is predictive of students' enhanced positive perceptions of teachers' autonomy supportive behaviours, mediated by feelings of intrinsic motivation relating to the perceived relevance of and personal interest in learning activities (Shih, 2008).

Prompted by the findings of all of the studies discussed within this MER, the puzzle continues to arise as to whether all three SDT constructs are simultaneously and equally influential upon self-determined motivation and the desire to be engaged in learning activities. That is, it may be that the quality of the teacher-student relationship (relatedness) and satisfaction of the need to feel competent (competence) are vital pre-requisites if students are to feel motivated to be autonomous. That is, that the need to exercise autonomy and to be volitional within learning contexts is an outcome that may be regarded as predictive of autonomous engagement with learning. (These points have been investigated within the main study: Chapters 3 and 4). Such a puzzle was supported by the findings of Zhou et al. (2012). Their study compared Chinese and American students' perspectives of their teachers' relational and instructional behaviours. A paradox was the starting point for the study, in that although Chinese students (aged 10 and 11 years old) were taught by teachers who appeared to use DCTB in the classrooms, the result was consistent high academic achievement amongst the children. This was a paradox in that high achievement by students is usually associated with autonomous approaches to learning within autonomy supportive learning environments. Their focus, therefore, centred upon students' affective perceptions of their teachers' behaviours, within selected Chinese and American classrooms, to determine if the differences were cultural rather than a universal human norm. By comparison with the sampled US students, for the Chinese students, the quality of the teacher-student relationship (relatedness) had a moderate effect upon the quality of motivation (0.21). Such motivation was mainly confirmed through internalisation via consideration, reflection, prior experience, and goal orientation. By contrast, for the US sample, the direct association between relatedness and motivation was weaker (0.12). However, for the sample of US students, comparative to the Chinese sample, the quality of the teacher-student relationship (relatedness) had a stronger influence upon internalisation (0.52), with the resulting internalisation having a significant impact upon the quality of motivation (0.74). This suggests that, for both cultural samples, there are mediating variables that influence the quality of students' motivation in the classroom. This appears to include the affective meanings that the DCTB of teachers have upon students' perceptions of relatedness (Zhou et al., 2012, p. 1169). The authors note that "… students with high (vs. low) social-emotional relatedness with their teachers reported more positive and less negative feelings toward the same controlling behaviors of their teachers. Student perceptions of teacher controlling behaviors depended largely on the level of the teacher–student relationship" (p. 1170). Therefore, the quality of the teacher-student relationship appears to have an affective and cognitive influence upon how students' perceptions are skewed towards teachers' instructional behaviours, in terms of the degree to which they are regarded as encouraging autonomy or being controlling.

Across the reviewed research, relatedness (students' perceptions of the quality of their relationships with their teachers) consistently emerged as having a mediating influence upon students' academic motivation, including the desire for autonomy, an outcome supported by the research of Ryan et al. (1994). Their findings suggested that perceived autonomy and the motivated desire to engage fully with learning activities was enhanced and more positive when students held positive perceptions of the teacher-student relationship quality. Amongst the 606 sampled US students, aged between 12 and 14, the girls reported higher levels of relatedness than boys. However, regardless of gender, there were positive correlations between students' positive perceptions of the teacher-student relationship and their perceived competence, enjoyment and motivation to be autonomous. The conclusion drawn was that early adolescents' positive perceptions of the quality of their relationship with an individual teacher was a significant factor in positive functioning and adjustment during lessons. Such adjustment was based upon students feeling secure with the teacher through the provision of the teachers' supportive behaviours, especially interpersonal support, behaviours that enhance students' perceived competence, and that teachers, as individuals, are regarded as approachable and helpful in terms of assisting students with their need to be more competent and confident (Ryan et al., 1994, p. 244). The mediating association between relatedness and engagement is potentially reciprocal via perceived competence and autonomy (p. 245), with associated teacher behaviours leading to stronger and more positive perceptions of competence, motivation and well-being temporally. Therefore, whilst the motivation to be autonomous and self-determined have been shown to be predictive of engagement and achievement, the pre-requisite appears to be a strong interpersonal relationship between the student and teacher. This relationship is strengthened by the teacher's afforded behaviours that lead to the enhancement of students' positive perceived competence. This was also found by Shen et al. (2009), who administered surveys to 253 students aged 12 to 14 at two data points four months apart. These surveys investigated the effect of students' autonomous motivation and perceptions of autonomy need satisfaction based upon the provision of teachers' autonomy supportive behaviours, and their potential relation to overall achievement within PE lessons. Further to Ryan et al. (1994), Shen et al. (2009) reported that students' perceptions of teachers' autonomy supportive behaviours predicted students' adjustment to social-contextual influences within the classroom, which, it was posited, led to enhanced knowledge and achievement. Perceptions of relatedness and competence was particularly enhanced amongst students who had not, prior to the study, regarded themselves as autonomously motivated to learn. Positive perceptions of teachers' autonomy supportive behaviours were associated with positive perceptions of the teacher-student relationship. In turn, changes in students' perceptions of teachers' autonomy support positively predicted changes in the students' autonomous motivation, their perceived quality of the teacher-student relationship, and the satisfaction of the need for competence (p. 49). It was concluded that the presence, absence or variance of teachers' autonomy support predicts learning achievement and changes in students' autonomous motivation for learning activities (p. 50). Such changes in the evolution of students' perceptions of the quality of the teacher-student relationship and perceived competence were positively associated with enhanced perceptions of teachers' autonomy support and interrelated changes to students' autonomous motivation (p. 51).

2.19.2 Studies primarily focusing upon Competence

Five of the included studies focused primarily upon the enhancement of perceived competence through the lens of SDT. Conroy et al. (2005) focused upon the impact of the satisfaction of the three SDT basic psychological upon the enhancement of 165 US students (aged 7 to 18) perceived competence and subsequent engagement with activities. The research design was longitudinal, with surveys being administered at the beginning, middle and end of the swim season. The specific focus was the influence of feedback from adults upon students' perceived competence and self-esteem, and the resultant potential impact upon sustained engagement with activities.

Common across the age range cohorts was the association between higher levels of perceived competence and higher self-efficacy, higher self-esteem, and higher competence need satisfaction. This association was correlated with higher levels of self-determined motivation and intrinsic motivation. Clearly, the variance in perceptions was measured at the within-subject level. However, it was also possible to make inferences as to the key mediating and influential variables at the between-subjects level. As with other studies focusing upon the influence of the teacher upon students' engagement with learning, a central influence upon the enhancement or thwarting of self-determined motivation, and the resultant quality and persistence of the desire to engage with learning in a specific context, was the motivating presence of upon teacher-afforded variables such as care, support and feedback. Ultimately, perceived competence was found to be predictive of sustained engagement, higher levels of self-reported intrinsic motivation and self-esteem. Such findings were based upon the satisfaction of all three SDT basic psychological needs. Students who self-reported a fear of failure (absent or low self-efficacy) reported negative perceptions of low self-esteem, as well as low domain-specific self-concept and competence (p. 107). Similar to Bandura (1977), Conroy et al. (2005) conclude that "Settings where children and youth have opportunities to practice a set of … skills while receiving reasonable instruction and feedback should enhance self-efficacy and perceptions of competence" (p. 108).

The influence of perceived competence upon students' acceptance of teachers' autonomy supportive behaviours was explored by Guay et al. (2001). The longitudinal prospective design utilised two data points in order to test three hypothetical models. The first model was based upon the SDT microtheory, Cognitive Evaluation Theory (CET: Deci and Ryan, 1985): this posited that teachers' autonomy supportive behaviours led to changes in students' intrinsic motivation. Such changes were due to mediating changes in students' perceived competence. The second and third models tested were based upon the Diathesis Stress Model of Achievement (Boggiano, 1998). The two models emphasised intrinsic motivation as the mediating variable between changes in perceived competence and teachers' support of students' autonomy during learning activities. The view central to all three models is that teachers' autonomy supportive behaviours can directly satisfy students' sense of competence and have a causal influence upon intrinsic motivation. By contrast, it was argued that DCTBs thwart students' perceived competence (Guay et al., 2001, p. 643). Whilst the findings provided some support for the SDT-based CET model, there was stronger correlative support for the other two models: that the influence of intrinsic motivation appears to be the mediating variable between students' perceived competence and their self-reported motivation for autonomy. That is, changes in perceived competence were positively associated with changes in intrinsic motivation (p. 649). Such changes in intrinsic motivation appeared to mediate between changes in perceived competence and students' receptiveness to teachers' autonomy support behaviours and methods (p. 649).

Kajala et al. (2009), similarly, focused upon the motivational relationship between the teacher, perceived competence, and self-determined motivation within the social context of the classroom. The research method was a single survey of 370 12 to 13 year-old students in

Finland, which harvested their responses regarding the key variables that informed their engagement or disengagement during PE lessons. The results revealed that the teacher's affordance of a task-involving climate (where students are rewarded for effort, and are involved in learning activities that emphasise mastery goals, in-depth conceptual understanding, cooperation and task mastery) has a positive influence upon the enhancement of perceived competence. In turn, enhanced perceived competence had a positive impact upon students' perceived self-determined motivation. By contrast, within an ego-involving climate (where the teacher places an emphasis upon performance goals, achievement benchmarks and comparisons between students), there was found to be a negative impact upon the enhancement of perceived competence, which, in turn, had a negative influence upon students' perceived self-determined motivation. The findings emphasise the importance of placing teacher behaviours and methods within the classroom at the heart of the satisfaction of all three of the SDT basic psychological needs. For example, competence was enhanced by success within learning activities and the quality of relationships within the classroom, which, in turn, mediates the development of self-determined motivation to engage in further activities (p.328). Kajala et al. (2009) suggest, similar to other studies, that perceived competence is the key mediator between the quality of the teacher-student relationship (relatedness) and the motivation to be autonomous (autonomy) within SDT, as:

> "… a mastery supportive motivational climate influences perceived competence, which in turn affects motivation…" and that "…teachers are in a position to stimulate students' [learning] by emphasizing student effort, progress and learning. Such a climate seems to facilitate the stimulation of students' need for competence, in turn stimulating more self-determined forms of motivation…"
>
> (p. 328)

They also note that whilst students' autonomous motivation can lead to the enhancement of mastery skills, students need to perceive themselves as having the self-efficacy to develop such skills through the exercise of their autonomy.

Jaakkola et al. (2013) investigated the influence of selected contextual motivational variables and perceived competence as variables predictive of engagement with activities during PE lessons. This was a three-year longitudinal prospective design, with responses being harvested through the use of surveys at three data points. The results shared similarities with Kajala et al. (2009), which, given that Jaakkola was involved in both studies, is hardly surprising. Both studies confirmed the important influence of a teacher-afforded task-involving climate upon students' positive desire for engagement via the mediating motivational variables of students' perceived competence and intrinsic motivation for learning. These findings also bear similarities to and are built upon the assertions of Cox and Williams (2008). The findings from all three studies suggest that perceived competence, including self-efficacy, when encountering a new learning activity, has implications for cognitive, affective and behavioural engagement within a specific context. Within the settings investigated, it appeared that classroom environments where teachers placed an emphasis upon the support of students' mastery of learning activities had a resultant positive influence upon students' perceived competence and intrinsic motivation. In turn, within the confines of the study, both perceived competence and intrinsic motivation emerged as predictive of initiated and sustained engagement during activities.

The findings of Kajala et al. (2009) and Jaakkola et al. (2009) have been indirectly supported by the study of Skinner et al. (2012). The latter study involved 310 US 11 to 13-year-old students, the majority of whom self-reported that their feelings of intrinsic motivation and the need to engage with learning were predicted by perceived competence and autonomy. The strength and direction of these perceptions were, in turn, predictive of sustained engagement and subsequent achievement. It is emphasised throughout the study that teachers ultimately influence and shape students' self-perceptions and, as a consequence, their engagement. This study, which built upon the prior findings of many years of research studying students' perceived competence, revealed that "…perceptions of self-efficacy, ability, academic competence, and control are robust predictors of school engagement, learning, academic performance, and achievement ..." (p. 19) through "… the quality of student-teacher relationships, in the form of caring supportive alliances, has been emphasized as a key predictor of academic engagement, effort, and achievement expectancies …" (p. 19). They note that only "recently, autonomy supportive instruction (giving choices, making learning relevant) has also been linked to engagement" (p. 19). Behavioural engagement, affective engagement and disaffection were reported to be significant predictors of students' engagement with learning activities. By contrast, the need for autonomy and intrinsic motivation appeared to have indirect effects on learning and achievement. Of the two, intrinsic motivation had a stronger predictive influence upon learning and achievement than students' need to be autonomopus (p. 32). Therefore, it was inferred that "… there may be other mediators besides engagement through which autonomy and intrinsic motivation shape learning … At the same time, they may also reflect reciprocal effects, in which greater learning … fosters more intrinsic motivation and a greater sense of autonomy" (p. 32).

2.19.3 Studies primarily focusing upon Autonomy through Autonomy Support and Autonomous Motivation

Whilst reviewing the studies discussed within sections 2.19.1 and 2.19.2, there arose a puzzle as to the classroom-based variables that influence students' motivation to be autonomous and their receptiveness to teachers' autonomy supportive behaviour. From the review of the prior research during the current MER process, it appears that autonomy may be a motivation-regulated behavioural outcome when considered through the lens of SDT. That is, that the motivation to be autonomous may be an outcome that is indicative of the students' perceived quality of the teacher-student relationship (relatedness) and the extent to which they perceive themselves as competenent in relation to specific learning activities. Such autonomous motivation may also impact upon students' self-direction and autonomy during learning activities. This puzzle, in particular, was borne in mind whilst analysing the seven included studies that had focused upon autonomy and autonomy support. The puzzle has also been explored further within the main study through the two research questions (section 1.1).

Autonomy has been defined as the student's desire to have and make the most of opportunities for self-initiation and self-direction within learning activities. Prior research has suggested that the need to be autonomous is often predictive of students' intrinsic motivation (Shih, 2008, p. 323). Gillet et al. (2012) proposed that students' perceptions of teachers' autonomy support are predictive of the strength and direction of students' self-determined motivation to engage with learning. They report a decline in motivation between the ages of 9 and 12, particularly when students made the transition from Canadian elementary to middle schools. There was stabilisation in levels of self-determined motivation between the ages of 12 and 15, with a positive enhancement noted from 15 years onwards. On this basis, Gillet et al. (2012) suggest that forms of engagement-predictive motivation (including intrinsic, self-determined, extrinsic motivation and amotivation) are functions of and are dependent upon age, mediated by students' perceptions of the teacher and teacher-afforded support. Teacher autonomy supportive behaviours were positively predictive of intrinsic motivation and self-determined motivation to engage with learning activities, whilst a lack of autonomy support by the teacher was predictive of amotivation and the absence of a self-determined motivation to engage with learning (pp. 88, 90).

Hagenauer and Hascher (2010) found that teachers' autonomy supportive behaviours have a positive mediating influence upon intrinsic motivation via the positive or negative influence of students' perceived competence. Their study revealed perceived competence as the mediating construct between students' intrinsic motivation to engage in learning activities and the extent to which they perceived the teacher's behaviours to be autonomy supportive. By applying SDT as a theoretical lens, it was self-reported by students, aged between 11 and 13 years, that they were more likely to be motivated to engage with learning activities during the time after their transition to middle / junior high school when they were taught by teachers who enhanced their perceived competence.

Shih (2008, 2009) both reported that the students they had surveyed had self-reported that when they felt more intrinsically motivated, they perceived correspondingly higher levels of teacher autonomy supportive behaviours. Their findings suggest that the students' self-reported perceptions of their motivation to engage with learning within a specific classroom was a significant predictor of perceived levels of teachers' autonomy-supportive behaviours. By contrast, students who did not regard themselves as motivated to engage with their learning activities perceived correspondingly lower levels of teacher autonomy supportive behaviours. One of the suggestions for further research was the need to investigate if autonomous motivation is potentially predictive of the extent to which a student's motivation or amotivation to be engaged in learning is based upon either positive or negative perceptions of teacher autonomy support. This was partially explored by Van Ryzin (2011), who reported that autonomy support and engagement were enhanced over time, mediated by relatedness in the form of teacher support. Reciprocal effects were found between students' earlier perceptions of engagement with learning activities and their later perceptions of the motivating and engaging nature of the classroom. Van Ryzin (2011) argued that the positive enhancement of adolescents' engagement levels may be linked to a variety of interrelated positive outcomes, such as academic achievement and adjustment within the school setting. The study measured perceived autonomy, perceived teacher support, perceived mastery and performance goal orientations, engagement in learning, and academic achievement. There was attrition bias in that there was some missing data from the second data point, as a result of absenteeism, departure of students to other schools, and the unwillingness of a small number of students to participate (p. 1572). To address this, the demographics of the student population at the second data point were compared with those at the first data point: these were found to be very similar. The findings were that engagement was predictive of significant variance in perceptions of teacher support and autonomy, and that both predicted changes in engagement. Goal orientation was proposed as a mediating variable, with performance goal orientation being predictive of low levels of perceived teacher support and autonomy. By contrast, mastery goal orientation was found to be predictive of higher /

enhanced levels of perceived teacher support and autonomy (p. 1574). The influence of autonomy upon engagement was not found to be a direct effect, but autonomy did exert indirect effects upon hope via engagement in learning. Significantly, autonomy was not correlated with achievement but may have a mediating influence. Van Ryzin (2011) states that students' perceptions of the school / classroom context have an influence upon students' motivation to engage with learning.

Arnone et al. (2008) investigated the perceptions of 1272 13-year-olds, in terms of the extent to which they perceived that adults exhibited motivating autonomy supportive behaviours, and the impact that such perceptions had upon students' perceived competence and intrinsic motivation. The results from the single data point questionnaires revealed that, according to the sample surveyed, the adult plays a key role in building students' confidence in their own competence and their intrinsic motivation to engage in learning activities within specific contexts (p. 128). These perceptions of motivation appear to mediate for achievement, with intrinsic motivation to engage in learning activities being based upon a student's confidence in their own ability to undertake activities successfully. Whilst the focus of the study was upon teachers' autonomy support of students, the vast majority of the recommendations for encouraging students' autonomy pertain to enhancing students' relationships with the teacher and the students' perceived competence. These include frequent interactions with teachers during collaborative projects, a focus upon relationship enhancement, modelling enthusiasm for and confidence in students' ideas, providing academic and emotional support which result in regular opportunities to achieve success, and providing informative feedback in a positive manner. Such feedback included an emphasis upon had been done well and why, and what may be done next to achieve further competence and success.

De Naeghel et al. (2012) investigated the contextual factors that appear to enhance students' volitional and autonomous engagement with reading activities and overall achievement in reading. The findings were that autonomous motivation was predictive of and predicted by reading frequency, engagement and achievement. They surveyed 1260 students, aged between 10 and 11 years old, alongside measuring reading comprehension. Explicit reference was made to intrinsic motivation as both a cognitive and affective psychological factor manifested as autonomous, self-determined behaviours. Such behaviours include seeking challenge during learning activities (p. 1007). On the basis of the evidence collected, it was proposed that positive perceptions of autonomous motivation and subject-specific self-concept are predictive of more positive engagement behaviours and achievement.

Conversely, more negative perceptions were predictive of subject-specific disengagement, amotivation and comparative lower levels of achievement (p. 1015). Similar to other research, De Naeghel et al. (2012) regarded academic self-concept as a form of perceived competence whilst autonomous motivation was presented as synonymous with self-determined motivation. It was noted that academic self-concept was predictive of persistence of engagement with activities whilst autonomous motivation was predictive of the frequency of involvement in an activity (p.1016). In addition, autonomous motivation had a stronger influence upon students' engagement with recreational reading, whilst reading competence was more frequently a mediator of classroom-based reading. A middle ground may be achieved when students engage in classroom-based reading through a mixture of intrinsic motivation (enjoyment and an interest in reading and the encountered reading materials) and the need to enhance competence, achievement and self-efficacy through success in academic reading tasks. Changes in students' orientation between intrinsic and the need to enhance perceived competence may be developmental, and was noted as being worthy of further research (see main study and section 5.6).

Ntoumanis (2005) investigated the influence of the satisfaction or non-satisfaction of all three SDT basic psychological needs upon students' cognitive and affective perceptions informing their motivation to engage with learning. Analysis of the evidence enabled further interpretations of the impact of students' perceived relatedness and competence upon their receptiveness to autonomy support behaviours and feedback provided by the teacher. For example, students who self-reported high levels of SDT basic need satisfaction were more likely to self-report higher levels of self-determined motivation. As a result, these students were found to be more receptive to a teacher's competence-informing feedback and autonomy supportive behaviours. Students choosing to engage further in PE activities self-reported that they had enjoyed more positive motivational experiences in the previous school year, when compared with those who did not. These positive experiences were founded on social-contextual and personal factors, including a positive teacher-student relationship based upon teachers allowing students to take leadership roles within the classroom, involving students in decision making, affording a motivational climate that emphasises the competence of students, and encouraging students to develop their perceived competence as the basis for becoming more self-efficacious when approaching new learning activities. The results, as correlations, indicate that whilst there is a strong association between competence and autonomy, there is an equally strong association between relatedness and competence. However, there was a more moderate association between relatedness and autonomy.

Therefore, further to section 2.9, it may be that perceived competence has a hierarchical impact as the mediating SDT basic psychological need between the teacher-student relationship quality and the motivation to be autonomous. This is investigated within the main study.

Vansteenkiste et al. (2005: Study 3) investigated students' perceptions of factors informing the extent to which teachers' behaviours were regarded as autonomy supportive as opposed to controlling. It was found that such perceptions are entirely subjective, both within-subject and between-subjects, and was partially framed by the goals informing early adolescents' (aged 11 and 12) involvement in learning activities. The outcomes of the survey of 80 students suggest that students' intrinsic goal framing – the extent to which goals, and related learning activities, were regarded as enjoyable, interesting and enjoyable – informed the effort, persistence and task involvement central to their engagement with learning activities. It was also reported that the surveyed students' perceptions of teachers' autonomy supportive behaviours were predicted by autonomous motivation, dependent upon whether goals are perceived by students as intrinsic or extrinsic:

> "… by framing a particular learning activity in terms of the attainment of either an intrinsic goal (e.g., self-development) or an extrinsic goal (e.g., financial success) … [and] presenting the learning material as serving the attainment of an extrinsic goal undermined deep processing of the learning material, academic achievement, and persistence compared with intrinsic goal framing"
>
> (p. 484)

One outcome was that teacher phrases such as "You could" and "You might" (as opposed to "You should" and "You must") were regarded by students as more autonomy supportive, and therefore more predictive, than controlling phrases, of the motivation to engage with learning activities. These intrinsically framed goals and teacher statements (communication style) were proposed as the motivational impetus for students' willing engagement with task involvement and conceptual learning (p. 496). Such an impetus resulted in increased engagement with tasks, involvement at a more in-depth level with learning tasks, enhanced motivation to be autonomous, and enhanced conceptual learning temporally. Similarly, students' positive perceptions of teachers' autonomy supportive behaviours predicted students' positive perceptions of relative autonomy (0.89) and, to a lesser extent, conceptual learning (0.39) (p. 497). In summary, the key finding was that "… when early adolescents were approached in an autonomy-supportive way rather than being pressured in a subtle way to pursue these goal contents, their conceptual learning was enhanced as well. Such results were not found for rote learning" (p. 499).

Vansteenkiste et al. (2012) investigated the associations between students' autonomy support perceptions and the influence of perceived relatedness and competence had upon such perceptions, as well as resultant changes in their self-regulated motivation and engagement with learning. The findings were that teaching characterised by clear expectations of students and teacher autonomy supportive behaviours were predictive of positive motivational and engagement outcomes. Conversely, unclear expectations and DCTBs were related to negative perceptions and behaviours, such as amotivation and disengagement (Reeve et al., 2014). Autonomous functioning by students were not regarded as independent learning or unlimited freedom during learning activities. Instead, optimal autonomous motivation was posited as involving teachers' autonomy supportive behaviours that are built upon students' positive perceptions of a strong interpersonal relationship with the teacher, who provides feedback and assistance that has a positive influence upon students' perceived competence (Vansteenkiste et al., 2012, p. 432).

The frequency, persistence and intensity of engagement in activities where there were opportunities for students to exercise volition and self-direction was perceived as predictive of autonomous motivation, autonomy need satisfaction, and thus, in consequence, students' engagement and academic achievement (Jang et al., 2012). Teachers' autonomy supportive behaviours were also predictive of engagement and learning achievement. Although the study was the only one within the MER that focused exclusively upon the association between autonomy, autonomy support and engagement, no opportunity was taken to consider the influence of other SDT and mediating variables upom engagement. This is, however, acknowledged by the authors within their conclusions (Jang et al., 2012, p. 1184).

Therefore, in summary, a volitional and willing engagement with learning activities is dependent upon teachers' optimal autonomy-supportive behaviours (such as offering direction to ensure success and enhanced competence, setting achievable goals that enable temporal progress, giving clear expectations, communicating progress through regular and informative feedback) reinforced by students' enhanced perceived competence and self-efficacy, based upon the care and support provided through teachers' feedback. One translation of these findings is the influence of the quality of the teacher-student interpersonal relationship upon students' positive or negative receptiveness to teacher's competence support and autonomy support behaviours and methods. This presumes that where there is a positive perception of the teacher-student interpersonal relationship, there will be corresponding positive perceptions of competence and autonomy, and, in turn, upon a student's motivation for and actual engagement with learning.

2.20 A potential modification to SDT in the classroom informed by the emergent influence of teacher-student relationship quality upon students' engagement with learning activities

The MER findings suggest that, when considered through the lens of SDT, students' perceived quality of the teacher-student relationship has an associated influence upon their perceived competence. The quality and persistence of perceived competence has commonly emerged as having an impact upon students' desire to be autonomous within learning activities. From the MER, it most frequently emerged that students' perceived relatedness (especially the quality of the teacher-student relationship) and the satisfaction of their need to perceive themselves as competent are potentially the central motivational SDT-based variables within the classroom environment. These, in turn, appear to act as the catalysts for competence motivation, self-determined motivation, autonomous motivation, and sustained engagement behaviours during a learning activity. From the emergent pattern of common motivational patterns across the MER, it appears that, within formal learning settings such as classrooms, students' autonomous motivation may be an outcome predicted by and predictive of the perceived quality of the teacher-student relationship (SDT: relatedness) and the direction and persistence of students' perceived competence (SDT: competence). Both the perceived quality of the teacher-student relationship and students' perceived competence appear to be informed by cognitive and affective responses to learning activities. Such responses include perceived self-efficacy and desired competence motivation. This resonates positively with the findings of numerous prior research studies, whuch have reported that, during specific learning activities, autonomous motivation and self-determined motivation are both influenced by students' perceived competence and relatedness (Reeve, 2002, 2012).

From the MER, a common pattern is suggested. That is, that students' autonomous motivation for learning appears to be based upon the development of a positive teacher-student relationship informed by the direction and persistence of the students' perceived competence. These were informed, for example, by teachers' interpersonal care and teaches competence support of students respectively. It may, therefore, be that the perceived teacher-student relationship (relatedness) influences students' direct perceptions of competence and their receptiveness to competence-related feedback from the teacher. In turn, it appears that the quality and nature of perceived competence informs motivational drives, including self-efficacy and enhanced intrinsic motivation, accompanied by affective responses predictive of engagement. Positive perceptions of competence were associated with stronger perceptions of relatedness, such as a positive teacher-student relationship quality, and greater incidences of self-reported intrinsic motivation. By contrast, students with lower or more negative perceptions of their competence reported lower levels of intrinsic motivation or regarded themselves as relying upon the teacher as a source of extrinsic motivation.

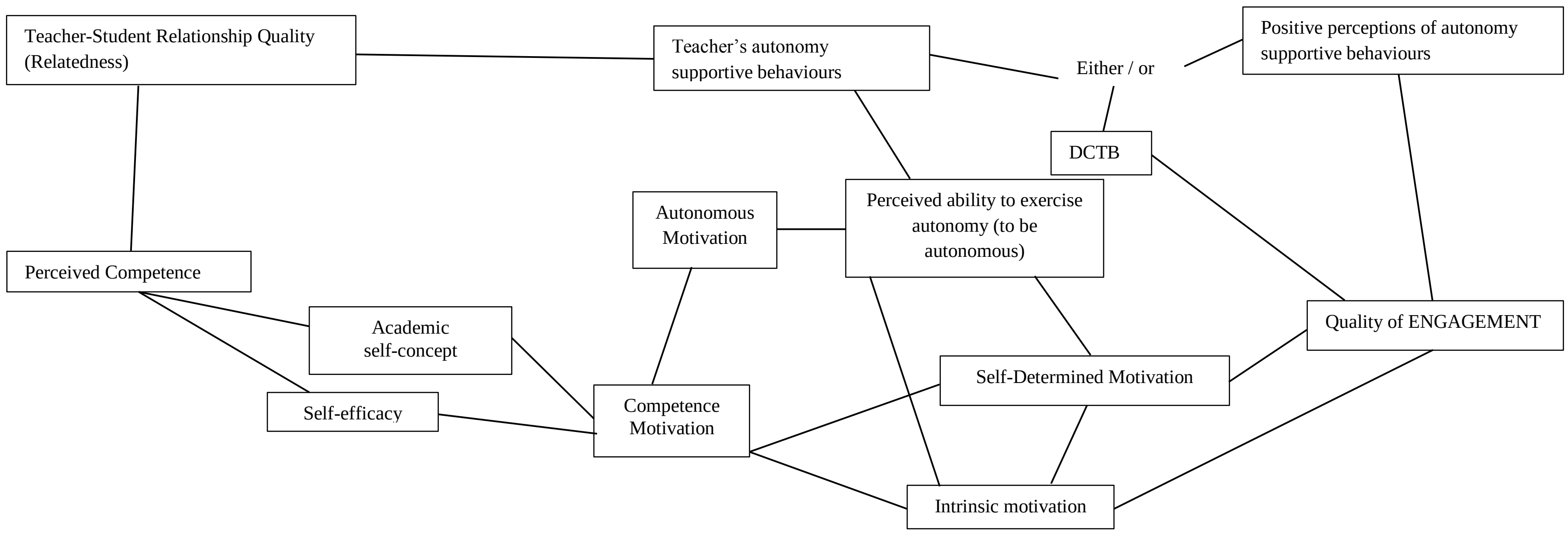
The emergent variance in the hierarchical influences of each of the SDT basic psychological needs upon the other two needs, and the impact of variance in the hierarchy, and students' motivated engagement with learning has led to a puzzle: the extent to which autonomy is a motivation-regulated outcome within SDT. The patterns across the reviewed research within the MER suggest that autonomy is an outcome directly mediated by students' feelings of relatedness and competence associated with interactions with individual teachers. That is, autonomy is a motivation-regulated behavioural outcome within SDT rather than having the same probabilistic causal influence that relatedness and competence have upon students' self-determination motivation. As a teacher, it makes experiential sense to posit the quality of the teacher-student relationship as central to the positive development of a student's psychological security and a sense of belonging, as the perceived quality of the teacher-student relationship has an impact upon the development of adolescents' self-concept and perceived competence-informed capabilities (Ryan et al., 1994).

If autonomy is an outcome in classroom-based learning, when viewed through the lens of SDT, the decision to be autonomous will be made in response to affective and cognitive perceptions of the extent to which students perceive that the teacher meets their needs for both relatedness and competence (Appleton et al., 2008; Hipkins, 2012; Lam et al., 2012; Park et al., 2012). That is, while the basic need for autonomy is an essential element of self-determined engagement with learning, its presence as optimal autonomous motivation is only predicted by students' positive perceptions of the teacher-student relationships *and* competence.

Finally, a number of researchers have mooted that the association between SDT-informed motivational variables is reciprocal in influence. However, they do not state which, if any, of the constituent variables has a greater influence upon the others or upon students' motivation to enage with learning activities (for example, Hattie, 2009; Marsh, Craven and Debus, 2006; Marsh and Martin, 2011; Reeve, 2012). Therefore, it is suggested that further research may lead to the identification of the key behaviours and strategies that teachers can use to reciprocally enhance both students' motivation and the quality of the teacher-student relationship. This should include how such behaviours and methods influence the transformation of different forms of motivation into affective, cognitive and behavioural engagement outcomes. These could then be used to inform further predictive outcomes for the reciprocal benefit of student and teacher alike (Zhang et al., 2012).

The consistency of the motivational patterns, on the whole, within the MER was such that, based upon the second-and third-order interpretations, an overarching model has been developed (Figure 2.6). This illustrates the potential motivational pathways between the SDT constructs, motivation-based responses, and student engagement. Both the BES (Table 2.4) and the potential motivational pathway informed the research and analysis methods within the main study central to the current research (Chapters 3 and 4). Within the proposed model, autonomous motivation is presented as an outcome predicted by and predictive of the quality of intrinsic and self-determined motivation, both of which are, in turn, predicted by competence motivation. The proposed model is represented as a 'net of causation' built upon conditional probability (Morrison, 2009, pp. 13, 45). It is envisaged that the development of the proposed model may be used by teachers as the basis for contextual behaviours and methods that may enhance students' self-determined motivation to engage with learning activities.

Figure 2.6 *Potential motivational pathway between the three SDT constructs based upon the findings of the MER (Stage One)*



CHAPTER THREE

THE MAIN STUDY: The in-situ investigation of the interplay between SDT constructs and the impact of such upon students' engagement with learning

Stage One – QUESTIONNAIRES

3.1 Using the common findings across the MER as the research focus for the Main Study

The most frequent common finding that emerged across the MER studies (Chapter 2) was that the satisfaction of students' needs both for a positive teacher-student relationship and to perceive themselves as competent appear to be significant predictors of students' motivation to be autonomous, alongside their enhanced enjoyment of and engagement with learning. Conversely, teachers' neglect of students' needs for a positive teacher-student relationship and to perceive themselves as competent appear to be significant predictors of diminished autonomous motivation and increased disengagement for learning. Such common findings stimulated a puzzle as to the potential motivational pathways of influence between classroom-based relatedness, competence and autonomy. The importance influence of the quality of the teacher-student interpersonal relationship upon students' corresponding positive or negative perceptions of teacher's autonomy- supportive behaviours and methods was proposed and supported at both the within-study and cross-studies level. That is, where there were self-reported positive perceptions of the teacher-student interpersonal relationship, there were corresponding positive perceptions of competence and autonomy, and in turn, the students' motivation for and actual engagement with learning was positive. It was also consistently revealed that students' positive desire to be in a specific classroom, studying a specific subject with a specific teacher, is likely to result in a positive outcome in that students will perceive a personal value in engaging with learning activities, and will be more receptive to the teacher's interpersonal, competence-enhancing and autonomy-supportive behaviours (Black and Deci, 2000; Reyes et al., 2012).

These findings all point to the possibility that students' autonomous motivation (SDT: autonomy) is a motivational outcome influenced by the combined impact of students' affective and cognitive perceptions of the extent to which an individual teacher affords opportunities that enhance their perceived competence and the perceived quality of the teacher-student relationship (see section 2.20). These ideas have been explored further within the main study (Chapters 3 and 4).

3.2 Introduction to the Research Design of the Main Study

Further to the criticisms of SDT discussed in section 2.9, the conclusions drawn by prior research within the MER have been explored within the main study (section 2.20). This study has used a research design that enabled the investigation of the impact of students' perceptions of SDT-based relatedness and competence upon students' autonomous motivation, self-determined motivation and engagement with science within the teacher-researcher's school setting. An identified gap within the reviewed studies was the absence of interviews or focus groups as a means of enabling the in-depth exploration of the classroom-based experiences and perceptions that influence students' decisions to either engage or disengage with learning (Section 1.6). This gap has been addressed within the current study through focus group interviews across four different cohorts.

The main study, herein, has investigated the extent to which the common motivational patterns proposed across the MER studies may be applied as one means of identifying and understanding key variables that inform students' motivation to engage with learning activities. Through the two research questions, the MER findings and conclusions have informed the research design, research methods and analysis methods for the main study.

Both research questions pointed towards a research design which acknowledges that the responses of students are subjective, interpretive perceptions, informed by the individual circumstances which they perceive themselves to be in. Having defined a research design that would ensure that the data collected would provide answers to the research questions, the next stage involved identifying the methodology appropriate to the research design (Clough and Nutbrown, 2012; Gorard, 2013; Robson, 2011; Thomas, 2009). Given that each school will be unique in terms of its teachers and the students they teach, there was the need to ensure that the findings from the context-based research methods used within the school under scrutiny can be applied by teachers within similar settings. This led to the choice of methods that would optimise the harvesting of students' self-reported perceptions of the key behaviours and factors within the learning environment that motivate them to become engaged with learning. In addition, an objective of the current research was that the methods should be replicable by teachers within their own classrooms. Therefore, the research methods for the main study were selected and designed to enable the teacher-researcher to easily and reliably collect student perceptions of key influences upon their engagement with learning in science, together with underlying experiences that informed these.

A mixed methods approach was chosen as a means of achieving an in-depth understanding of key teacher behaviours and methods that influence the motivation and engagement of students within their learning environments (Denzin and Lincoln, 1994, p. 49). In order to answer the research questions, students' self-reported perceptions regarding the contextual and behavioural variables that inform their motivation for and engagement with learning within their formal science lessons were needed. This led to a retrospective study which followed four student cohorts within the same school over the course of six months. The design that evolved has utilised questionnaires and focus group interviews (FGIs). The FGIs were used as a means of exploring the students' responses in depth, to gain a more informed understanding of the extent to which the quality of the teacher-student relationship and students' perceived competence have an influence upon students' perceptions in three particular areas: their motivation to be autonomous, the autonomy supportive behaviours afforded by the teacher, and perceptions of engagement during science lessons (Chapter 4). The selected research methods, therefore, harvested students' views regarding the key motivational influences upon their engagement with learning activities in science lessons. These measures enabled the tracking of how and why perceptions, if at all, had changed over the course of the six-month research period, in relation to variables such as different teachers' interpersonal motivating styles and the enhancement of perceived competence. Cohort studies enabled the identification of factors that have a potential developmental influence which, in time, could be used as the basis for identifying and developing interventions for trial with different age groups within a specific school setting (Petticrew and Roberts, 2006).

As students are the focal point of the teaching processes and methods within a school, the harvesting of student perceptions and experiences was approached as a more viable means of understanding what engages students with learning, rather than relying, as many prior studies have done, upon the perceptions of teachers alone (Parsons and Taylor, 2011). That is, as educational researchers, if we are to have an impact upon teachers' classroom-based professional practices:

> "We need to better understand these youth and determine how best to engage them in learning; [as] yet, there is a notable lack of 'student voice' or student perspectives in the literature on student engagement."
>
> (Parsons, and Taylor, 2011, p. 4)

3.3 The Aim of the Research

The aim of this study was, further to the MER (see section 3.1), to investigate the impact of science teachers' key behaviours and contextual factors within the learning environment upon students' engagement with learning activities in science. These were viewed through the lens of SDT as a theoretical and conceptual framework.

3.4 Research Objectives

1. To gather students' perceptions, including an exploration of the underlying experiences and ideas informing their perceptions regarding:
    a. the quality of the teacher-student relationship through a focus upon key teacher relational behaviours;
    b. the mechanisms that the teacher and student use to affirm self-attributes such as perceived competence and self-efficacy, and;
    c. their autonomous motivation and desire for autonomy during learning activities such as science investigations.

2. To explore if and how students' perceptions of the quality of the teacher-student relationship differ with the varying methods and behaviours of individual science teachers, and:
    a. where differences are reported, to identify which teacher behaviours and methods impact upon the changes in the teacher-student relationship, perceived ompetence, and the perceived desire to be autonomous and to exercise autonomy where opportunities are perceived to exist.

3. To determine, further to the conclusions drawn within the MER, the extent to which the quality of the teacher-student relationship influences students' perceived competence, and if these have a corresponding influence upon the motivation to be autonomous and to exercise autonomy where opportunities are perceived to exist.

3.5 The retrospective research design

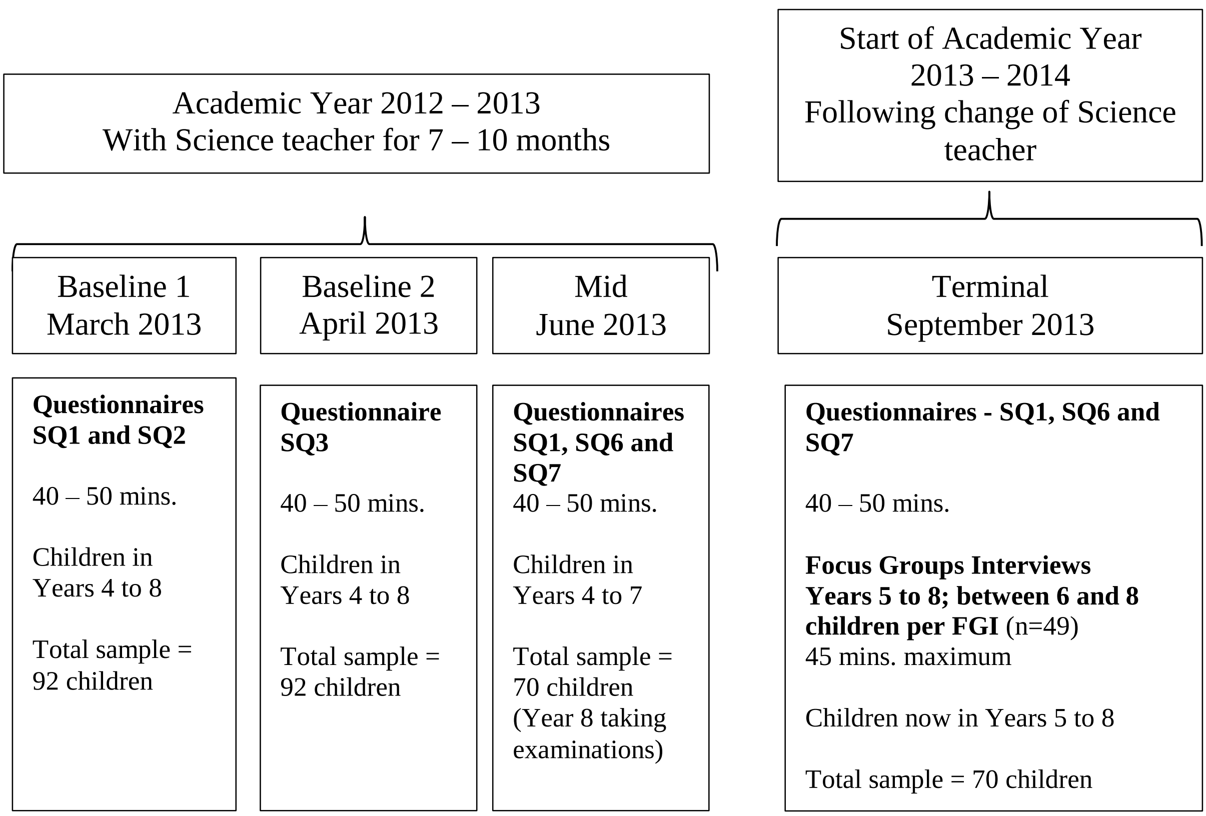
The two parts of the main study (Chapters 3 and 4) build upon the conceptual framework that was developed for the MER, further to the Literature Review (Chapter 2) (see Figure 3.2), and the common influential motivational patterns within the MER (Table 2.4). Thia framework predicts the influential motivational pathways between different SDT constructs and their translation into an overall perceptions and types of engagement during learning activities. In addition to correlations (*r*), the results of the questionnaires are presented as descriptive statistics to show the changes by percentage between March and June, and then, finally, with a change of science teacher in September 2013 (Appendices 3.1 and 3.3 to 3.10). This data was collated under the headings of relatedness, autonomy support and competence. Where there were positive or negative changes in variables over the course of the three data waves, the data was scrutinised for corresponding changes in other associated engagement-enhancing variables. Clearly, these changes are not asserted as having a causal relationship within this non-experimental research design. However, similar changes across associated variables have been analysed in the light of the conclusions formed within the MER and the conceptual framework (Figure 3.2) as the evidence-informed basis of proposed probabilistic associations between engagement-mediating variables (Morrison, 2009).

A retrospective research design was developed, enabling the collection of data across four student cohorts. The longitudinal timeframe for the research involved three data collection points and seven focus group interviews. The design was based upon the multicohort-multioccasion approach developed by Marsh et al. (1998). A mixed method approach combining quantitative and qualitative methods (Cresswell, 2009; Gorard and Taylor, 2004; Robson, 2011) collected students' self-reported perceptions of the mediating influence of science teacher behaviours and methods upon students' engagement with learning activities in a science learning environment. The two research methods were questionnaires and focus group interviews (to cross-check and explore the responses in greater depth).

The research design pathway is summarised in Figure 3.1 (below). Three data waves were scheduled: baseline measures within the pilot study (March 2013), mid-point measures (June 2013), and terminal measures following a change of science teacher (September 2013). Five questionnaires were administered across the three data waves, with each exploring students' perceptions regarding the key factors that influence their engagement with learning in science. The first were of the kinds of experience that inform the perceived quality of the students' interpersonal relationship with their science teacher (relatedness), including any changes in response that, in the students' views, were due to the different interpersonal motivating style of, where applicable, their new science teachers from September 2013. Secondly, the questionnaires harvested the students' perceived competence within science and the teacher behaviours that have an influence upon such perceptions. The final set of perceptions collected related to the degree of autonomy that students perceived they are able to exercise within their science lessons and science investigations: that is, their autonomous motivation.

The questionnaire responses were collated using SPSS (Statistical Package for the Social Sciences, version 21) under the headings of relatedness (TSRQ: Teacher-Student Relationship Quality, Hughes et al., 2008), autonomy support and competence. These were used to calculate Pearson's product-moment correlation coefficients (*r*) for the correlative relationships between the three SDT constructs for the sample group as a whole. The analysis of the questionnaire responses during the first two data waves (March and June 2013) generated the questions to be asked during the focus group interviews. These were utilised to enable the in-depth exploration of the students' perceptions of their competence, experiences that enhanced their motivated engagement with learning activities, and their interpretations of their teachers' key motivating behaviours.

Figure 3.1 *The Research Design Pathway for the Main Study*



The focus group interviews were chosen as a research method based upon three oft-cited limitations when using questionnaires, the third being especially pertinent within this study. The first is that questionnaires can only give a superficial insight into the experiences and perceptions that the student draws upon for their responses to each statement within the questionnaires (Cohen et al., 2007; Mertens, 1997; Robson, 2011). The second limitation of questionnaires is that how students respond to a statement is often dependent upon how the statement is interpreted, even under circumstances where questionnaires are administered with the researcher being in the room, and the students are able to ask for clarification of the meaning or intention of a statement (Mertens, 1997). The third limitation was the sample size which was unavoidably small as the research was undertaken with the teacher-researcher's students. This was due to convenience sampling, in that, by focusing upon enhancement of teachers' understanding of the motivational dynamics informing students' engagement with learning within the teacher-researcher's school setting, "A sample of convenience is … a sample in which elements have been selected from the target population on the basis of their accessibility or convenience to the researcher" (Ross, 2005, p. 7). With convenience sampling, it was noted that "It is always wise to treat research results arising from these types of sample design as suggesting statistical characteristics about the population – rather than as providing population estimates with specifiable confidence limits" (Ross, 2005, p. 6). Therefore, although questionnaires were used and correlations gained, the implications of the sample size were such that a second research method was needed in order to form a more in-depth understanding of the students' reasoning behind their responses.

With this need in mind, seven focus group interviews were conducted (see Chapter 4). These were used to explore the perceptions informing each group's experiences of their relationship with their science teacher, the teacher's influence upon the students' feelings of competence, and the impact upon both autonomous motivation and their desire to capitalise upon teacher-afforded opportunities to exercise their autonomy during science lessons and investigations upon their motivation for and engagement with learning.

3.6 PARTICIPANTS AND PROCEDURES

3.6.1 The setting for the data collection

The research fieldwork took place within an independent day and boarding preparatory school in Great Britain. The school prepares children for entry into a variety of independent senior schools in Great Britain. The main external examination used as an internal and external benchmark of the school's academic achievement is the Common Entrance examinations which the 12-13 year-old children sit in June each year. The age range of children within the school is from 4 to 13+ years of age. The school is positively regarded by the parents and teachers for its perceived high academic emphasis, and high levels of trust exist between the school and its parent body. The children were mainly of white British origin, with parents, under the most recent social or socioeconomic classification, being of the elite and established middle classes (as defined by Savage et al., 2013). These bandings are synonymous with social strata being classified as the middle, upper middle and upper classes as defined by family background rather than by profession or income. As the school is classified as an independent school, parents pay fees each term in order for their children to be admitted as and remain as pupils at the school. The day children reside mainly within the local area (within a radius of 20 miles), whilst the children who board at the school hail from all parts of Great Britain and overseas.

Until the end of the academic year during which the child celebrates their ninth birthday (Year Four in Britain, Third Grade in the USA), the child will mainly be taught by their class teacher for subjects such as English and Maths. The children up to the age of 9+ are taught by specialist teachers within curricula subjects such as science, history, geography, Latin, music, ICT and Games (Physical Education). The children have access to a wide range of extra-curricular activities outside the classroom which are led by both the teaching staff and specialist coaches / teachers brought in specifically to lead activities. Once children enter the academic year group during which they will celebrate their tenth birthday (Year Five, Fourth Grade), they are taught by specialist teachers for all subjects including science.

Science is taught as a general subject up until the end of Year Six (Fifth Grade), and from the start of Year Seven (Sixth Grade) to the end of Year Eight (Seventh Grade) the teaching and learning of science is separated into the scientific areas of biology, chemistry and physics. At the end of Year Eight, the students sit either a single general science Common Entrance examination paper or three Common Entrance papers, one for each of the scientific areas studied during the prior two academic years. The school has its own dedicated science laboratory and preparation room. During the data collection period, Science was taught by three male teachers, with different age groups being taught by the same teacher. The Year Eight students were taught by the school's Head of Science, a qualified scientist by background. Of the other two science teachers, one was a non-specialist (having a background in an academic area other than science) whilst the other was from a specialist science background. The latter had been employed in an industrial scientific setting prior to qualifying as a teacher. All three teachers have specific roles within the school, in addition to teaching science. The Head of Science (aged c. 40) was a form teacher and Head of Boys' Games, which included the coaching of rugby with boys in the 11 to 13 age range. He has been at the school for over 20 years, with this being the only school he had taught within. The teacher with a specialist scientific background (aged c. 30) had been at the school for 3 years, and was the assistant boarding housemaster for the 8 to 11 year olds, as well as teaching ICT and assisting with the coaching of school-based Games. The non-specialist science teacher (aged c. 40) had been at the school for 3 years, and was the boarding housemaster for boys aged 11 to 13, and taught a variety of other subjects including English (9 to 11 age range) and Games (10 to 13 age range). This teacher had taught at two other preparatory schools.

The school was chosen as the sample site due to ease of access, as the teacher-researcher was known to the teaching staff, students and parents. The teacher-researcher was already undertaking work within the school, and was granted access to the setting by the head teacher, who gave permission for the research to be conducted within the school. The three science teachers all gave their consent for timetabled science lessons to be set aside to allow their students to complete questionnaires, and to participate, if selected, in the focus group interviews.

3.6.2 Recruitment of Participants

Two methods of recruitment were utilised. The first was a Letter of Informed Consent which was e-mailed to the parents of children who were attending the school and were aged between 9 and 13 years old at the start of the first data collection wave. It was made clear to the parents that they could withdraw their informed consent for their child(ren) to participate in the research study with immediate effect and without having to give a reason for withdrawing their consent (see Letters of Informed Consent: Appendices 3.11 and 3.12). The second recruitment method was a school assembly which was attended by all of the children aged between 9 and 13 years. During the assembly, the children were given details of how they would be asked to participate in the research project, if both they and their parents were willing to give their informed consent. None of the teaching and non-teaching staff attended the assembly, so that the children had the opportunity to ask questions about the research. Their questions included how their responses would be harvested, the involvement of the science teachers during the data collection stages, and ensuring that their anonymity would be maintained throughout. The latter included a discussion about the security of all written materials including completed questionnaires, and the recordings and written transcripts of the focus group interviews. It was made clear to the children that they could withdraw their consent to be involved in the research study at any time and with immediate effect, without having to give a reason for withdrawing their consent.

The recruitment rate at the start of the first data collection wave, in March 2013 was 84 % further to the return of the signed letters of informed consent from parents, with 92 children having been given permission to participate in the research study. Of the 92 students, 61 were male and 31 were female. At the end of July 2013, students in the final age group (Year Eight / Grade Seven) left to join their senior schools. Following their departure, in September 2013 there was a recruitment rate of 86 % which consisted of 70 children aged between 9 and 13. All procedures relating to the recruitment of participants via an informed consent process together with the questionnaires and the focus group interviews were approved by the ethical review committee of the University of Birmingham (see Section 3.7.3). The characteristics of the sample group are summarised in Table 3.1.

Table 3.1. Characteristics of the student sample group

Age range	Number of students	Male	Female	Ethnicity	Social class	Nationality
9 – 10	10	6	4	White Scottish / British	Middle and upper middle class	British
10 – 11	18	9	9	White Scottish / British	Middle and upper middle class	British
11 – 12	16	14	2	White Scottish / British	Mainly middle class, and upper middle class, with one or two upper class	British
12 – 13	26	16	10	White Scottish / British	Middle and upper middle class	British
13+ snapshot	22	16	6	White Scottish / British	Mainly middle class, and upper middle class, with one or two upper class	British
TOTAL	**92**	**61**	**31**			

3.6.3 Ethical considerations

With research designs involving the collection of evidence from and about people, it is important to ensure that all participants or respondents are participating with informed consent and that no physical or mental harm comes to those involved. Denscombe (2010) stated that the central ethical ground rule is that the interests of the participants are protected at all times (p. 59). The school setting investigated within the main study had its own guidelines for child protection, and it was ensured that these were adhered to by the researcher at all times. As the children were less than eighteen years old, the informed consent of each child's parent(s) was gained (see Appendices 3.11 and 3.12). Whilst the anonymity of the school and the participating teachers cannot be guaranteed, all necessary steps have been taken to ensure that the anonymity of individual students has been protected as far as possible. This includes, as outlined above, data being stored in such a way that access is not available or permissible to anyone other than the researcher. To ensure that all ethical matters were taken into consideration, the procedures for the research methods were designed and undertaken in accordance with the ethical guidelines laid down by the British Educational Research Association (2011) and Social Research Association (2003).

3.7 RESEARCH METHOD ONE – Questionnaires

In an ideal world, the research design would have tracked several cohorts over a five-year period, beginning when the students were 9 years old and proceeding until the end of their formal education at the school (when the students were 13+ years old). However, constraints during this study restricted the research period to six months (see Section 1.8). To ensure that sufficient evidence was collected over the course of several waves of data collection to answer the two research questions, the research design enabled data collection over a longitudinal time frame (Cohen et al., 2007).

Survey instruments that had been tested, pre-validated and modified within previous empirical research formed the basis of the design of each questionnaire and the final choice of questionnaire statements. The format of each questionnaire and the statements therein, therefore, were formed through an emergent synthesis from a number of similar prior-validated instruments, thereby ensuring rigour, as well as internal and external validity of the harvested evidence. Consequently, the questionnaires evolved to focus upon SDT-based constructs translated to enable three areas for investigation: the students' perceptions of the quality of their interpersonal relationship with their science teacher, their perceived competence in terms of their ability to achieve and make progress with learning within science lessons, and the extent to which students felt autonomous during their science lessons.

One advantage of the use of the same questionnaires across cohorts was that a fixed design was enabled, whereby all respondents were surveyed using the same questionnaires, and it enabled comparisons and contrasts to be drawn across cohorts within the same sample population (Robson, 2011). However, a disadvantage of questionnaires is that they can be regarded as intrusions into the privacy into the life of the respondent (Cohen et al., 2007, p. 317) Therefore, the involvement of a respondent as a subject completing questionnaires, and participating in other methods such as semi-structured focus group interviews, relied upon their ongoing informed consent and wish to participate, and the assurance that their anonymity and confidential will be assured (Cohen et al., 2007, p. 318). The means of addressing this within the current research study and, thereby, reducing possible accusations of intrusion, was to ensure that participation involved informed consent. This informed consent took two forms given that the respondents were aged between 9 and 13 years old (see Appendices 3.11 and 3.12). The first was that the ongoing informed consent of the respondents was reinforced by the written informed consent of the respondents' parents. That is, at all times during the course of the study and, particularly, at the start of each questionnaire and focus group interview sessions, students were reminded that they could withdraw from the research project at any time and without the need for explanation. The importance of respondents' willing participation was vital, as "… subjects not objects of research [as] respondents cannot be coerced into completing a questionnaire" (Cohen et al., 2007, p. 317).

The completion of the questionnaire in the way that the researcher would wish, which reflects the full range and depth of the respondents' informed views, is clearly dependent upon a variety of respondent characteristics, such as their experiential memory, knowledge, the nature of prior experiences, motivation, personality, and willingness to share their responses in full (Robson, 2011, p. 240). Therefore, an additional research method that would enable the harvesting of more in-depth insights was needed, especially one that would enable triangulation of questionnaire responses. Hence the selection of focus group interviews as a means of detecting emerging themes across age groups and within-age groups. Focus group interviews were used in preference to semi-structured individual interviews for two reasons. The first was recognition, based upon informal discussions with the students prior to the first data wave, that the students, especially female students, may have felt more comfortable discussing their ideas amongst a group of their own peers, rather than individually with a lone male researcher. The second reason was that when the students discussed their experiences together and began to verbalise their own perceptions evolving from such experiences, the researcher may gain a comprehensive insight into the students' own attributed causal pathways leading from teacher behaviours and teacher-afforded classroom-based activities to students' motivational perceptions and their consequential engagement-predictive responses.

3.7.1 STAGE ONE: The rationale behind the choice of questionnaires

The choice of questionnaires was based upon the key areas associated with engagement that had been investigated by TIMSS (Trends in International Mathematics and Science Study) 2011 (Martin and Mullis, 2012; Martin et al., 2012). The key areas investigated were the students' attitudes to science and the potential correlative relationship with achievement in science education, and how these were associated with self-attributes such as competence and abilities, engaging classroom instruction and a positive interpersonal relationship between the teacher and student (Martin et al., 2012; Chapter 8). A key variable in the development of students' positive attitudes to learning and their positive engagement with science education was proposed as being over-arching engaging classroom instruction, central to which are the presence of key teacher-afforded behaviours, including positive expectations of academic success for all students, and an emphasis upon learning methods that enable students to investigate scientific phenomena and knowledge with a degree of autonomy. Martin et al. (2012) described such engagement variables as having, at their heart, "a cognitive dimension specifying the thinking processes that students are likely to use as they engage with the content" (p. 82). Other key factors that were linked to students' positive engagement and subsequent achievement within science were the individual school's emphasis upon academic success, and the learning methods that students are allowed to utilise within science education. These have all, through extensive prior research, been asserted as key aspects of the school climate central to student engagement and success within science include effective teaching and students' own desire to do well within their learning (Martin et al., 2012).

The methods of teacher-afforded classroom instruction were noted as being, potentially, most important as "… students with positive attitudes toward science have higher achievement, but these attitudes deteriorate over time" (Martin et al., 2012, p. 329), as was teachers' high expectations of their students' ability to succeed within science lessons (Martin et al., 2012, p. 250). These expectations drive teachers' motivated efforts to help their students achieve desired performance goals. In turn, a school's emphasis upon academic success and the obvious manifestation of teachers' expectations of their students' achievements may have a reciprocal temporal influence upon students' desire to do well within such assessments (Martin et al., 2012, p. 330). In turn, there was purported to be a direct relationship between students' positive attitudes to science and high levels of academic achievement in science. These positive attitudes include and are underpinned by the extent of an individual's competence and self-efficacy, the perceived gain from learning within science lessons and of scientific knowledge for its own sake, and an enjoyment of and motivated interest in learning scientific knowledge and skills (Martin et al., 2012). Therefore, the questionnaires that have been used within this research were selected as the as the first means of collecting students' responses regarding the influence of the perceived quality of the teacher-student relationship, their perceived competence, and their autonomous motivation and satisfaction upon their engagement within science lessons.

The challenge was to locate and test, within the pilot study initially, a number of pre-validated questionnaires that had been previously devised, tested and refined across a range of similar studies. The questionnaires, in common with those used by TIMSS 2011, enabled data to be collected in the form of respondents' self-reported perceptions regarding the key factors that inform their motivation for learning science and for optimal engagement within science-based learning activities. In addition, the classroom factors, teacher behaviours and the students' attitudes and self-attributes that TIMSS 2011 regard as being central to enhanced engagement with science are common to the SDT theoretical framework. Therefore, questionnaires were sought that would enable students' perceptions to be collected regarding three key factors; one, teachers' interpersonal behaviours that, two, inform students' self-attributes, such as competence and self-efficacy, within, three, a learning environment that emphasises engaging instructional and learning methods. Whilst some of the questionnaires investigated a specific SDT construct, such as relatedness, others enabled a cross-check of perceptions of all three SDT constructs. This was done in order to ensure triangulation across responses (Cohen et al., 2007; Robson, 2002).

Clearly, the evidence required to answer the research questions included students' self-reported perceptions of the key teacher verbal and non-verbal relatedness, autonomy supportive and competence enhancing behaviours that influence the students' motivation for /

engagement with science. Such evidence was collected and triangulated using two research methods (questionnaires and focus group interviews), and has been further triangulated by an online survey of the researcher's former students (see section 5.1).

3.7.2 STAGE TWO: The review of prior-validated SDT questionnaires

Instruments were selected that have been rigorous in recording the students' perceptions through a specific focus on the following key areas:

1. The perceived quality of their interpersonal relationship with the science teacher (relatedness);
2. If, and how, the students believed the quality of their interpersonal relationship had altered with a change of science teacher in September 2013, by pinpointing;
3. The key teacher behaviours that influenced or undermined their intrinsic motivation for and engagement within learning;
4. The influence of students' perceived self-attributes (competence, self-efficacy and self-agency / autonomy inclination) in relation to science upon their motivation to engage in learning activities, and;
5. The classroom factors that are more likely to engage the students' interest, curiosity, enjoyment and value perceptions during science lessons.

These five key areas informed the choice of questionnaires that have enabled exploration of all three constructs of SDT through a format that could be easily accessed by children aged between 9 and 13 years old. The official SDT website (www.selfdeterminationtheory.org [last accessed 5th January 2015]) presented fifteen questionnaires that have been used to measure self-determination through participants' self-reported responses. These questionnaires have been developed to assess the impact of the three constructs within SDT theory. A review of the fifteen SDT-related questionnaires revealed that there was neither a single questionnaire nor a series of questionnaires that had been developed to measure all three constructs of SDT in a format that would enable the investigation of the students' self-determined perceptions of specific and potentially simultaneously engaging aspects of their science lessons and schooling in general (see Appendix 3.13). Therefore, the questionnaires that have been developed for the purposes of this study have added to the bank of questionnaires that may be used with younger students (see section 1.7).

3.7.3 STAGE THREE: Variables and associated statements selected for the design of the questionnaires

As none of the key questionnaires on the afore-mentioned SDT website were seen to be suitable for the purposes of this research study (see section 4.8.2), there was the need to locate other pre-tested pre-validated questionnaires that:

1. Would measure children's perceptions of SDT related aspects of their learning experiences within the classroom;
2. Had wording accessible to children aged between 9 and 13 years old, and;
3. Could be used on a number of occasions to harvest snapshot data of perceptions that were evolving between data waves.

As discussed, instruments and constituent statements were needed that would effectively record students' perceptions of the following SDT / engagement-informing constructs:

1. The perceived quality of their interpersonal relationship with the science teacher (relatedness);
2. If, and how, the students believed the quality of their interpersonal relationship had altered with a change of science teacher in September 2013, by pinpointing;
3. The key teacher behaviours that influenced or undermined their intrinsic motivation for and engagement within learning;
4. The influence of students' perceived self-attributes (competence, self-efficacy and self-agency / autonomy inclination) in relation to science upon their motivation to engage in learning activities, and;
5. The classroom factors that are more likely to engage the students' interest, curiosity, enjoyment and value perceptions during science lessons.

Within the next section, each of the five selected questionnaires is outlined. This includes the origins of the questionnaires prior to their adaptation for use within the sampled school. The questionnaires were initially adapted prior to the pilot study based upon the researcher's knowledge of the children within the sample population and groups therein, with adaptations being made throughout the pilot study to form the final wording of the questionnaire statements (see Appendices 3.15 to 3.19).

3.7.3.1 SQ1 QUESTIONNAIRE: The Factors / Behaviours informing the Quality of the Teacher-Student Relationship

The objective of Student Questionnaire 1 (SQ1) was to investigate the students' perceptions of the teacher-student relationship quality (TSRQ) using the Student-Teacher Relationship Scale (STRS: Pianta, 2001, Pianta and Steinberg, 1992) and the Amended Student-Teacher Relationship Scale (ASTRS: Koomen et al., 2012). The STRS had been developed by its authors through the merge of three pre-tested questionnaires. The first was a 16-item instrument (Pianta and Nimetz, 1991) which, in turn, had evolved from Q-Set (Waters and Deane, 1985) and the Teacher-Child Rating Scale (TCRS: Hightower et al., 1986). All three centre upon teacher perceptions of their students' behavioural, social and competence abilities and problems. This, therefore, presented a limitation in that the original questionnaires were designed to measure teachers' perceptions of their professional relationships with individual students, who were selected either by the researcher or the teacher respondent. As a means of addressing this limitation, the SQ1 questionnaire was an adaptation of STRS and ASTRS in order to measure students' perception of the quality of their relationship with the science teacher, the reactions and behaviours of science teacher as perceived by the student, and the responses of student to teacher's key interpersonal behaviours. The statements were as follows:

- STRS – 1, 2, 9, 11, 21 (10 on STRS), 20 (28 STRS), 21 (24), 22
- ASTRS – 1, 2, 3 (15 ASTRS), 7, 8, 14 (18 ASTRS), 27 (12)
- Questions specifically adapted for use within SQ1 – 4, 10, 13, 15, 16, 17, 19, 20, 21, 24, 25, 26, 27, 28, 29 (The questions specific to SQ1 have been developed by adapting statements within STRS and ASTRS).

Following the pilot study, statements 5, 6, 18 and 23 were removed as the children found these to be ambiguous. (See Appendix 3.15)

3.7.3.2 SQ2 and SQ6 QUESTIONNAIRES: Perceptions of the Classroom Factors enhancing Student Engagement

The objective of Student Questionnaires 2 (SQ2) and 6 (SQ6) was to investigate students' perceptions of the key factors that they regarded as central to the autonomously supportive science classroom. Velayutham et al. (2011) argue that students' affective and behavioural engagement with learning is influenced by their motivational beliefs and teacher-afforded ability to be self-regulated learners. These factors are asserted as mediating upon students' desire to learn and participate in learning activities. Velayutham et al. (2011) developed and validated The Students' Adaptive Learning Engagement in Science (SALES) Questionnaire as an instrument that measured students' perceptions of their motivation and self-regulated learning specifically within science lessons. The SALES questionnaire evolved from the WHIC (What is Happening in Classrooms?) instrument (Aldridge et al., 1999). The WHIC instrument assessed seven dimensions of classroom learning, including teacher support, attitudes towards investigation and student involvement, and orientation towards tasks, was tested and validated in Western Australia and Taiwan. Similar instruments reviewed were the Learning Environment Inventory (LEI: Walberg, 1979), the Questionnaire on Teacher Interaction (QTI: Wubbels and Levy, 1993), the Individualized Classroom Environment Questionnaire (ISEQ: Fraser, 1990) and the Classroom Environment Scale (CES: Moos, 1979).

The limitation of these instruments is that they often overlap in terms of the variables they measure and, in some cases, do not reflect upon what was happening in modern classrooms (Aldridge et al., 1999, p. 49). However, the WHIC Questionnaire (Fraser et al., 1996) has attempted to reduce this limitation by combining scales from some of the above questionnaires to investigate more of the factors that have been shown to have influence the correlative association between students' outcomes and what happens within their classrooms. Therefore, the WHIC questionnaire (Fraser et al., 1996), as adapted by Aldridge et al. (1999), was used as the basis for seven scales within the SQ6 Questionnaire (see Table 3.2).

Table 3.2 *The seven subscales within the SQ6 Questionnaire*

Subscale	**Heading**	**Statement Numbers**
Subscale 1	Student Cohesiveness (Student – Peer Relationships)	1 - 6
Subscale 2	Teacher Support	7 - 14
Subscale 3	Involvement (Relatedness / TSIR)	15 - 22
Subscale 4	Investigations	23 – 30
Subscale 5	Task Orientation (Achievement-expectancy)	31 – 37
Subscale 6	Cooperation	38 – 45
Subscale 7	Equity	46 - 53

(See Appendix 3.18)

3.7.3.3 SQ3 and SQ7 QUESTIONNAIRES: Students' self-attributes as the basis for their motivation for and engagement with science

The objective of Student Questionnaires 3 (SQ3) and 7 (SQ7) was to investigate students' self-attributes and attitudes to learning within science through the Competence construct of SDT. This includes perceived competence in science lessons, confidence, and the perceived value of making engaged efforts within science lessons. The Trait and Motivation Scales of Christophel (1990) focuses upon the classroom and lesson-based motivational dynamics and conditions central to learning, and, in particular, how students are taught by their teachers and given opportunities to learn for themselves as opposed to an overconcentration upon curricula and syllabus content. The development of the instrument by Gorham and Christophel (1992) enabled investigation of the relationship between teacher behaviours and student learning outcomes. In particular, the instrument enabled exploration of the specific teacher behaviours that students associate with encouraging them to participate and engage in learning: science teacher characteristics and traits; science teacher effectiveness; involvement of students by science teachers; student's science self-confidence; teacher actions, and science investigations (see Appendices 3.17 and 3.19).

3.7.3.4 SQ7 QUESTIONNAIRE: Motivation factors influencing students' engagement with science

Further to adaptation of the WHIC instrument (Aldridge et al., 1999), the evolved Students' Adaptive Learning Engagement in Science (SALES) Questionnaire (Velayutham et al., 2011) was used as the basis for SQ7.

Table 3.3 *The four subscales within the SQ7 Questionnaire*

Subscale	Heading	Statement Numbers
Subscale 1	Learning Goal Orientation	1 – 8
Subscale 2	Task Value	9 – 16
Subscale 3	Self-Efficacy	17 – 24
Subscale 4	Self-Regulation	25 - 32

(See Appendix 3.19)

3.7.3.5 THE PILOT STUDY – testing the questionnaires

The first wave of data collection was the pilot study, which was conducted at the beginning of March 2013 with the following objectives in mind:

1. To check that the statements within each questionnaire were unambiguous and clear to students aged between 9 and 13 years old, including ensuring that the statements could be read and understood by all four cohorts;
2. To amend or remove any statements that were too ambiguous or the majority of students were confused by. (N.B. Where statements were removed, the original numbering in the revised questionnaires has been maintained);
3. To gain student feedback regarding statements that they perceived as leading;
4. To gain students' feedback as to the layout of the questionnaire, including the size of the response boxes within the Likert scales;
5. To ensure that sufficient time was made available for the questionnaires to be completed in their original and revised forms, and;

6. To test the SQ2 and SQ3 questionnaires as the basis for the final design of the SQ6 and SQ7 questionnaires.

3.7.3.6 Summary

A review of numerous pre-tested, pre-validated questionnaires relating to students' engagement with learning led to the final selection and adaptation of questionnaires for the main study. These enabled the successful collection of evidence relating to five key areas (as outlined in section 3.8.3). The sources of statements within the five questionnaires are summarised within Table 3.4 (below). Three of the questionnaires were adapted following the pilot study, further to feedback from the children: the wording of some of the statements was changed to ensure that the statements could be better understood and were not regarded as ambiguous.

TABLE 3.4 *Sources of the questions forming the Teacher and Student Questionnaires; pre-tested and pre-validated questions (See Appendices 3.15 to 3.19)*

QUESTIONNAIRE	SOURCES	REFERENCES
SQ1 **STUDENT-TEACHER RELATIONSHIP SCALE**	Student-Teacher Relationship Scale (STRS) – Short Form Amended STRS	Pianta (1991) Pianta and Steinberg (1992) Koomen et al. (2012)
SQ2 **STUDENT ENGAGEMENT WITH SCIENCE**	Student Engagement Instrument (SEI) Significant Persons Influence upon Attitudes towards Science (SPIAS)	Appleton, Christenson, Kim and Reschly (2006) Betts et al. (2010) Sjaastad (2013)
SQ3 **KEY TEACHER BEHAVIOURS and METHODS IN SCIENCE**	Trait and Motivation Scales	Gorham and Christophel (1992) Christophel (1990)
SQ6 **WHAT IS HAPPENING WITHIN SCIENCE LESSONS?**	WHIC? - What Is Happening In this Class? (WIHIC) Questionnaire	Aldridge, Fraser and Huang (1999) further to Fraser, McRobbie and Fisher (1996)
SQ7 **STUDENTS' ACTIVE ENGAGEMENT IN SCIENCE**	Science Attitude Scale; Fennema-Sherman Attitude Scale TIMSS 2011 Student Questionnaire – Science – Grade 4 – Sections MS4/5/6 TIMSS 2011 Student Questionnaire – Integrated Science – Grade 8 – Sections 17, 18, 19 Test of Science-Related Attitudes (TOSRA) – sections H2, H3 and H4	Fennema and Sherman (1976) OECD (2012) OECD (2012) Fraser (1981)

3.8 Administration of the Questionnaires

The questionnaires were administered within the students' science classroom, as it was felt that they would be more comfortable within surroundings familiar to them. The researcher was the only adult present during the questionnaire sessions. This was done in order to protect the anonymity and confidentiality of the students (further to the details in sections 3.6.3 and 3.9). Therefore, no other adults were allowed to enter the room during the questionnaire sessions. An advantage of having the researcher present during the questionnaire sessions was that any ambiguities within the statement, uncertainties of understanding, or omissions / mistakes with the design of the questionnaire could be addressed immediately (Cohen et al., 2007, p. 344). A second advantage was that the researcher could check each questionnaire to ensure that all of the statements had been responded to before accepting the questionnaire from individual respondents, thereby reducing the number of gaps in the data sets (Cohen et al., 2007). A disadvantage of the researcher being present for the completion of the questionnaires, rather than distributing the questionnaires to the students for them to return in their own time, was that it could not be guaranteed that all participating students would be present. This was due to a variety of reasons such as students being absent from school, or them attending lessons such as learning support and individual musical instrument lessons.

TABLE 3.5 *Questionnaire completion by year group cohorts*

AGE Year Group	SQ1 March	SQ1 June	SQ1 September	SQ2 March	SQ3 April	SQ6 June	SQ6 September	SQ7 June	SQ7 September
9 - 10	●	●	●	●	●	●	●	●	●
10 – 11	●	●	●	●	●	●	●	●	●
11 – 12	●	●	●	●	●	●	●	●	●
12 – 13	●	●	●	●	●	●	●	●	●
13+ (Leavers in July 2013)	●			●	●				

3.9 The security of collected data: ensuring the anonymity of the students and the confidentiality of responses

Each participating student was allocated a unique identification number (ID). All students retained the same individual ID throughout all three data collection waves. Each questionnaire recorded the ID of the student respondent, rather than his/her name, age or class name. In this way, it would not be possible for the respondent's identity to be determined. The match between each student and his / her identification number was known only to the researcher, and the written list of students and individual IDs was not carried with the questionnaires. All completed questionnaires were kept in a locked briefcase, and were later transferred to a locked filing cabinet: only the researcher had the keys to the filing cabinet. The data from the questionnaires, and the recordings and transcripts of the focus group interviews were held within password-secured folders and files on the researcher's laptop. The security measures put into place to ensure the anonymity and confidentiality of the data relating to the students and their responses will be maintained by both the doctoral researcher and the University throughout the ten year storage period required by the University. After the said ten years, the data will be destroyed (as required by the University of Birmingham Code of Practice for Research 2013-14, p. 6, Section 3.3 – http://www.birmingham.ac.uk/Documents/university/legal/research.pdf [last accessed 29th June 2014]).

3.10 PREPARING THE DATA FOR ANALYSIS

3.10.1 The preparation of the questionnaire data for analysis

When preparing the questionnaire data for analysis, it was important to ensure that the descriptive statistics would facilitate understanding of the influence of motivational variables upon students' engagement with learning. The objective was to be able to utlilise the outcomes of this analysis as a means of inferring relationships as the basis for predictions that would, in turn, lead to modifications to the proposed motivational pathway (see Figure 4.1), which could be further developed through triangulation (section 5.1). Descriptive statistics were used as a means of organising and simplifying the data in such a way that it was accessible to all readers, and not just those with a background in statistics (Thomas, 2009) (Appendices 3.3 to 3.10).

3.10.2 Stage One

In order to understand the correlative associations between the students' motivation to engage with learning and each of the three constructs of SDT, the first stage was to divide the responses to the five questionnaires between SPSS datasheets that combined responses for relatedness, autonomy support and competence. The questionnaire responses were divided between datasheets as shown in Table 3.5. The analysis of the quantitative data involved bivariate correlation tests using the Pearson product-moment correlation, which generated Pearson correlation coefficients (*r*). The coefficient indicates the direction and magnitude (also called the effect size) of the liner relationship between two continuous independent variables (Field, 2013). (A perfect negative linear relationship is denoted as -1 whilst, conversely, a perfect positive linear relationship is labelled +1. A coefficient of 0 indicates there is no relationship between the two variables which may also be presented as a null hypothesis).

Table 3.6 *Areas of Self-Determination Theory explored by the different questionnaires (as divided on SPSS)*

TEACHER-STUDENT INTERPERSONAL RELATIONSHIP QUALITY	
SQ1, subscale 1	Warm, trusting relationship - 1, 8, 21, 27, 29
SQ1, subscale 2	Reactions of science teacher as perceived by the student - 3, 11, 13, 15, 17, 25, 28
SQ1, subscale 3	Responses of student to teacher's key interpersonal behaviours - 2, 4, 7, 9, 10, 12, 14, 16, 19, 20, 22, 24, 26
STUDENTS' ENGAGEMENT WITH SCIENCE	
SQ2, subscale 1	Student's perception of science teacher's role and behaviour - 1, 4, 5, 7, 9, 12, 15, 17, 19, 21, 25, 28
SQ2, subscale 2	Student's perceptions of the value / importance of science - 2, 8, 10, 13, 20, 27
SQ2, subscale 3	Student's Enjoyment of science - 3, 14, 24
SQ2, subscale 4	Student's contribution to own learning in science - 6, 16, 26
SQ2, subscale 5	Perceptions re science investigations – 23

SQ2, subscale 6	Relationship with Perception of other students - 11, 18, 22

WHAT IS HAPPENING WITHIN SCIENCE LESSONS?

SQ6, subscale 1	Student Cohesiveness (Student – Peer Relationships): 1 - 6
SQ6, subscale 2	Teacher Support: 7 – 14
SQ6, subscale 3	Involvement (Relatedness / TSIR): 15 - 22
SQ6, subscale 4	Investigations: 23 – 30
SQ6, subscale 5	Task Orientation (Achievement-expectancy): 31 – 37
SQ6, Subscale 6	Cooperation: 38 – 45
SQ6, Subscale 7	Equity: 46 - 53

KEY TEACHER BEHAVIOURS and METHODS IN SCIENCE

SQ3, subscale 1	Science teacher characteristics and traits - 1, 7, 12, 16, 20, 21
SQ3, subscale 2	Science teacher effectiveness - 3, 5
SQ3, subscale 3	Involvement of student by science teacher within science lessons - 6, 10, 17
SQ3, subscale 4	Student’s science self-confidence; teacher actions - 4, 13, 15, 18
SQ3, subscale 5	Science investigations - 2, 8, 11, 14, 19

STUDENTS’ ACTIVE ENGAGEMENT IN SCIENCE

SQ7, Subscale 1	Learning Goal Orientation	1 – 8
SQ7, Subscale 2	Task Value	9 – 16
SQ7, Subscale 3	Self-Efficacy	17 – 24
SQ7, Subscale 4	Self-Regulation	25 – 32

OTHER AREAS

SQ2, subscale 6	Relationship with Perception of other students - 11, 18, 22

SQ6, subscale 1 Student Cohesiveness (Student – Peer Relationships): 1 - 6

TABLE 3.7 *Distribution of the five questionnaires between the three SDT construct datasheets on SPSS*

SDT Construct / Date	March / April 2013	June 2013	September 2013
Relatedness	SQ1 / SQ2 / SQ3	SQ1 / SQ6	SQ1 / SQ6
Autonomy Support	SQ2	SQ6 / SQ7	SQ6 / SQ7
Competence	SQ2 / SQ3	SQ6 / SQ7	SQ6 / SQ7

The following questionnaires recorded temporal changes to students' perceptions over the course of the data collection period;

- SQ1 – Relatedness (the TSRQ) from March to September 2013
- SQ6 – all three components from June to September 2013
- SQ7 – Autonomy Support and Competence from June to September 2013

SQ2 and SQ3 were used to gain snapshot responses from students at the start of the data collection period, and therefore provided baseline data. The statements within SQ2 relating to students' engagement with science and SQ3 relating to key teacher behaviours and methods in science were, in particular, explored during the Focus Group Interviews. SQ6 and SQ7 were designed and presented as extensions of the areas explored within SQ2 and SQ3. In total, nine SPSS datasheets (Appendix 3.14) were formulated that would enable interrogation of the harvested data at the Mean and Standard Deviation levels.

The population size for the three data collection stages remained constant at 70. This was 86 % of the total population of 81. All bar one of the seven groups of students were taught, from September 2013, by a different science teacher from their science teacher that they had been reflecting upon within their responses in March and June 2013. The questionnaire responses were filtered using SPSS, and means were calculated for each respondent for relatedness, autonomy support and competence. The means from June 2013 were compared with those from September 2013 to see if a change of science teacher influenced students' perceptions of the quality of their relationship with their teacher, and their correlated perceptions of competence and autonomy within science lessons (see Appendices 3.1, and 3.3. to 3.10). The perceptions of the 13+ (Leavers) cohort were also collected using questionnaires as a means of drawing upon their cumulative experience of and comparisons between being taught by all three science teachers. The responses of the students were interrogated to acquire the following:

1. Means for relatedness (TSRQ), autonomy and competence for each of the students for each data collection wave (see Appendices 3.1, and 3.3. to 3.10), and;
2. Pearson's *r* correlations for the three SDT components between June and September 2013 (see Tables 3.8 to 3.10).

3.10.3 The Final Stage

The final stage involved measuring the students' perceptions of the quality of their interpersonal relationships with their peer groups and the level of peer support when participating in science learning activities. The mean ranges and variances were calculated from the students' responses to questions 1 to 6 and 38 to 45 within the SQ6 questionnaires completed in June and September 2013. These figures were calculated to determine if and how students' perceptions of their interpersonal relationships with their peers changed during the course of the research study, and to determine if these perceptions were stronger or weaker than the students' perceived quality of their relationship with their teacher (see Appendices 3.4. to 3.10).

3.11 RESULTS

3.11.1 RESULTS from the Questionnaires – Bivariate correlations

Table 3.8 *Correlations: Questionnaires = SQ1, SQ6 and SQ7*

DATE	VARIABLE ONE	VARIABLE TWO	Pearson's *r* CORRELATION	Significance (2 tailed)
June 2013	TSRQ	Autonomy Support	0.282	.400
June 2013	TSRQ	Competence	0.599	.052
June 2013	Autonomy Support	Competence	0.406	.215
September 2013	TSRQ	Autonomy Support	0.320	.337
September 2013	TSRQ	Competence	**0.756**	**.007**
September 2013	Autonomy Support	Competence	**0.761**	**.007**

Table 3.9 *Correlations: Questionnaires = SQ1 and SQ6*

DATE	VARIABLE ONE	VARIABLE TWO	Pearson's *r* CORRELATION	Significance (2 tailed)
June 2013	TSRQ	Autonomy Support	0.262	.205
June 2013	TSRQ	Competence	0.277	.180
June 2013	Autonomy Support	Competence	**0.699**	**.000**
September 2013	TSRQ	Autonomy Support	0.282	.172
September 2013	TSRQ	Competence	0.169	.429
September 2013	Autonomy Support	Competence	0.366	.072

Table 3.10 *Correlations: Questionnaires = SQ1 and SQ7*

DATE	VARIABLE ONE	VARIABLE TWO	Pearson's *r* CORRELATION	Significance (2 tailed)
June 2013	TSRQ	Autonomy Support	0.186	.433
June 2013	TSRQ	Competence	**0.530**	**.016**
June 2013	Autonomy Support	Competence	**0.705**	**.001**
September 2013	TSRQ	Autonomy Support	0.368	.111
September 2013	TSRQ	Competence	0.325	.161
September 2013	Autonomy Support	Competence	**0.787**	**.000**

Key:

- TSRQ = Teacher-Student Relationship Quality (Relatedness)
- Autonomy Support = Autonomy
- Statistically significant results are highlighted in bold

The highest correlative associations emerging from analysis of the questionnaires were between relatedness and competence (r = 0.599, p = .052; r = 0.756, p = .007; r = 0.53, p = .016), and between competence and autonomy (r = 0.761, p = .007; r = 0.699, p = .000; r = 0.705, p = .001; r = 0.787, p = .000). All of the aforementioned associations were statistically significant: i.e. all were <0.05 or <0.01. The weakest correlative relationship emerging from the questionnaires was between relatedness and autonomy support (r = 0.282, p = .400; r = 0.262, p = .205; r = 0.186, p = .433). None of these associations were statistically significant: i.e. all were >0.05 or >0.01. The descriptive statistics (Appendices 4A and 4C) revealed that there was a slight decline in TSRQ / relatedness between March and June but this stabilised in September (based upon means - 2.86 March; 2.96 June; 2.95 September, respectively). Perceived autonomy improved (2.57 to 2.27 (SQ6) and 2.5 to 2.32 (SQ7)). Perceived competence also improved over time (2.91; 2.55 to 2.48 (SQ6) and 2.65 to 2.49 (SQ7)).

3.11.2 RESULTS of the Descriptive Statistics

Analysis of the descriptive statistics by cohort revealed a wide range of positive and negative responses (Appendices 3.1, 3.3, and 3.8 to 3.10). With the 13+ Leavers' group, three snapshot questionnaires were administered in order to draw upon their cumulative experience of and comparisons between being taught by all three science teachers (see Appendix 3.4). Their responses were similar to those of their younger peers. For TSRQ (relatedness), there were similarities of response in that, on the whole, there was a decline in the TSRQ across all cohorts from one data wave to the next. Interestingly the SQ1 statements revealed more negative responses whilst the responses to SQ6 revealed improvements in perceived relatedness. One reason for this difference across the two questionnaires is that SQ1 focuses specifically upon students' general perceptions of the quality of the interpersonal relationship with the teacher, whereas SQ6 contextualises the perceptions within science lessons. Therefore, the results suggest that students have a more positive perception of the TSRQ when responses are focused upon specific variables within science lessons and learning activities therein, rather than when considered without a particular context in mind. The descriptive statistics for Competence revealed improvements between June and September (all three cohorts; SQ6 and SQ7), whilst Autonomy improved (SQ6: 10-11 and 11-12; SQ7: all three cohorts) whilst the means for the 12 to 13 age cohort remained relatively stable (2.655 June, 2.621 September). Clearly, the correlations and the descriptive statistics tell different stories: however, what is very clear from both sets of results is that, in one respect, they do not match the majority view that emerged from the MER (Chapter 2). That is, whilst the correlations emphasise the important association between relatedness and competence, and between competence and autonomy support, across the cohorts as a whole, the descriptive statistics present positive improvements in competence and autonomy, despite a decline in the perceived TSRQ.

On the basis of these contrasting results, the FGIs were not only very useful in enabling comparisons with the findings of the MER, they were also an effective means of gaining in-depth insights into why the perceived competence and need for autonomy of this particular sample had not been affected by their perceived negative TSRQ.

CHAPTER FOUR

THE MAIN STUDY: Stage Two - Focus Group Interviews

Focus group interviews are a qualitative research method, defined as "… a group interview or discussion" (Cronin, 2008, p. 227). Focus group interviews enable the discussion and exploration of respondents' views in depth. Within the main study, such interviews led to a greater understanding of common themes relating to engagement with learning activities amongst the respondent sample. Focus group interviews (FGI) are used as a means of exploring the myriad of different ways in which different students see and make sense of their social world and the immediate environs (Krueger, 1998). The researcher, when analysing FGI data, is advised to make few assumptions and to be reluctant to attribute everything that is said as grounds for claiming causation (Kruerger, 1998, p. 4). Analysis of the FGI was, therefore, focused through the objective(s) of the research and, in particular, the research questions form the basis of the thematic content analysis of individual FGIs and the FGIs as a collective group (Anderson, 1998, 2004). The qualitative analysis of the FGIs creates an intersubjective focus upon the analysis of ontological phenomena (Krueger, 1998).

A focus group interview typically involves between six and ten respondents who discuss their views about given topics and often, although not always, in response to a researcher's questions. The researcher conducting the interview is often referred to as the moderator (Cronin, 2008, p. 228). The interaction between respondents is regarded as an essential feature of the focus group as it enables the sharing and discussion of common and opposing perceptions (Morgan, 1997). Conducting a focus group interview should be something that the researcher-moderator is comfortable with, as guiding the discussion and ensuring that all respondents have the opportunity to participate if they so wish requires complex social skills (Puchta and Potter, 2004; Stewart et al., 2007). Within the current research, the role of a low-level moderator was taken by the doctoral researcher: the role was low-level in that interruptions were kept to a minimum, other than repeating what respondents had said or when seeking clarification of a response (Morgan, 1997). This approach was taken as a means of ensuring that "… data produced in this way can be said to be free of research influence …to gain an insight into the perspective of the participants without the researcher imposing any limits on their understanding of the subject" (Cronin, 2008, p. 229).

Within the current research, FGIs facilitated the exploration of students' perceptions and experience-informed interpretations of the engaging or disengaging nature of their learning environment. This included following up as to why students responded as they did to statements within the questionnaires. To elucidate, the researcher does not have a reliable assurance that the respondent has understood questionnaire statements in the way that the researcher intended by including them, or if the range of responses available within the given Likert scale were either unambiguous or allowed for the full range of responses (Krueger, 1998). An advantage, therefore, of utilising FGIs is that they provide a means of exploring students' responses in more depth and enabling respondents to determine how they respond, and to exploring their own perceptions and experiences. Interaction between the respondents within the FGI enabled discussion, elaboration through agreement or disagreement with the views of other respondents, and clarification of thinking. Whilst two people may agree and share the same perceptions and experiences, they may still differ in the words they use and the order in which responses are expressed. This includes being aware of the emphasis and intensity of responses, which may also differ between respondents.

From the thematic content analysis (TCA: section 4.2), the emergent results reflect multiple perspectives where similar questions are used across FGIs, and, with this in mind the questions were phrased to ensure researcher neutrality. That is the questions could not be regarded as leading the respondents towards pre-determined views or responses. In addition, a semi-structured approach was taken to enable unplanned questions to be asked if the researcher required clarification if he either did not understand responses or wished to explore them in greater depth.

In summary, FGIs have been used within this study to harvest data which has enabled the researcher to gain an improved understanding of how knowledge, ideas, experiences, perceptions and expectations have been formed and what the sources of these are (Cronin, 2008). As Krueger (1998) asserts, the FGI, as with all qualitative research methods, should not be regarded as scientific research, in that the "… goal of qualitative research is to understand and communicate, not to control or replicate a study" (p. 64).

4.1 How the Focus Group Interviews were administered

4.1.1 Selection of Participants

The FGI participants were selected so that there would be, wherever possible, the same number of male and female students within each group so that the views of both genders were equally represented. Although the sample for the questionnaires as a whole was not split equally by gender, the views of equal numbers of male and female students was important as a means of not only avoiding gender bias (Sackett, 1979) but also because the questionnaire responses revealed that the female respondents were more negative in their perceptions of the science teacher(s), comparative to male respondents within the same class. Therefore, within the FGIs, an objective was to investigate the experiences and perceptions underlying such responses. Most FGI groups had six members. With some groups, however, given the small class sizes, being rigid about the size of a focus group would have excluded one or two students. If this was to unwaveringly be the case, all of the students within the age group were included. One class group contained only male students, and therefore all nine male students from that group were interviewed. Therefore, in total, 47 students were involved in the FGIs as follows: Group 1 – 6 students aged 10-11 (3 male, 3 female); Group 2 – 9 students aged 10-11 (all male); Group 3 – 8 students aged 11-12 (5 male, 3 female); Group 4 – 6 students aged 11-12 (3 male, 3 female); Group 5 – 6 students aged 12-13 (3 male, 3 female); Group 6 – 6 students aged 12-13 (3 male, 3 female), and; Group 7 – 6 students aged 12-13 (3 male, 3 female). Prior to each of the seven FGIs the objectives of the session were outlined, concluding with all students being asked if they were willing to participate and voluntarily gave their informed consent. None of the students withdrew from their respective FGI at any stage.

4.1.2 Timing and location of the Focus Group Interviews

All of the FGIs were conducted in the same room within the main school building. This room was located away from classrooms and offices so that students were less likely to feel that their discussions were being overheard, from outside the room, by their science teacher or other members of the school staff. The researcher was the only adult present during each FGI.

4.1.3 Recording of the Focus Group Interviews: the security of recordings and transcripts

The FGIs were recorded on two separate digital voice recorders, with one acting as an auxiliary device in case the main digital voice recorder failed to record the FGI. The recording was transferred to the researcher's computer and then transcribed. Once the recording had been fully transcribed, the recording on the digital voice recorder was erased. The recordings and transcribed interviews were held securely on the researcher's computer within password-secured folders and files.

4.1.4 Questions used as the basis for the Focus Group Interviews

The emphasis with each of the FGIs was that it should be semi-structured, with a common framework of questions as the structure for each FGI whilst enabling the researcher to explore any of the questions in greater detail with further, supplementary questions. The structured questions central to the FGIs stemmed from common similar responses within the questionnaires, and explored:

1. The students' relationship with their science teacher outside the classroom;
2. Relatedness – the quality of the teacher-student relationship during science lessons and the factors / teacher behaviours informing the students' perceptions;
3. Competence, especially perceived competence, including teacher behaviours that had a positive or negative influence upon students' perceived competence levels;
4. Autonomy within the classroom such as the opportunity to decide the direction and content of learning activities, including investigations;
5. The teacher behaviours that were perceived by student as being autonomy supportive;
6. Aspects of classroom learning that, the students' view, promoted or inhibited the feelings of motivation to learn and make engaged efforts within science lessons, and;
7. Factors perceived as having either an engaging or disengaging influence upon students' learning and / or participation within science lessons.
8. The key behaviours and methods central to the perceived 'ideal science teacher'.

The generic questions used across the FGIs may be found within Appendix 4.2.

4.2 Thematic Content Analysis of the Focus Group Interviews

The transcribed Focus Group interviews were analysed using Thematic Content Analysis protocols (TCA: Anderson, 1998, 2004) (see Appendix 4.1: this summarises the main conclusions drawn from the focus group data). TCA enables the descriptive presentation of data collected using qualitative methods such as focus group interviews. The advantage of conducting a TCA is that the outcomes are descriptive and analytical (Cresswell, 2009; Fischer, 2006; Smith, 1992, 2008). However, TCAs are also a form of intuitive inquiry: a constructivist epistemology and ontology based upon the intersubjective, inferential interpretations of subjective data that has been focused by the interviewer's selection of questions and the order in which they are asked (Anderson, 1998, 2004). As TCA is a form of interpretive inquiry, quite often the data collected and its analysis usually leads to far more questions than have been posed and answered (Aldridge et al., 1999, p. 50). Throughout, therefore, it is acknowledged that the current TCA, herein, is grounded within the assumptions associated with interpretivism, which are based upon subjective and interpretive paradigms (Thomas, 2009).

The transcribed FGIs were analysed in order to identify common themes across the sample as a whole and individual year groups (Appendix 4.1 summarises the main conclusions drawn from the focus group data). TCA involves selectivity on the part of the researcher as themes are selected on the basis of focusing upon areas that help to answer the research questions and provide an overview of:

1. The self-perceived affective, cognitive and self-attributional factors that students regard as being influential upon their engagement with learning;
2. The key motivating teacher characteristics and behaviours regarded as mediating influences upon the initiation and sustaining of engagement behaviours;
3. Specifically, the key teacher behaviours that;
    a. Inform students' views of the quality of the teacher-student interpersonal relationship during and outside science lessons;
    b. Inform students' self-attribute perceptions, such as competence for learning science and self-efficacy within science lessons and activities
    c. Encourage or inhibit students' participation and autonomy within learning activities within the classroom and written assignments, and;

4. Based upon the responses above, students' perceptions as to how their science teachers may further enhance their students' motivation for and engagement within science learning activities.

At the start of the TCA process, each of the transcribed files was saved in two forms: one as the original file and the other as an analysis file. This meant that each of the analysis files could be highlighted and assigned headings for each of the emerging common themes. The two research questions informed the selection of themes for extraction and analysis. The extracted passages within the Analysis and Discussion sections (4.13.2, 4.13.3 and 4.14) have been used as illustrative examples of the key themes as verbalised by students from different cohorts and genders. In addition to the thematic data that was extracted from the transcripts, categories were identified that were missing from the interview data.

Changes were made to the transcribed text to preserve the anonymity of the students being interviewed and, as far as possible, where he was being discussed, the identity of each individual science teacher, in that:

- Where the name of a student or some of the students is mentioned, this was replaced with [name of student(s)]
- Where the name of a science teacher is mentioned, this was replaced by [the current science teacher] or [the previous science teacher]
- Where the title of another role that the science teacher holds within the school is mentioned, this was replaced with [title held within school]
- Where it would be possible to identify an individual student or group of students from the particular behaviour that they exhibit, or the concepts approached could assist in the identification of a year group this was replaced within [ ].

Based upon the research questions for the main study, the following themes were the focus of the TCA. These are summarised within Appendix 4.1. The abbreviations within the following list are the same abbreviations that have been used within Appendix 4.1.

Relatedness:

- Students' perceptions of the quality of the Teacher-Student Interpersonal Relationship (TSIPRQ – Teacher-Student Interpersonal Relationship Quality)
    - Student likes the teacher (SLikeT = Students Like Teacher)
    - Student dislikes the teacher (SDislikeT = Student Dislikes Teacher)

- Teacher Care (R(TC) = Relatedness (Teacher Care))
- Teacher Support – autonomy supportive v controlling behaviours / external regulation (R(TS) = Relatedness (Teacher Support))
- Students' perceptions of teacher expectations (TExp = Teacher Expectations)
- The influence of students' interpersonal relationships with teachers outside of science lessons (TSRExt = Teacher-Student Relationship external to science lessons)
- Positive treatment by the teacher – students' perceptions (PosTreat = Positive Treatment)
- Negative treatment by the teacher – students' perceptions (NegTreat = Negative Treatment)

Students' Perceived Competence:

- Perceived competence within science lessons (PCom = Perceived Competence)
- Self-efficacy for learning and activities within science (SelfEff = Self-Efficacy)
- Self-confidence (SelfConf = Self Confidence)
- Strategies that have helped the students achieve success (ComStrat)

Students' Perceived Autonomy Support by teachers:

- Being able to plan and develop their own investigations and problem-solving activities (PAS = Perceived Autonomy Support by the teacher)

Students' affective perceptions

- Positive affect in reponse to teacher behaviours / perceived competence / variables within science lessons (PosAffec = Positive Affect)
- Negative affect in reponse to teacher behaviours / perceived competence / variables within science lessons (NegAffec = Negative Affect)

Students' engagement with science lessons and learning activities

- Cognitive engagement with science lessons and learning activities (CogEng = Cognitive Engagement)
- Cognitive disengagement with science lessons and learning activities (CogDiseng = Cognitive Disengagement)

- Academic engagement with science lessons and learning activities (AcaEng = Academic Engagement)
- Academic disengagement with science lessons and learning activities (AcaDiseng = Academic Disengagement)

4.3 Outcomes of the Focus Group Interviews

As noted within the previous section, whilst the correlations proved useful in terms of revealing the associations between the three SDT constructs, and the influence of each upon engagement, the disparity from the descriptive statistics and the small sample size meant that the qualitative evidence from the FGIs had to the main source of evidence drawn upon as the basis for the findings of this study and for modifications to the proposed motivational pathway (see Figure 4.1). Therefore, for the current research, the FGIs have proved the more reliable means of understanding the perceptions and experiences that informed students' engagement with learning. Consequently, given that the size and convenience of the sample has led to the limited generalisability of the quantitative data alone, the remainder of this analysis section focuses upon the evidence from the FGIs. The analysis of the FGI transcripts has enabled a more generalisable comparison between the conceptual findings of the MER and the students' verbalised perceptions of the key classroom-based impacting upon their engagement with learning (Appendix 4.3).

4.3.1 Analysis and Discussion of the FGI transcripts: influences upon engagement with learning

Within this section, the headings used for the TCA (section 4.2) have formed the basis for the analysis and discussion of the psychological interplay between the three SDT constructs and the impact of such interplay upon students' perceived motivation and engagement with science learning activities.

4.3.1.1 The Teacher-Student Relationship Quality (Relatedness)

The students regarded teachers' relational behaviours, affective reactions and the feedback they provide during and following learning activities as central to their motivated and sustained engagement with science. These motivational perceptions, in turn, informed students' engagement with science through, for example, intrinsic interest, enjoyment, and, where the teacher made it possible, the exploration of students' ideas and understanding through inquiry-based learning.

The quality of the teacher-student relationship was confirmed, by students across all seven FGIs, as outcomes of repeated, confirmatory interactions. It was clear that the relationship quality was informed by the consistency of teachers' interactions with the students. For example, one student (aged 11-12) stated that, "…he's sometimes really nice to me, but then he sometimes gets really angry at me, for not much at all, so ... I'm a bit confused really, and so I don't really know" (Group 3: Relatedness), whilst another stated that, "last year, he could sometimes be very, very nice to me, and he could sometimes be very, very… I really, really hated him, and it was like so hard to tell if he liked me or not, sometimes I thought that he didn't really like me that much at all, and sometimes I thought that he sort of liked me…" (Group 3: Relatedness).

Some 11 to 12 year-old students reported an ambiguity regarding the extent to whether their engagement within science lessons was based upon whether their perceptions of the teacher-student relationship were positive or negative. However, other 11 to 12 year-olds reported that the teacher was central to their enjoyment of and engagement with science. For example, one student reported feeling that, "If you don't like the teacher, you don't like the subject" (Group 4: Relatedness). He explained that "… if your teacher is always on your back, you know, … then you're just going to think, "What's the point of going to Science? I'm just going to get shouted at" (Group 4: Relatedness). This viewpoint was articulated by a number of groups: that where there was a perceived positive quality to the teacher-student relationship, this was associated with positive perceptions of competence and autonomy within investigations (for example, Groups 2 and 4).

Stronger perceptions of positive relationships were sustained where the teacher was receptive to students' confidence levels and obvious competence, thereby enabling students' to perceive themselves as more competent during learning activities. Group 1 stated that the ideal lesson involved a mixture of inquiry-based activity and the opportunity to fully participate in learning activities without unnecessary delays, such as having to wait until equipment was available for use. The students enjoyed and appreciated lessons where they had opportunities to demonstrate their competence through, for example, the discussion of their ideas, exploring their understanding of scientific concepts, and demonstrating their learning within practical activities.

From the students' perspectives, teacher-student relationships were improved through science teachers' feedback that was regarded as positive. Such feedback should include encouragement regarding the quality of work and the extent to which understanding of concepts has been gained. Feedback should also enable the correcting of misunderstandings and reinforcing the mastery of knowledge. Specific factors that influenced the students' perceptions that the teacher-student relationship is a positive one included the teachers' ability to help students feel competent during science lessons (Group 7: Relatedness):

"he is easier to understand."

"He is just more patient …"

"I like our current Science teacher better, because he understands…, I understand him more, sort of."

"He explains stuff really well."

"And he is sort of fun to be around …"

"He makes stuff that you are doing fun."

A similar factor informing the extent to which the teacher-student relationship is regarded as positive or negative was the quality of the teacher's explanations of scientific concepts and theory. This included perceptions that teachers work hard to help students develop their understanding and, in consequence, their perceived competence within the subject (expressed within all FGIs). Group 2 felt, for example, that teachers should be receptive to students' competence and confidence levels, and should act upon them to enhance these accordingly during science lessons.

There was perceived to be a more positive teacher-student relationship when all students were treated the same and were given time to complete tasks, without any sense of favouritism being involved: for example, one student remarked, "he treats everyone equally, which is really good, and he just…, well, everyone seems to be…, everyone seems to be getting on at the same level this year" (Group 4: Competence and Autonomy). A wide-spread perception of favouritism and the need for it to be absent was a common factor expressed by most groups. Favouritism was mentioned by students on a regular basis, being based upon the amount and frequency of attention that students received. Students who received more attention perceived that the science teacher liked them, whereas students who received less attention often perceived that the science teacher did not like them. As one student commented, “If he doesn’t like you, he won’t ask you questions, and say, if you wanted to go with someone, say I would want to go with [names of two students], …he would know that, and he would say “No, I want you to go with these other people” and he gives you a hard time about it, and you don’t learn as much” (Group 3: Relatedness). Some students were unwavering in their perception that a science teacher had favourites amongst the students, which, in turn, influenced their negative perception of the quality of the teacher-student relationship: for example, one student stated that, “… he has favourite people, and he just doesn’t like certain people”, while others commented that, “…he doesn’t give you a chance to try and be one of his favourites, and he is always just giving you a hard time …he just doesn’t like you, whereas some people, he just favours a lot” (Group 3: Relatedness).

Positive teacher-student relationships were reinforced when the students believed that their teacher listened to them, for example, by acknowledging their questions and ideas. Students’ perceptions that the teacher liked them were based upon the consistency of positive reactions from the teacher, including affective responses and relational behaviours: for example, “With [the current science teacher], he…, he doesn’t change his mood, he is always just like that, he is pretty cheery most of the time, a positive attitude” (Group 4: Relatedness).

The development of positive teacher-student relationships within science lessons were revealed to be based not only upon the students’ perceptions of the presence of motivating or demotivating factors within science lessons, but also upon the quality of the teacher-student relationship outside science lessons. The majority of students regarded a good relationship with the science teacher outside the science lesson as being predictive of a good relationship within science lessons, and vice-versa. The students reported that these perceptions had an impact upon their perceived competence and self-efficacy prior to, during and after science lessons. In some cases, the students felt that previous science teachers had based their interpersonal perceptions and relationship dynamics upon interactions with students around the school as much as in science lessons, as well as an interpersonal liking of older siblings (Group 3).

The students were asked if they only perceived a positive sense of competence and the motivation to be autonomous when a perceived positive teacher-student relationship was in place. The students, on the whole, agreed, although the responses of Group 3 (11 to 12 year-olds) differed from those of the other groups in this respect. Whilst this group reported negative relationships with their current science teacher, these students still felt that they were learning more than they had with their previous science teacher. Competence, despite the lack of a positive teacher-student relationship or enjoyment, was attributed more to how the teacher taught the subject rather than the sense of relatedness that this particular group of students attributed to the teacher-student relationship (Group 3: Competence). Although there was a decreased emphasis upon investigations with the change of science teacher in September 2013, the Focus Group 3 students felt that they were learning more in terms of the range and depth of scientific concepts encountered within lessons. In some instances, where there were fewer investigations, students believed that the teacher had not tried to make the learning enjoyable, or that the teacher has ignored the responses of the students when they either state or demonstrate that they are already able to do or have already done something within the concept or subject area under consideration. Where students felt their ideas were not being incorporated into lessons, they regarded the teacher as 'lazy'. Other factors that undermined the students' perceptions of the teacher-student relationship included not being allowed sufficient time to investigate concepts as a means of understanding them in depth, and the repetition of topics that had been previously covered and that the students felt confident about.

4.3.1.2. Autonomy

All FGI groups expressed their desire to be autonomous within learning activities, especially investigations, a need they based upon a combination of interest and curiosity. Following a change of science teacher in September 2013, Group 1 perceived a more positive teacher-student relationship quality and motivation to be autonomous with their previous science teacher, comparative to their current teacher. All of the students in Group 1 confirmed that the teacher was the most important factor influencing and informing their enjoyment of science. This perception was similar to those expressed by all of the other focus groups. Interestingly, however, Group 1 perceived a negative teacher-student relationship quality, regarding their new teacher as being more controlling within science lessons by comparison with their previous science teacher. This view was based upon the students' perception that they had limited or no opportunities to exercise their autonomy within investigations through, for example, choice and self-direction. The students preferred having the choice as to whether they wanted the teacher to either direct the investigations or to allow them more freedom by, for example, encouraging them to be entirely self-directing. However, despite this factor having a positive influence upon their engagement with science, none of the focus groups felt that there were regular opportunities for them to exercise open-ended autonomy within investigations. For example, one group of 12 to 13 year-olds (Group 5: Ideal Science Lesson) commented:

[Student 4] "Yeah, because we never ever get to do our own investigations, they are all set up by the teacher. We never get to do anything that…, yeah."

[Student 5] "It's the teacher's question that goes into the investigation."

[Student 4] "There is a set way of doing it that you have to do it by that way, you can't, like change it or anything."

[ALL] "Yeah."

[Student 6] "We don't ever get to do our own questions. It is always just set questions."

Autonomy through inquiry-based learning, such as investigations, were important to the students as means of increasing and enhancing their perceived competence (Group 2: Competence; Group 4: Competence and Autonomy). All focus groups felt that, within their present science lessons, there were fewer opportunities for them to be autonomous than they would have liked. This did not, however, diminish their sense of perceived competence within science. Fewer, or indeed no, investigations had potentially resulted in missed opportunities for the children to learn or master concepts as autonomous and independent learners, especially where the children had been used to being so with their previous science teacher.

The students reported that the opportunities for autonomous inquiry-based activities were reduced as they progressed through the older age ranges within the school. The reason for this, in their opinion, was because, with the older cohorts, the teachers placed a greater emphasis upon the importance of acquiring competence and competence-related confidence through the understanding and retention of scientific concepts. One of the older groups stated that they would prefer a science teacher that teaches in such a way that students' feelings of competence were enhanced, especially as they were preparing for external examinations later in the academic year (Group 6). However, this was not seen as a negative, as the students' preferred means of ensuring competence, understanding and retention whilst, for example, preparing for examinations was through on-going interactions and discussions with the teacher and with each other. This included the revision of previously encountered concepts through discussion with the science teacher: for example, "… I think [the current science teacher] is much better at explaining things than [the previous science teacher], because, [previous science teacher] kept just going on about things, and he didn't really explain them very well, so, I think [current science teacher] is a bit better, like at explaining them, and helping you understand" (Group 6: Relatedness).

Sustained engagement within science lessons was also partially reliant upon students' perceived opportunities to interact with the teacher, by developing explanations that enhanced the students understanding of concepts. The group were engaged by the format that had been introduced by their current science teacher: "with [the previous science teacher], we just did either a whole lesson of practical or a whole lesson of writing textbooks. With [the current science teacher], it's…, it's like 20 minutes writing textbooks, and then 20 minutes practical, and then sometimes we will change the other way around, and then we will have most of our prep, and do a small report, rather than writing a whole report out" (Group 4: Engagement). One reason given for this was that the opportunity to work alongside the science teacher was a means of correcting misunderstandings and confirming individual understanding of concepts, as well as being able to demonstrate such understanding through the design of their own investigations (Group 2: Competence).

Another optimal method that the students regularly pinpointed as having a positive influence upon their engagement with science was a teacher who created a balance between inquiry-based investigations and ensuring that they had opportunities to record the details and understanding of encountered concepts. Writing was seen, for example, as a means of ensuring that an optimal basis for revision was in place: for example, "[The current science teacher] makes us do a lot more writing than [the previous science teacher], but that is better, because when it comes to exams, you have something to revise from, and you can revise and that when…." (Group 4: Engagement).

4.3.1.3 Competence

Students' feelings of perceived competence are enhanced when they are afforded opportunities to work together and help each other during learning activities (Group 4: Engagement). In addition, students expressed a universal desire to move on to new scientific concepts as and when they felt that *they* understood them, rather than always having to wait upon teachers' decisions to do so: for example, "…you are not spending ages on one subject, like you're not spending like five lessons …you're only spending one lesson… because you have done it in much less time, and if you're just doing that every single time, in detail, it can get quite boring …" (Group 4: Engagement).

Students felt that their perceived competence could be further enhanced by teachers who have a positive questioning style and that gave feedback which promoted further understanding of and confidence with concepts (Group 3: Competence). Other means of enhancing students' perceived competence included students being given more time to investigate concepts, to develop their understanding and to complete work proficiently. The students preferred more direct input from their science teacher: for example (Group 7: Competence);

"Mr [current science teacher] explains things really well, and he is easier to understand … and Mr [current science teacher] is just really…, he keeps it quite simple and understandable."

"… it's the way he makes you understand it, and then he can tell when you know, if…, so he is really good at … knowing if you are finding it hard, and then he explains."

"If you find it hard, he explains it really well, what you are doing wrong, and if you get it right, he says what you are doing well …"

Student 4: "And before you move on to the next subject, he asks, he makes sure that everyone has understood it."

Student 5: "And then you can go back to points if you want to."

Student 4: "If you don't understand."

Therefore, careful explanations and feedback were welcomed by students as the basis for improving upon their current competencies, as long as it was accompanied by guidance upon how to improve (Group 3: Relatedness). One student, for example, suggested that there was the need for more focused feedback upon the content of the work rather the presentation of the work: "I don't think he gives out enough feedback on what we've done" and "I know that he marked my work wrong, but he didn't explain it why, so, I didn't really know what to do" (Group 3: Relatedness).

It is possible that as students mature and develop, they base the quality of the teacher-student relationship upon their perceptions of a teacher's ability and efforts to help students develop their abilities, competence and their self-efficacious desire to be agentic and autonomous within learning activities (Ryan and Deci, 2009). In situations where students have regular opportunities to exercise their own autonomy, informed by their positive perceived competence (including self-efficacy), they self-reported being more proficient at recognising their own progress and capabilities during science learning activities. This is particularly so when the motivation to be autonomous originates with the students' affect-driven feelings of perceived competence, self-agency and self-determination. The key point, therefore, is that students who have self-perceived control over opportunities to demonstrate their competence through the autonomy supportive learning activities, supported by performance feedback from the science teacher, are more likely to self-report as engaged. This, in turn, appears to inform students' view of their relationship with their teacher, the extent of which is dependent upon the age and maturity of the student, and their independence as a learner who has confidence in their perceived competence.

It may be that where a student perceives their competence through the mastery of science concepts alongside teacher-afforded opportunities to be autonomous, such as making agentic contributions to learning activities, the student is more likely to feel intrinsically motivated to learn and develop their competence. As a result, if this inference is correct, the student will have a more positive perception of the quality of the relationship with their science teacher. Conversely, the student is more likely to have a negative perception of their relationship with the science teacher where s/he is unable to perceive their own competence and, therefore, feels less confident in their self-ability to exercise their autonomy within learning activities. This may lead to overdependence on the teacher: such overdependence being negatively associated with extrinsic motivations for learning (Harackiewicz et al., 1992; Harter, 1992; Seligman and Altenor, 1980).

4.3.1.4. Defining the ideal Science teacher

Each FGI group was asked to summarise the key factors that they regard as central to the notion of the 'ideal science teacher'. Common to all groups, the students reiterated that their science teacher was central to their motivated engagement with science, and that this was dependent upon the science teacher that was leading science lessons. For example, "I think that a Science teacher should have a perfect balance of experiments and written work, but they should also allow their pupils to have their own ideas and theories", should emphasise "...the fun side of teaching, so that we can do experiments, rather than just writing things from textbooks", and "…you want to be doing lots of experiments, I mean, that is personally what I think Science is about, you know, experimenting to find new stuff" (Group 4: Engagement).

The personal qualities of the ideal science teacher included consistently positive relational behaviours: for example, “If, for instance, he told off someone for something, for laughing in lessons or … something, then that would just be the end of it, and he would just be nice to everyone else” and “But with Mr [current science teacher], if he gets annoyed at somebody, then he is like consistently angry” – a sense of humour and obvious approval through smiling, and making a concerted effort to ensure that students understand and can apply concepts – "“…[current science teacher] has got a bit more of a commitment to making us realise what is actually happening, while [previous science teacher] will just go and teaches it, and then [current science teacher], he will try and really get it into our heads that this is what happens” (Group 6: Relatedness).

In addition, students stated that teachers should not have ‘favourites’ amongst the students, either as individuals or because of their gender: “…it’s just that at the moment, when [current science teacher] asks questions, in particular, he normally asks the boys, and if he asks one of us, and then, we got it right, that would probably, but if we got it wrong, and he explained it, but, I just think that he normally asks boys the questions… ” (Group 6: Relatedness) or on the basis of siblings that the teacher has taught previously - “our old Science teacher…,because my [name of family relationship], he didn’t have a very strong relationship with him, he doesn’t really have one with me” (Group 7: Relatedness). As one student explained, “… it’s different because he doesn’t like…, doesn’t like my [name of family member relationship], as I said, [name], but he liked my other one, [name of family member relationship] [another name] but for some reason, because mine…, mine and [identifying information] I think he knows we’re [name of family members’ relationship] though, but for some reason, he just has a hatred for me, well, doesn’t really like me…” (Group 7: Relatedness).

4.4. Discussion of the findings of the main study

The second-order interpretations generated from the emergent concepts in the MER were supported by the evidence collected during the main study. Responses to the questionnaires confirmed that perceptions of the quality of the teacher-student relationship were directly influenced by students’ affective and cognitive perceptions of the methods that individual science teachers had used to enhance the students’ perceived competence. Across the cohorts, students reported that their teachers have the direct ability to enhance the pace and depth of the students’ perceived competence. The students also confirmed that the teacher is the most important factor influencing and informing their enjoyment of and engagement with science. This was based upon a teacher's perceived ability to enhance the pace and depth of the students' perceived competence.

In common with the emergent findings of the MER (sections 2.18 and 2.19), the responses from all of the FGIs revealed that the students base their views of the quality of the teacher-student relationship upon their perceptions of the teacher's effectiveness at enhancing students' perceived competence. This was regarded as more important than satisfying any wish they had for their teacher to be autonomy supportive. In-depth analysis of the FGI transcripts revealed that students' perceived competence influenced their motivation to be autonomous within learning activities. That is, the more positive the perceived competence the greater was the individual's desire to be autonomous during learning activities. It appears that such motivational processes and learning opportunities, if effectively afforded by teachers, should result in students being encouraged and supported to become more independent, self-competent and self-agentic learners who have positive perceptions of their self-efficacy. This, in turn, will inform their sustained desire to be autonomous (Bandura, 1986, 1997; Dewey, 1902. 1938; Vygotsky, 1978). This posit was supported by the students' responses to questionnaires across the three data waves, which revealed that the strongest correlative association informing their engagement was between relatedness and competence. The weakest correlative relationship informing their engagement was between relatedness and autonomy support.

During all FGIs, relatedness (the quality of the teacher-student relationship) emerged as the most influential SDT construct in terms of its impact upon students' motivated engagement with science learning activities. Students revealed that they based their views of the quality of the teacher-student relationship upon their perceptions of the teacher's effectiveness at enhancing students' perceived competence. Students' perceived competence was revealed as predictive of their motivation to be autonomous within learning activities. It was also affirmed that the teachers were central to students' enjoyment of and engagement with science. The quality of the teacher-student relationship appears to be inextricably linked to the extent to which a teacher's behaviours and afforded learning provision during lessons promote the students' perceived competence specific to science, based upon repeated, confirmatory interactions. Students' perceived competence was based primarily upon the performance feedback provided by the teacher. Teachers' affordance of autonomy-supportive learning activities that were regarded as enjoyable, interesting and enjoyable also informed and predicted students' engagement with learning activities (Jang et al., 2012; Vansteenkiste et al., 2005, 2012). In addition, teacher care and affective support was revealed as a potential predictive basis for enhancing students' feelings of belonging, academic enjoyment, self-efficacy (perceived competence) and engagement (Hardre et al., 2006; Pat El Tellima and van Koppen, 2012; Zhou et al., 2012).

Student responses, therefore, confirmed that whilst the satisfaction of all three SDT basic psychological needs is important, relatedness (positive teacher-student relationships) and competence are the two most influential SDT constructs upon their motivation to engage with science. As stated above, students' perceived competence was regarded as a stronger basis for a positive teacher-student relationship than satisfying any wish that the students had for their teacher to be autonomy supportive through, for example, the affordance of inquiry-based learning activities. However, where such opportunities were afforded, the students did confirm that this reinforced and promoted more positive perceptions of the quality of the relationship with their science teacher. Where students had increased and / or sustained opportunities to exercise their own autonomy through inquiry-based learning, they self-reported more positive perceived competence and progress in science. This suggests that a student who is afforded the autonomy to demonstrate their competence through, for example, inquiry-based learning activities, whilst supported by positive feedback from the science teacher, is more likely to develop a strong teacher-student relationship and, reciprocally, is more likely to be engaged with science. In addition, the reciprocal feedback perceptions of relatedness and competence have been asserted by students as having a direct impact upon their engagement with learning (within the main study, and, for example, Harter, 2012a; Mahatmya et al., 2012). The basis of this reciprocal relationship may be that perceived competence is influenced by an intrinsic motivation orientation, which, in turn, is informed by a student's perceptions that they have frequent opportunity to be autonomous and be supported in this by the teacher (Guay et al., 2012).

Students across all cohorts self-reported that they temporally developed a stronger sense of competence and autonomy support. This was despite their more negative perceptions of the teacher-student relationship quality and the negligible improvement of the teacher-student relationship comparative to perceived competence over the course of the research study. That is, the students reported feeling self-efficacious and competent regardless of whether the teacher's motivating style during science lessons was perceived as autonomy supportive or controlling. This suggests that students are temporally able to develop positive perceptions of their competence and self-efficacy across the full continuum of teacher motivating styles from autonomy supportive to controlling (Close and Solberg, 2008).

Further to the above findings, it appears that of the three SDT constructs the one that is most *resilient* with regards to engagement is competence, in the form of an individual's sustained need and desire to be competent. This resilience was affirmed, even when the quality of the teacher-student relationship is regarded as negative and there are limited opportunities for students' autonomy to be exercised. Whilst none of the cohorts reported a consistent positive relationship with their science teacher, a small number of individuals within each group did report a positive relationship with the science teacher: in some cases, this was very positive. These students reported similarly positive perceptions of their competence within science learning activities, of positive levels of the autonomy allowed and, where afforded, autonomy support. However, with the increasing age of the groups it was interesting to note that although the quality of the teacher-student relationship was regarded overall as negative by the students there were still steady increases in the students' perceived competence and motivation to be autonomous. The cohort of 10 to 11 year-olds revealed that the perception of their teacher-student relationship had a strong reciprocal influence upon their temporal feelings of competence, autonomy and autonomy support. The quality of the teacher-student relationship influenced these perceptions, which, in turn, reinforced the students' cognitive and affective responses re the quality of the teacher-student relationship. With the eldest cohort (12 to 13 year-olds), students appeared more confident about their perceived competence and motivation to be autonomous within science lessons, and in their ability to master science concepts regardless of their negative perceptions of the quality of the teacher-student relationship. This suggests that whilst the teacher-student relationship quality appears to be predictive of students' perceived competence and autonomous motivation with younger students, the relationship may become less influential with the increasing age of the students as they developmentally move from dependence upon the teacher to interdependence (Harter, 2012a; Mahatmya et al., 2012; Pitzer and Skinner, 2012; Ryan, 1982). However, it may be that younger students perceive the quality of the teacher-student relationship as being more important, comparative to their older peers, as the motivational basis for feeling engaged and competent within learning activities. It has been suggested that younger students' perceptions of the teacher-student relationship quality may be based upon a form of learned helplessness: manifested as dependency upon the teacher for guidance, and for making the student's competence-based progress, successes and achievements overtly evident (Harter, 2012ab; Hattie, 2009, 2012; Pat El Tellima and van Koppen, 2012). As students mature, they usually become less dependent on their teacher (Harter, 2012a). However, there will still be adaptive help-seeking alongside an increasingly greater psychological need to be more independent, as well as engaging in tasks and behaviours where they increasingly feel more competent by making progress as a result of their own self-motivated and self-determined autonomy (Harter, 2012a; Mahatmya et al., 2012).

The resilience of perceived competence and its impact upon motivated engagement with learning was found across all four cohorts. Each group similarly reported their need to feel competent and to become more competent, even when the teacher-student relationship quality was viewed as negative and there were limited opportunities for students' autonomy to be exercised. In addition, the positive affect generated in response to perceived and actual achievement was instrumental in enhancing students' perceived competence and, in turn, an a more positive teacher-student relationship quality (MER: sections 2.18 and 2.19). For example, enhanced engagement was observed during learning activities when there were positive associations between students' perceived competence and intrinsically regulated motivation (Cox and Williams, 2008). These motivated perceptions and increased engagement resulted in the student feeling more self-efficacious and, therefore, motivated and enthused by the challenges within new learning activities. This appears to be due to perceived competence and self-efficacy combining to create an overall academic self-concept which influenced the beliefs that the student has about their academic capabilities, skills and strengths, and the experiences that have informed these (Bandura, 1977, 1986, 1997; Cleary and Zimmerman, 2012; Hughes et al., 2011; Marsh and Shavelson, 1985; Pajares, 1996; Urdan and Turner, 2007). An outcome of a positive academic self-concept has been asserted as students' enhanced academic intrinsic motivation. This form of motivation has been seen to lead, via reciprocal feedback pathways, to further optimistic engagement with learning. Due to the associated persistence, effort and resilience typical to learning engagement, this engagement has been proposed, within other studies, to lead to further achievement and academic progress (Boggiano and Pittman, 1992; Marsh and Martin, 2011; Marsh and O'Mara, 2008; Park et al., 2012).

Despite the majority of the students perceiving their relationship with their science teachers to be either neutral or negative, they still self-reported positive feelings of perceived competence, which increased temporally. This sense of increasing competence was closely interlinked with their motivation to be autonomous, regardless of whether it was in the form of actual opportunities to exercise their autonomy within science lessons or simply the motivation to be autonomous. It was interesting, also, that the students' regarded their perception of competence as sustaining their motivation for learning within science even if they did not always get the chance to translate this into autonomous, self-regulated behaviours often associated with optimum engagement. This differs from the findings of other studies that have focused upon the importance of the teacher-student relationship as the motivational basis for effortful engagement (Archambault et al., 2013; Birch and Ladd, 1997; Hamre and Pianta, 2006; Hughes et al., 2008; Pianta and Steinberg, 1992; Pianta and Stuhlman, 2004; Pianta et al., 1995, 2002, 2003). A possible reason for the responses of the current participants differing from those reported by other studies may be that they have learnt through experience to not only be less reliant upon the quality of the teacher-student relationship as the basis for informing their perceived competence but also at an earlier age than one would normally expect (Lynch and Cicchetti, 1997). The students' perceptions revealed that, rather than looking to their teachers, they had become more reliant upon their peers at this stage. They appeared to be using interactions with peers as an influential means of informing their perceived competence within science lessons. Although this could not be confirmed, it may be that the excellent quality of the teacher-student relationships that the children had when they were younger had helped them to internalise benchmarks for judging their perceived competence and self-efficacy earlier than one would expect developmentally. That is, an increased reliance upon the peer group has already occurred at the ages of 11, 12 and 13, when would normally expect this to be a developmental trait of older students (Harter, 2012a). Ryan (2001) has highlighted the important compensatory role of peer influence, especially when the teacher-student relationship is either negative or regarded as less important, reporting that there is a tendency amongst young adolescents to group together according to perceived homophily: shared attributes including "…the norms, values, and standards that concern academic motivation and achievement. This shared peer group context is likely to influence adolescent motivation and engagement in school" (p. 1136).

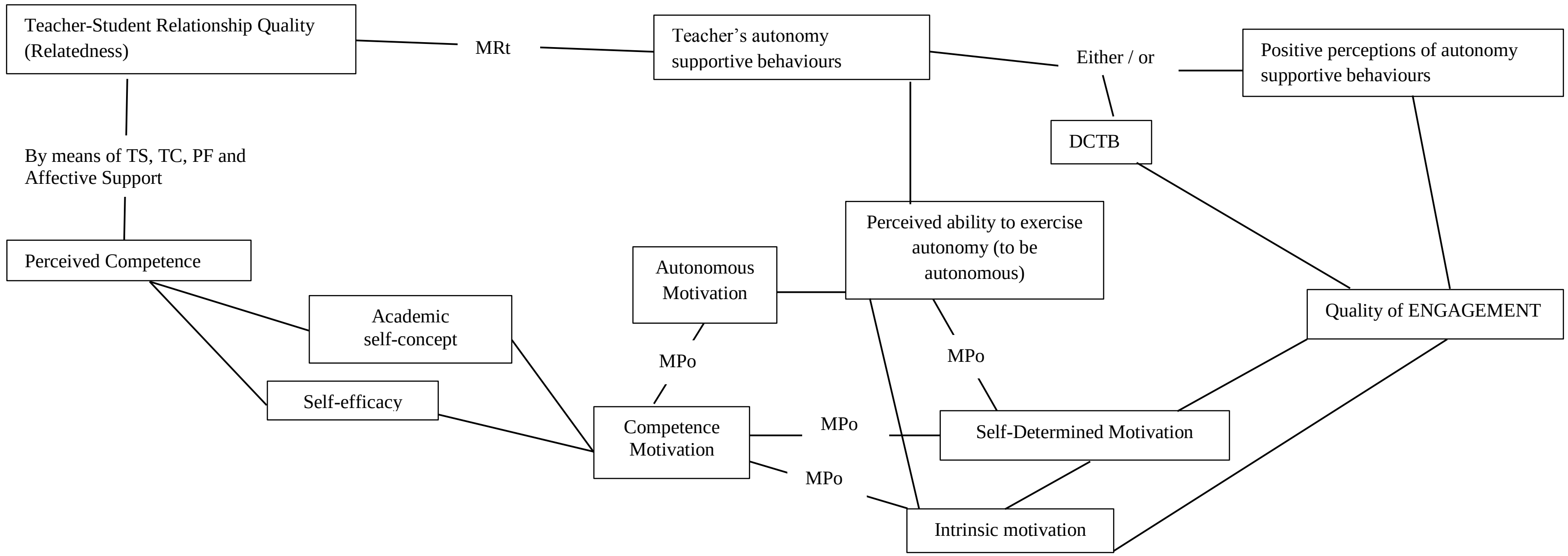
Therefore, it may be that the preadolescent / early adolescent children within this particular independent boarding school had formed much stronger peer bonds than may ordinarily be found amongst their counterparts within day schools. That is, the strengthening of the peer bond where children are residing together for up to three weeks at a time may act as a protective cushion that enables the students to maintain a strong sense of competence and a desire for autonomy. For example, the students, regardless of age, felt temporally competent within their learning and understanding of science concepts, and expressed the view that they felt able to proceed to the next stages in their learning and mastery of science at a faster pace than the teacher sometimes allowed. Usually, older students are regarded as more capable than their younger peers of forming such perceptions of their competence

(Harter, 2012a). In the case of the younger FGI participants, it appears that they have already begun to form such perceptions based upon two potential informing variables. The first variable consists of independent judgements of what is expected of them within a learning activity, with the second being internal cognitive criteria upon which they form a mental picture of success and failure (Harter, 2012a, p. 239). These combined variables form the perception of competence, which results in the mediating effect of a positive, negative or mixed affective response. This, in turn, informs the extent to which a student feels self-efficacious within a specific subject and learning activity therein. However, the influence of peers may support or refute these self-perceptions.

In summary, the students regarded their teachers as being central to the enhancement of students' engagement and achievement within learning activities. This was based upon the view that the students perceived that the teacher has the direct ability to particularly enhance the pace and depth of the students' perceived competence, mediated by teacher feedback. Students' willingness to listen to and act upon competence-based feedback is informed by the perceived quality of the teacher-student relationship (Hipkins, 2012). Receptiveness to feedback from the teacher has the potential to reciprocally inform students' self-efficacy, and, in consequence, impact upon their engagement within learning activities (Cleary and Zimmerman, 2012). Students' perceived quality of the teacher-student relationship was directly influenced by their affective and cognitive responses and perceptions, mediated by their perceived competence, which had been influenced by the methods that individual science teachers had used to enhance students' perceived competence.

Therefore, further to the findings of the main study (this section) and MER (sections 2.18 and 2.19), three tentative claims are proposed regarding the nature of the SDT motivational pathways associated with students' positive engagement with school-based learning. The first is that, when considering classroom psychosocial dynamics through the lens of SDT, the motivation to be autonomous is an outcome of students' satisfied need for positive teacher-student relationships and perceived competence (as the basis of positive self-efficacy). The second is that perceived competence as the mediating variable between relatedness and autonomy is directly informed by and informs the quality of the teacher-student relationship. The third is that there is a potential cumulative relationship between students' perceived competence and the quality of the teacher-student relationship (relatedness).

Figure 4.1 *Potential motivational pathway between the three SDT constructs based upon the findings of the main study and MER. (Stage Two)*



Key: MRt – Mediates Receptiveness to
MPo – Mediates Perceptions of
DCTB – Directly Controlling Teacher Behaviours
TS – Teacher Support
TC – Teacher Care
PF – Performance Feedback (Positive / Negative)

CHAPTER FIVE
GENERAL DISCUSSION

PART ONE

5.1 Triangulation of the three tentative claims to knowledge regarding students' motivated engagement with learning activities

The proposed SDT motivational pathways model for informing teachers' understanding of students' engagement with learning activities (Figure 4.1) evolved from the three tentative claims to knowledge that emerged from the findings of the MER and the main study (see section 4.4). This has enabled a level of conceptual clarification with regards to the potential pathways between the different types of motivation that influence students' engagement with learning. This, in turn, has led to the modification of the initial conceptual framework for the MER (Figure 2.3) to form the proposed conceptual framework (Figure 5.3). In addition, as a means of further exploring the findings common to the main study and MER, and as the basis of a more informed overall discussion of such findings, an online survey was conducted. This survey has explored the extent to which the three tentative claims were supported or refuted by the responses of the teacher- researcher's former students. The survey was used to collect and analyse the perceptions of a much larger sample group than had been accessible during the main study.

5.1.1 The Methodology for the Online Survey

The survey was designed, distributed and analysed using Bristol Online Survey (http://www.survey.bris.ac.uk/) (see Appendix 5.1). The questions were based upon the claims and emergent findings, with wording being based upon two prior-validated SDT questionnaires: Perceived Autonomy Support: The Climate Questionnaire and the Perceived Competence Scale (PCS) [acquired from www.selfdeterminationtheory.org]. The questions and accompanying statements were all designed and tested (by means of a pilot study with a small group of former students) to ensure that they were phrased in such a way that they were not ambiguous, and that they enabled respondents to call upon their opinions through fact-based answers. (The same principles of design and testing of surveys has been applied as in the main study). Questions and statements were included in order to determine:

1. The gender of the respondent;
2. The ranking of five classroom-based factors that respondents regarded as most important to their motivated engagement with learning within lessons, with 1 being ranked as most important and 5 as the least important;
3. The ranking of five teacher behaviours and perceived teacher behaviours, with 1 being ranked as most important and 6 as the least important;
4. Using a four-point Likert scale, respondents were asked to indicate the strength with which they agreed or disagreed with 5 statements in relation to their own learning and perceptions when they were being taught by a teacher they regarded as motivating their engagement with learning;
5. The ranking of four aspects of teachers' behaviours and methods were most important to their involvement as an engaged learner during lessons perceived as motivating, with 1 being ranked as most important and 4 as the least important;
6. Using a four-point Likert scale, respondents were asked to indicate the strength with which respondents agreed or disagreed with 10 statements in relation to the factors that informed the perceived quality of the teacher-student relationship, and;
7. Deciding upon the motivational pathway in order of influence, in terms of how each of the psychosocial variables (SDT-related) led to another as the basis for respondents' motivated engagement with learning. (For example, if the teacher-student relationship led to a respondent feeling competent and this, in turn, led to feeling more competent or willing to direct their own learning, s/he was asked to rank the statements as 1,2,3).

Participants were recruited by convenience sampling, in that the chosen audience for the online survey were the teacher-researcher's former students aged 18+ at the time of the survey being made available, of whom he had regular access to approximately 400 through regular e-mail contact and social media. As the former students were all aged 18 or over, they implicitly gave their informed consent by participating in the survey online. Clearly, there is the issue of obvious bias to be considered when one is calling upon former students to reflect upon the positive aspects of teachers' behaviours. However, this has been addressed by ensuring that the identities of the former students were not known to the researcher and that the participants were not required to name the teacher they were reflecting upon whilst responding to the survey. The survey drew upon their self-reported perceptions within their schooling in general as opposed to within a specific subject, i.e. science.

The Likert scales in questions 4 and 6 enable one of four responses – Strongly Agree, Agree. Disagree and Strongly Disagree. The use of questionnaires in the main study revealed the difficulties of including the midpoint response ‘Neither Agree nor Disagree’ (on a 5-point Likert scale) in that, whilst it allows the respondent to provide a neutral answer it is also ambiguous as a response in that the researcher does not gain an insight as to whether the respondent was skewed more to the Agree or the Disagree side of the scale (Tsang, 2012). The inclusion of the midpoint within the main study questionnaires gave students an opportunity to remain neutral and / or non-committal in their responses. That is, it gave respondents the opportunity to choose a neutral stance when they either cannot or do not wish to make a commitment to one end of the Likert scale or the other. This neutrality can skew both the reliability and validity of the overall responses in terms of ambiguity. However, omitting the midpoint does not necessarily impact upon the internal consistency of the survey (Weems and Onwuegbuzie, 2001) but it does enable greater clarity in that participants are required to choose either a more positive or more negative direction within each of their responses (Tsang, 2012).

The use of a survey, whether electronic, face-to-face or administered by another means, presents its own advantages and limitations (as discussed in Chapter 3). The advantages of an online survey are that the survey may be distributed quickly and easily to the target sample populations, and reminders may be sent on a regular basis whilst the survey is available online; the responses can remain closed in terms of the range of answers available, thereby enabling a focus upon testing specific claims to knowledge; responses can include rankings, Likert scales, and ‘yes’ or ‘no’ choices; access is available to a much larger population than one might necessarily have access to face-to face, and; the anonymity of the respondents is assured as they were only asked to indicate their gender. (However, given the focus of the two research questions (Section 1.1), it should be noted that there has not been a specific focus upon gender within the results)). Limitations of an online survey include the need to decide upon the questions and, with Likert scale and multiple-choice questions, the range of answers and / or choices. That is, if the same online survey was used for further research there would be space for respondents to suggest other options if they disagreed with or wished to reject such options. In addition, there would spaces for free responses as the basis for gaining more reflective insights. A further limitation, as discussed in Chapter 3, is that the use of a survey does not enable the exploration of former students’ responses on the basis of the perceptions and experience-informed interpretations of the engaging or disengaging nature of their learning environment (Cohen et al., 2007). However, this was not a major limitation in the case of this study as the objective was to test the three claims and use the 14 across-study findings as a further means of evolving the proposed SDT motivational pathway model (see Figures 4.1 and 5.2). The objective of this model is to provide a potential insight into the cognitive and affective impacts of the three SDT basic needs and motivational responses upon students' engagement with learning, which may be tested through further in-school research (see Section 6.4).

5.1.2 Results

Question 1

There were 191 completed surveys: 84 male (44 %) and 107 female (56 %) respondents. The response rate, based upon a target sample population of 400, was 48 %.

Question 2

Which classroom-based factors were most important to your motivated engagement with learning within lessons led by your chosen teacher? Please rank the following in order of importance (with 1 being the most important and 5 being the least important).

The evidence revealed that with regards to students' engagement to learning, the most important motivational variables were the teacher-student relationship quality and the positive feedback that teachers gave, together with the impact that these have upon students' self-efficacy. On the basis of the 191 responses, the ranking for the factors which act as the perceived motivators of engagement with learning were revealed as:

1. A positive relationship with the teacher;
2. Positive feedback from teachers about students' achievement / performance;
3. Feeling positive about the ability to make further progress;
4. The need to decide how different concepts are learnt;
5. The need to decide what was being learnt.

Table 5.1 *Responses to online survey Question 2*

CLASSROOM-BASED FACTOR and ranking	**1**	**2**	**3**	**4**	**5**
Positive relationship with the teacher	107 (56%)	32 (16.8%)	33 (17.3%)	8 (4.2%)	11 (5.8%)
Positive feedback about your achievement / performance	26 (13.6%)	86 (45%)	63 (33%)	10 (5.2%)	6 (3.1%)
Feeling positive about your ability to make further progress	39 (20.4%)	56 (29.3%)	78 (40.8%)	11 (5.8%)	7 (3.7%)
The need to decide what you learnt	12 (6.3%)	6 (3.1%)	13 (6.8%)	68 (35.6%)	92 (48.2%)
The need to decide how you learnt different concepts	7 (3.7%)	11 (5.8%)	4 (2.1%)	94 (49.2%)	75 (39.3%)

Question 3

The ranking of five teacher behaviours and perceived teacher behaviours, with 1 being ranked as most important and 6 as the least important.

The results revealed that with regards to students' perceived competence and enhanced academic self-concept, the need to perceive competence was more important than the need to exercise autonomy during learning. On the basis of 191 responses, the order of ranking for the teacher behaviours and perceived teacher behaviours which act as the perceived motivators of engagement with learning were revealed as:

1. My teacher conveyed confidence in my ability to do well in the lesson / subject;
2. My teacher made sure I really understood what I needed to do to improve;
3. I felt understood by my teacher;
4. My teacher encouraged me to ask questions;
5. The teacher provided me with choices and options;
6. My teacher listened to how I would like to do things during learning activities.

Table 5.2 *Responses to online survey Question 3*

TEACHER BEHAVIOUR / PERCEIVED TEACHER BEHAVIOUR and ranking	1	2	3	4	5	6
The teacher provided me with choices and options.	17 (8.9%)	14 (7.3%)	13 (6.8%)	33 (17.3%)	59 (30.9%)	55 (28.8%)
I felt understood by my teacher.	30 (15.7%)	32 (16.8%)	55 (28.8%)	29 (15.2%)	22 (11.5%)	23 (12%)
My teacher conveyed confidence in my ability to do well in the lesson / subject.	84 (44%)	38 (19.9%)	37 (19.4%)	15 (7.9%)	8 (4.2%)	9 (4.7%)
My teacher made sure I really understood what I needed to do to improve.	37 (19.4%)	69 (36.1%)	32 (16.8%)	32 (16.8%)	14 (7.3%)	7 (3.7%)
My teacher encouraged me to ask questions.	21 (11%)	31 (16.2%)	39 (20.4%)	50 (26.2%)	38 (19.9%)	12 (6.3%)
My teacher listened to how I would like to do things during learning activities.	2 (1%)	7 (3.7%)	15 (7.9%)	32 (16.8%)	50 (26.2%)	85 (44.5%)

Question 4

Using a four-point Likert scale, respondents were asked to indicate the extent to which they agreed or disagreed with 5 statements in relation to their own learning and perceptions when they were being taught by a teacher they regarded as influencing their motivated engagement with learning.

From the responses, it was revealed that all five teacher-centred perceived motivators had an influence upon students' perceived competence and self-efficacy, with the teacher helping students to feel more confident in their ability to learn the lesson materials being perceived as a slightly stronger influence than the other four strong contributory factors.

Table 5.3 *Responses to online survey Question 4*

Perceptions of the impact of teacher behaviour and methods upon students' engagement with learning	Strongly Agree	Agree	**Sum - Agreed**	Disagree	Strongly Disagree	**Sum - Disagreed**
The teacher helped me to feel more confident in my ability to learn the lesson materials.	122 (63.9%)	64 (33.5%)	**186 (97.4%)**	4 (2.1%)	1 (0.5%)	**5 (2.6%)**
I was capable of learning the lesson materials because of the teacher's behaviours.	92 (48.2%)	84 (44%)	**176 (92.2)**	13 (6.8%)	2 (1%)	**15 (7.8%)**
I was able to achieve my goals in this course through encouragement by the teacher.	92 (48.2%)	86 (45%)	**178 (93.2%)**	12 (6.3%)	1 (0.5%)	**13 (6.8%)**
I felt able to meet the challenge of performing well in this course because of the teacher.	85 (44.5%)	91 (47.6%)	**176 (92.2%)**	10 (5.2%)	5 (2.6%)	**15 (7.8%)**
I was capable of learning the lesson materials because of the teacher's methods.	96 (50.3%)	79 (41.4%)	**175 (91.6%)**	13 (6.8%)	3 (1.6%)	**16 (8.4%)**

Question 5

The ranking of four aspects of teachers' behaviours and methods were most important to their involvement as an engaged learner during lessons perceived as motivating, with 1 being ranked as most important and 4 as the least important.

The responses revealed that the four teacher-based factors in order of their impact upon students' involvement as an engaged learner during lessons perceived as motivating were:

1. I had a positive relationship with the teacher.
2. The teacher helped me to have confidence in my own ability within their subject / lessons.
3. The teacher gave me feedback that made me want to find out / learn by myself.
4. The teacher allowed me to direct what I learnt and how I learnt it.

Table 5.4 *Responses to online survey Question 5*

Teachers' behaviours and methods were most important to their involvement as an engaged learner during lessons perceived as motivating	**1**	**2**	**3**	**4**
I had a positive relationship with the teacher.	101 (52.9%)	47 (24.6%)	33 (17.3%)	10 (5.2%)
The teacher helped me to have confidence in my own ability within their subject / lessons.	64 (33.5%)	88 (46.1%)	33 (17.3%)	6 (3.1%)
The teacher allowed me to direct what I learnt and how I learnt it.	7 (3.7%)	10 (5.2%)	33 (17.3%)	141 (73.8%)
The teacher gave me feedback that made me want to find out / learn by myself.	19 (9.9%)	46 (24.1%)	92 (48.2%)	34 (17.8%)

Question 6

Using a four-point Likert scale, respondents were asked to indicate the strength with which respondents agreed or disagreed with 10 statements in relation to the factors that informed the perceived quality of the teacher-student relationship. The responses revealed the following order of strength of agreement, in that:

1. My positive relationship with the teacher was due to the teacher being friendly and approachable.
2. My positive relationship with the teacher was due to the teacher giving feedback that helped me to feel confident in my own ability.
3. My positive relationship with the teacher was due to the teacher giving feedback that helped me to feel self-competent.
4. My positive relationship with the teacher was due to the teacher having a sense of humour.
5. When I felt competent, it was mainly because of the teacher's influence.
6. The more competent I felt, the more I wished to self-direct how and what I learnt.
7. The more competent the teacher helped me to feel, the more I wanted to decide how I should learn.
8. The more competent the teacher helped me to feel, the more I wanted to decide what I should learn.
9. My positive relationship with the teacher was due to the teacher letting me decide how I should learn.

10. My positive relationship with the teacher was due to the teacher letting me decide what I should learn.

Table 5.5 *Responses to online survey Question 6*

Perceived factors that informed the perceived quality of the teacher-student relationship	Strongly Agree	Agree	**Sum - Agreed**	Disagree	Strongly Disagree	**Sum - Disagreed**
My positive relationship with the teacher was due to the teacher being friendly and approachable.	117 (61.3%)	66 (34.6%)	**183 (95.8%)**	7 (3.7%)	1 (0.5%)	**8 (4.2%)**
My positive relationship with the teacher was due to the teacher having a sense of humour.	74 (38.7%)	91 (47.6%)	**165 (86.4%)**	25 (13.1%)	1 (0.5%)	**26 (13.6%)**
My positive relationship with the teacher was due to the teacher giving feedback that helped me to feel confident in my own ability.	112 (58.6%)	67 (35.1%)	**179 (93.7%)**	11 (5.8%)	1 (0.5%)	**12 (6.3%)**
My positive relationship with the teacher was due to the teacher giving feedback that helped me to feel self-competent.	93 (48.7%)	82 (42.9%)	**175 (91.6%)**	15 (7.9%)	1 (0.5%)	**16 (8.4%)**
My positive relationship with the teacher was due to the teacher letting me decide how I should learn.	33 (17.3%)	52 (27.2%)	**85 (44.5%)**	82 (42.9%)	24 (12.6%)	**106 (55.5%)**
My positive relationship with the teacher was due to the teacher letting me decide what I should learn.	14 (7.3%)	40 (20.9%)	**54 (28.2%)**	94 (49.2%)	43 (22.5%)	**137 (71.7%)**
The more competent the teacher helped me to feel, the more I wanted to decide how I should learn.	48 (25.1%)	68 (35.6%)	**116 (60.7%)**	62 (32.5%)	13 (6.8%)	**75 (39.3%)**
The more competent the teacher helped me to feel, the more I wanted to decide what I should learn.	29 (15.2%)	80 (41.9%)	**109 (57.1%)**	62 (32.5%)	20 (10.5%)	**82 (43%)**
When I felt competent, it was mainly because of the teacher's influence.	53 (27.7%)	82 (42.9%)	**135 (70.6)**	53 (27.7%)	3 (1.6%)	**56 (29.3%)**
The more competent I felt, the more I wished to self-direct how and what I learnt.	56 (29.3%)	72 (37.7%)	**128 (67%)**	52 (27.2%)	11 (5.8%)	**63 (33%)**

Question 7

Deciding upon the motivational pathway in order of influence, in terms of how each of the psychosocial variables (SDT-related) led to another as the basis for respondents’ motivation / engagement with learning.

Table 5.6 *Responses to online survey Question 7*

The motivational pathway in order of influence, in terms of how each of the psychosocial variables (SDT-related) led to another as the basis for respondents' motivated engagement with learning	**1 First stage / initial motivating factor**	**2 Influences perceptions of (stage two in the pathway)**	**3 Outcome / final stage in the motivational pathway**
The quality of the Teacher-Student Relationship	112 (58.6%)	60 (31.4%)	19 (9.9%)
Feeling competent within a lesson / subject: able to achieve within that lesson / subject.	71 (37.2%)	109 (57.1%)	11 (5.8%)
I felt more able / willing to direct my own learning within the subject.	8 (4.2%)	22 (11.5%)	161 (84.3%)

These results revealed that the majority of respondents perceived that the order of influence within the motivational pathway impacting upon students' engagement is:

1. The quality of the Teacher-Student Relationship, having an influence upon;
2. Feeling competent within a lesson / subject: able to achieve within that lesson / subject, which has an impact upon;
3. Feeling more able / willing to direct his / her own learning within the subject.

In response to Question 7, for each result the percentage for each of the strongest factors was greater than the cumulative total of the other two: for example, 112 (58.6 %) perceived the quality of the Teacher-Student Relationship as the first contributory factor, which was greater than the cumulative total created by combining the figures for those who perceived 'Feeling competent within a lesson / subject: able to achieve within that lesson / subject' or 'I felt more able / willing to direct my own learning within the subject' as the first contributory factor.

5.1.3 Discussion of the results of the online survey

The outcomes of the online survey support the three tentative claims to knowledge that have arisen from the findings of the main study and the MER. Responses to question 7 revealed that the quality of the teacher-student relationship has the strongest self-reported impact upon students' motivated engagement with learning, with perceived competence being the next most influential factor in the motivational pathway. The responses revealed that the majority of the respondents' perceived the starting point of the motivational pathway informing students' engagement with learning being the quality of the teacher-student relationship. This was revealed as having an impact upon students' perceived competence and self-efficacy, and resulting in autonomy. The motivation to be autonomous was self-reported as the final stage in the motivational pathway by the vast majority of respondents (84.3 %). Therefore, across the survey, the most important factors influencing students' engagement with learning activities, in order of self-reported impact, were a positive relationship with the teacher, positive feedback from teachers about students' achievement / performance, and feeling positive about the ability to make further progress (self-efficacy) (for example, Question 2).

Factors influencing the quality of the teacher-student relationship were revealed to be based upon how the teacher used feedback to influenced students' perceptions of competence and self-efficacy (Question 2). The least important motivational variables in terms of their impact upon engagement were the need to decide how and what was being learnt (autonomy) (see also responses to questions 3, 5 and 6). The important role of the teacher in enhancing students' need for perceived competence and to be provided with feedback that would enable further progress was confirmed by question 3. As with questions 3.5, 6 and 7, the need to decide how and what was being learnt (autonomy) was considered not to be as important comparative to the need to feel competent and to be able to make further progress.

Responses to question 5 revealed that all five suggested teacher-afforded methods and behaviours have similar motivational impacts upon students' perceived competence and self-efficacy. The teacher helping students to feel more confident in their ability to learn the lesson materials was perceived as a slightly stronger influence than the other four methods and behaviours. Responses to question 6 revealed that the perceived teacher behaviours that have a greater influence upon the quality of the teacher-student relationship were teachers' friendliness and approachability and feedback that enabled students to feel self-confident in their perceived competence. The least influential upon their motivated engagement were students' needs to decide how and what was being learnt (autonomy).

Therefore, self-reported responses suggest that the desire to decide how different concepts are learnt and the need to decide what was being learnt (autonomous motivation) were of far less importance than the cumulative influence of the teacher-student relationship, perceived competence and the nature of teacher-afforded feedback (for example, questions 5 and 6). Indeed, the combined results of the survey revealed that, as previously asserted, that autonomy is a product of attachment based upon a positive teacher-student relationship which has been built upon students' burgeoning perceived competence and teacher-afforded feedback.

PART TWO

5.2. Introduction to the General Discussion

The quality of the teacher-student relationship has been referred to as a "supplement" within the SDT model, with autonomy and competence being more often emphasised as the basis for self-determined engagement (Ryan and Deci, 2009, p. 178). However, the evidence within the current research suggests that relatedness, in the form of positive teacher-student relationships, is the essential catalyst informing the quality of students' engagement through the enhancement of perceived competence. The remainder of this chapter draws together the cumulative findings of the current research. It highlights common patterns which appear to facilitate the influence of the three SDT basic psychological needs upon each other and the potential impact upon students' motivation to engage with learning. This discussion, in association with published key principles of SDT and prior school-based SDT research has informed the development of the proposed classroom-based SDT motivational pathway model (Figure 5.2).

The results of the main study suggest that the teacher behaviours and methods supporting students' perceived competence and motivation to be autonomous are optimised when students perceive that they have a positive relationship with the teacher within the classroom. Where there is a perceived positive teacher-student relationship, different forms of motivation were enhanced. These include intrinsic motivation, extrinsic motivation to work towards goals that are regarded as having a personal value, competence motivation and autonomous motivation (Hughes et al., 2008; Ryan and Deci, 2009). The desire for autonomy also appears to have a motivating impact upon perceived competence and the resultant competence motivation and intrinsic motivation to engage with learning. However, whilst the proposal that the satisfied desire for a positive teacher-student relationship and to feel competent is predictive of the motivation to be autonomous is supported across the current research as a whole, each SDT contruct may have different interplay implications and precursors in terms of their impact upon students' motivation to learn. With regards to autonomy, students’ motivation to exercise their own autonomy originated with the students’ affect-driven feelings of perceived competence, self-agency and self-determination.

Autonomy was self-reported as the least influential of the three SDT basic psychological needs in terms of its impact upon students’ motivation to engage with learning activities. That is, both relatedness and competence were confirmed as having much stronger impacts upon students’ motivated engagement than autonomy. Both needed to be satisfied if engagement was to be sustained. In addition, the potential cumulative relationship between students’ perceived competence and the quality of the teacher-student relationship was supported. Indeed, students revealed that they base their views of the quality of the teacher-student relationship upon their perceptions of the teacher’s effectiveness at enhancing students’ perceived competence as opposed to satisfying any wish they had for their teacher to be autonomy-supportive. However, students who have self-perceived control over opportunities to demonstrate their competencies through a teacher’s autonomy-supportive learning behaviours and positive feedback are more likely to self-report as engaged. This raises the question of whether teachers may be autonomy-supportive through their impact upon students’ cumulative perceptions of competence and relatedness both prior to learning activities that encourage students’ autonomy and during the learning activities themselves (see Section 5.8).

The motivational processes and perceptions that appear to inform the influence of the teacher-student relationship quality upon competence, and vice-versa, are unravelled and discussed as a means of forming an enhanced conceptual understanding as to how the motivational interplay between the three SDT constructs may merge to create various motivational pathways leading to students’ engagement with learning activities (see Figure 5.2). The findings and resultant claims of the current research are discussed in relation to some of the variables which prior research has argued to be pivotal to the potential motivational pathways between the teacher-student relationship and students’ learning engagement. These variables have been selected as they have consistently emerged, across all four data collection methods within the current research, as having a strong impact upon students’ motivation to engage themselves in learning within classrooms and their schooling in general. For brevity within this discussion, reference is made to the appropriate sections within Chapter 2.

5.3. The motivational impact of the quality of the teacher-student relationship upon students'engagement with learning

The evidence within the current research suggests that the perceived quality of the teacher-student relationship is the most constant variable central to the learning environment that sustains students' motivated engagement for and during learning activities (Hamre and Pianta, 2006; Hughes et al., 2008; Reeve, 2009; Ryan and LaGuardia, 1999). Indeed, of all the multiple mediating variables that lead the student to translate their motivational perceptions into engagement behaviours, the students self-reported the need for supportive conditions that are dependent upon the teacher-student relationship quality as the basis for enhancing the student's perceived competence (Christenson et al., 2008; Hamre and Pianta, 2006; Hughes et al., 2008; Reeve, 2006; Reeve, 2012, p. 152). In consequence, it is proposed that students will be more receptive to teachers' behaviours and methods that highlight and enhance their perceived competence. These perceptions as to whether a teacher uses competence-enhancing behaviours and methods successfully have an impact upon perceived competence, and, in turn, upon factors such as the perceived quality of the specific teacher-student interpersonal relationship, self-efficacy, and the motivation to engage positively with learning activities. As the current research suggests, different forms of motivation (competence, autonomous, intrinsic and extrinsic) appear to be outcomes initiated and sustained by the quality of students' perceptions of the cumulative impact of relatedness and competence. Indeed, Reeve (2012) asserts, within an SDT-informed review of numerous student engagement studies, that, "In the classroom, the teacher and the learning environment are so instrumental in supporting versus frustrating student motivation and engagement … because it cannot be separated or disentangled from the social context in which it occurs" (p. 152). From the findings of the main study, it became clear that, based upon the students' self-reported perceptions, that teachers' relational behaviours and the methods that they used within science lessons are associated with the enhancement or undermining of students' perceived competence (Darby, 2005). The stronger such perceptions, the more positive students are likely to be about making autonomous contributions that are built upon and further enhance their perceived competence (Schunk and Zimmerman, 2008).

The common patterns within the current research and prior research suggests that there may be an association between students' motivated engagement during learning activities with supportive and positive teacher-student relationships (for example, Hughes et al., 1999, 2008; Skinner et al., 1998). This makes sense in that within positive interpersonal relationships, a teacher often supports students perceived competence through positive, supportive feedback and tailored help (Becker and Luthar, 2002; Pianta et al., 2003; Stipek, 2004). Through such positive affective relationships, the teacher holds an important place in fostering children's curiosity-driven exploration of their physical and cognitive environment (Engel, 2011) (see sections 2.5 to 2.8 inclusive).

In addition, teachers' interpersonal behaviours and relational emphases were revealed as being important to the students within the positive sociably conducive classroom. These included friendliness, support of students both academically and socially, patience, warmth, a sense of humour, and the design of learning activities which enable students to affectively and cognitive engage with learning (Wubbels et al., 1991). Indeed, the majority of the children were certain that they either wanted or already had a positive interpersonal relationship with their teachers, and that this already had an influence upon the stability of students' views regarding their enjoyment of and the value of science (Beresford, 2000).

The FGIs with the adolescent students revealed an increased reliance upon their peers for social support during the course of their development, the teacher-student interpersonal relationship remained of importance to them (Weinstein et al., 1987). This may be due to enhancement of students' academic self-concept, perceived competence and self-efficacy, all of which are partly informed by expectations communicated by the teacher. This, in turn, may have a reciprocal influence upon students' evolving self-attributes, and, as a consequence, the quality of their motivation to engage with learning activities (Marsh et al., 2006; Marsh and Martin, 2011). The self-reported that positive teacher-student relationships are sustained and enhanced will depend to some extent upon the teacher's verbal and non-verbal behaviours and, importantly, how the student perceives and interprets these (Chapter 4). These perceptions and the interpretation were partly based upon prior experience, whether with a specific teacher or the students' teachers as a collective. These informed student responses such as affect (emotions) and the desire of the students to actively engage in science learning activities. The current research has highlighted further specific teacher behaviours that may enhance students' affective and cognitive perceptions that they are working within a secure learning environment where they feel that they have a positive relationship with the teacher therein (Reeve, 2002, 2012, 2013; Reeve et al., 2008; Ryan and Deci, 2009) (see sections 2.6 and 2.7).

5.4. Teachers promoting engagement with learning through the development of the teacher-student relationship and the enhancement of students' perceived competence

There were four essential characteristics of engagement affirmed as essential by students participating in the FGIs (Chapter 4): it is proactive, with an objective in mind; it is intentional and purposeful; it is undertaken with the intention of enriching learning through self-direction, by, for example, making learning more interesting, valued or challenging, and; on-going self-regulation and self-direction during the learning activity (Reeve and Tseng, 2011, p. 265). The respondents also stated that there were key teacher behaviour and methods that the students regarded having an optimal motivational impact upon their engagement (see section 4.4). These teacher-afforded variables centre upon perceived competence and the impact upon self-efficacy. This, in turn, is proposed as informing students' subsequent engagement with learning activities (Choi et al., 2001; Hughes et al., 2011; Miller et al., 1999).

As with perceived competence, the students' autonomous motivation emerged as potentially dependent upon their receptiveness to the teacher's afforded autonomy supportive behaviours and methods. The current research suggests that such receptiveness is dependent upon students' positive perceptions of a strong interpersonal relationship with the teacher, with the relationship evolving positively when the teacher regularly provides feedback and assistance that has a positive influence upon students' perceived competence (Vansteenkiste et al., 2012). The other self-reported dependent factor was the availability of teacher-afforded opportunities to be autonomous during science lessons: that is, being able to transform motivation into engagement behaviours can only happen at the teacher's behest. Empowered autonomy is, therefore, due to both "…a context of influences and opportunities for action" (Ryan and Deci, 2004, p. 450). When the desire to be autonomous is satisfied within the classroom, this should lead to empowered autonomy, which is further sustained via the teacher's autonomy-supportive behaviours.

Painter (2011) found that "students' perceptions of autonomy support had a positive and significant relation to perceived competence in science and intrinsic motivation. These findings are consistent with other studies that have shown students in classrooms with autonomy-supportive teachers, as compared with classrooms with controlling teachers, are likely to show greater perceived academic competence" (pp. 45 – 46). Within the school setting for the main study, however, a contrast existed in that students did not consistently feel that the teacher was proactive in enhancing their perceived competence in science, thereby missing opportunities to help make students aware of the progress they were making and could make (Chapter 4). The students were clear about the teacher-afforded methods and behaviours that motivated them to engage with learning activities during science lessons. In addition, they self-reported perceived competence and the motivated desire to be autonomous within activities, even when teachers did not provide opportunities for such motivations to be transformed into self-determined engagement. Whilst self-determined motivation may be perceived, the extent to which it is enacted through the satisfaction of the SDT basic psychological needs of relatedness, competence and autonomy support appears to depend upon the enhancing or thwarting nature of the behaviours and methods of a specific teacher at a given point (Deci, 1975; Ryan, 1982; Ryan and Deci, 2000; Ryan, Mimms and Koestner, 1983).

During the main study, it was self-reported across the older cohorts that when students hold negative perceptions about the quality of the teacher-student relationship, they develop compensatory mechanisms that enable them to become self-motivated and engaged with learning activities. This compensation may involve, amongst preadolescent and adolescent students, a shift from the need for a positive teacher-student relationship to a developmental focus upon increasingly proving themselves as independent, self-regulated learners, thereby perceiving themselves as ever more competent due to their own efforts. As preadolescent and adolescent students become more self-conscious, their need for relatedness may focus less upon feeling that they must like and be liked by the teacher and more upon developing an interdependent relationship with the teacher. Such an interdependent relationship needs to be carefully managed by the teacher to ensure that s/he is gradually increasing the opportunities for students to self-perceive competence and progress within learning activities, as a result of which they are more likely to be motivated to be autonomous during learning activities (Goodenow, 1993; Goodenow and Grady, 1993; Harter, 2012a; Krapp, 2000).

5.5. The impact of perceived competence and resultant self-efficacy upon autonomous motivation and engagement with learning activities

It appears, from common findings across the main study and MER, that the motivation to learn, to engage in learning activities, and to develop as competent learners has a consistent positive association with motivational variables such as self-efficacy (Ainley et al., 2009; Reeve, 2002; Zimmerman, 2002) (see section 2.6.1). It was affirmed, within the current research, that teachers' competence expectations of students have an impact upon students' perceived self-efficacy and competence, and, in consequence, competence motivation and autonomous motivation. These expectations were communicated through the teachers's verbal and non-verbal behaviours during science lessons. Students' perceptions of a teacher's behaviours were revealed as having an impact upon the formers' expectations of the chances of forming a successful interpersonal relationship with that teacher. This would make sense, in that students' affective perceptions appear to have a greater influence upon their motivated behaviours within the classroom and in the development of interpersonal relationships with his / her teachers than cognitive engagement (Ashton and Webb, 1986). Within the current research, it emerged whilst individuals self-reported a need to feel competent, the psychosocial variables informing the persistence and quality of competence motivation became more complex and elaborate developmentally (Elliot et al, 2002, p. 36). However, despite developmental differences, a constant was that engagement was positively associated with competence motivation and perceived competence, with engagement with learning activities being with the intention of enhancing perceived competence (Elliot et al, 2002, p. 363).

5.6. Developmental influences upon students' engagement through the cumulative impact of the quality of the teacher-student relationship and perceived competence

Further to the previous section, the current research suggests that the formation of competence-based perceptions and responses, such as the motivation to engage with learning activities, is similar amongst students, regardless of their age. However, responses within the FGIs revealed that, as the students matured, the quality of the teacher-student relationship was not as influential upon students' motivation for and engagement with learning as the support that the teacher provides in order to enhance students' perceived competence and their increasing independence as affectively satisfied, self-regulated learners. This support includes the planned affordance of learning activities that the teacher presents and the students regard as having a value in terms of enhancing their perceived competence (Eccles and Wigfield, 1995; Wigfield and Eccles, 2000). This may be because adolescent students become more positively motivated by his/her academic competencies and benchmark-informed successes than the quality of the teacher-student interpersonal relationship. However, there still appears to be a dependency upon the teacher to give performance feedback that enables a student to form a realistic view of their achievements and capabilities to date (Harter, 2012a; Klem and Connell, 2004; NRC, 2004). Therefore, the focus of the teacher-student relationship appears to shift from the student needing a positive, warm interpersonal relationship to the key informant of the quality of the relationship being, from the student's perspective, the teacher's subject-specific capabilities to enable and enhance students' affect-laden perceived competence and the meeting of achievement benchmarks within the subject (Baker, 2006; Hamre and Pianta, 2001, 2006; Hughes and Chen, 2011; Hughes et al., 2008; Kuyper et al., 2000; Reeve, 2006, 2012). These findings are similar to those within prior research: the proposal that there may be different combinations of mediating variables that are influenced by the variety of motivating styles used by teachers during different developmental stages (Eccles and Roeser, 2009; Krapp, 2000).

The actual impact of developmental differences upon the proposed motivational pathways and mediating variables therein, including the impact of the quality of the teacher-student relationship and students' perceived competence, and the stability of these, provides a further impetus for further school-based research (see section 6.4).

5.7. The reciprocal impact of the quality of the teacher-student relationship upon students' motivation to engage with learning activities

During the current research, students within all four cohorts self-reported inferred causal relationships between higher levels of engagement behaviours, such as persistence, effort and resilience, and the increased likelihood of success within appropriate learning activities (Chapter 4). It was revealed that the quality of such perceived competence informs related feelings of self-efficacy for future learning activities and self-agency to be proactive and autonomous within learning activities (Turner et al., 2014). These perceptions are formed through the psychosocial interweaving of numerous experience-informed interpretations, and will be specific to different areas of the student's schooling from wide generalisations relating to a curriculum subject, such as science, to more specific, situational variables such as the current learning task and the student's view of the teacher leading the lesson.

The discussion within the remainder of this section, informed by the evidence from the current and prior research, has been used to inform the evolution of the proposed classroom-based SDT-informed motivational pathways model (Figure 5.2). As stated, the results of the current research suggest that at the heart of the motivating and engaging learning environment there is the central influence of the quality of the interpersonal relationship that the student perceives s/he has with a specific teacher, and the reciprocal influence that this relationship, based upon confirmatory interpersonal interactions, has upon, primarily, competence and, as a competence-informed outcome, autonomy (see section 2.6.2). Further to the findings of such prior research and the current research, it is posited that in learning environments where the teacher affords learning activities that enable students to make positive progress on a regular basis, there should be a positive reciprocal impact upon perceived competence and self-efficacy (Marsh and Martin, 2011; Valentine et al., 2004). However, whilst a number of researchers have mooted that the associations between SDT-informed motivational variables are reciprocal in influence but do not state which, if any, of the constituent variables has a greater influence upon the others, further research is needed in order to inform teachers' understanding of the key behaviours and strategies that may be used to promote and enhance students' motivation (Zhang et al., 2012).

5.8. Understanding students' engagement with learning through the proposed pathway model illustrating the motivational interplay between the three SDT constructs

A puzzle that was only partially answered by the reviewed MER studies revolved around the hierarchical sequence of the SDT basic psychological needs within a potential motivational pathway that may enhance teachers' understanding of students' motivation to engage with learning activities. Similar findings across the main study and MER revealed that factors that were predictive of and are predicted by a positive teacher-student relationship include a teacher who is; receptive to students' perceived competence and self-confidence; mindful of students' competence levels, allowing learning to progress at an appropriate pace; adept at explaining scientific concepts and theories in such a way that all students may understand them; providing opportunities for the students to discuss their ideas and explore their understanding of scientific concepts; providing opportunities for the students to demonstrate their mastery, understanding and application of scientific concepts; listening to students, acknowledging their ideas and questions; positive and encouraging in his feedback about a student's progress and competence, including the correction of misunderstandings; perceived to be working hard to help students develop their competence and understanding of scientific concepts and processes; treating all students fairly and equally, avoiding nepotism, and; is adept at maintaining good relationships with students outside of science lessons. Conversely, factors that were revealed as predictive of negative teacher-student relationships included a teacher who plans lessons in such a way that is very different from the way that the students prefer to learn; is perceived to make no effort to make learning enjoyable; who ignores the responses of students, particularly when they are attempting to demonstrate that they are already able to do something or have completed something prior within the current concept area, and; who does not allow sufficient time for the students to investigate concepts. Therefore, it is posited that the teacher-student relationship quality may be used as a reliable predictor of perceived competence, academic achievement, and educational outcomes such as sustained engagement with learning activities (Hattie, 2003).

Furthermore, the evidence across the current research supports the posit that the motivation to be autonomous is an outcome dependent upon the combined motivational impact of students' perceptions of the quality of the teacher-student relationship and their own perceived competence. For the main study students, perceptions of competence, especially where there was perceived negative relatedness, were attributed more to the means by which the teacher taught the subject and emphasised learning, rather than the sense of relatedness that this particular group of students attributed to the teacher-student relationship. As none of the focus groups felt that there were regular opportunities for them to design and lead open-ended, autonomous investigations, the perceived quality of the interpersonal relationship with the teacher had become increasingly dependent upon the extent to which the teacher directly enhanced the students' perceived competence during science lessons.

5.9. Drawing together the findings of the three studies within the current research as the basis for the informed evolution of the proposed SDT-informed motivational pathways model

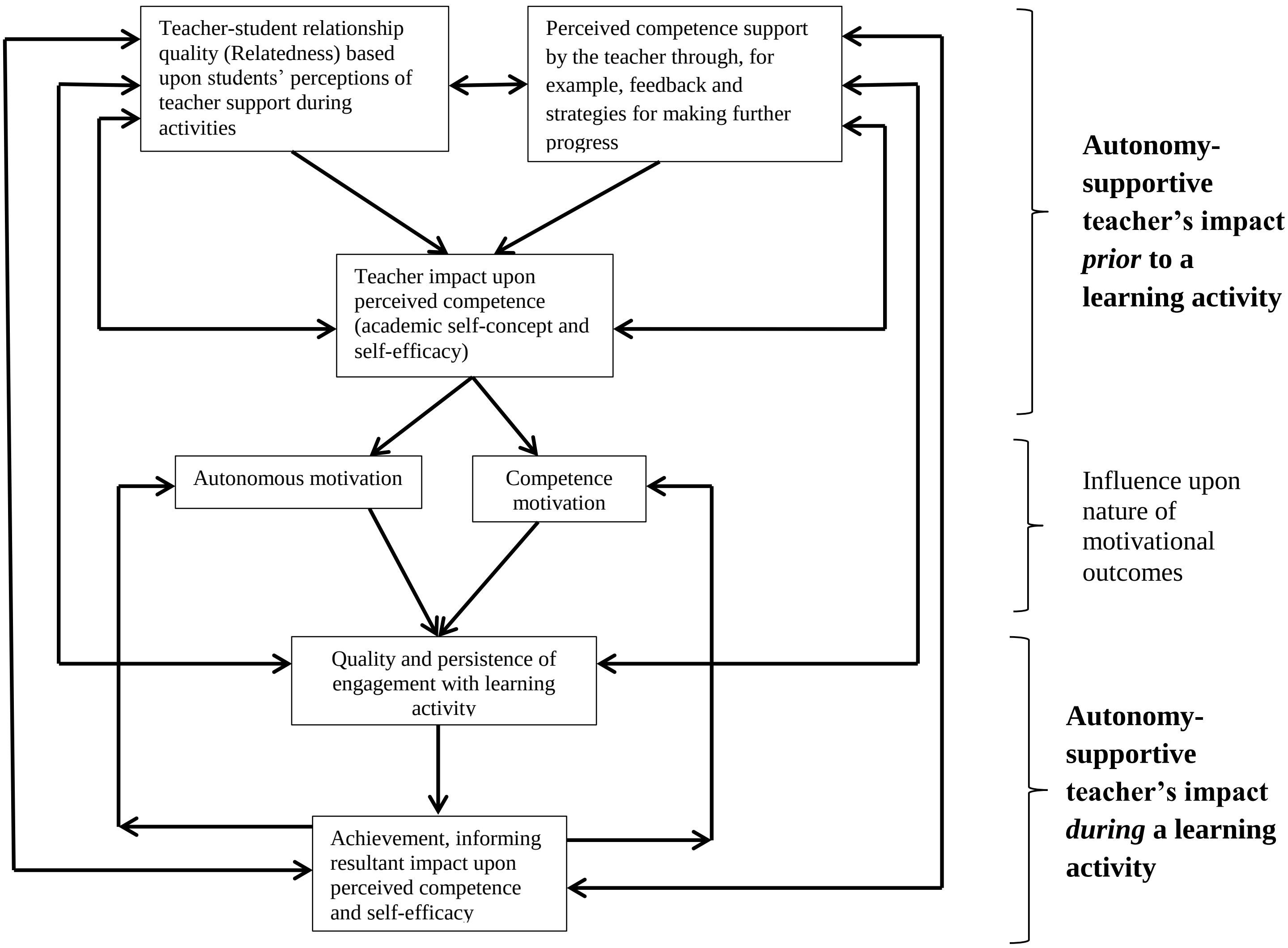
The current research collected evidence which, further to analysis, has led to insights that have been utilised, herafter, to suggest a solution to the afore-mentioned puzzle regarding a motivational pathway illustrating the potential interplay between the three SDT needs and their cumulative impact upon students' engagement. Ryan and Deci (2009) acknowledge that "both the social-contextual and personal motivation variables central to SDT have been found to predict engagement, performance and well-being" (p. 181) and assert that relatedness, autonomy and competence have salient motivational influences upon an individual's self-determined motivation to engage with learning activities. However, they and numerous other SDT researchers have not, within their writing, specified if one SDT construct is central to the positive psychosocial development of the other two when applied to students' motivated engagement in the classroom (see section 2.9). The evidence within the MER and main study differ, in the evidence suggests that each of the three SDT basic psychological needs has hierarchical influences upon the other two. These, in turn, appear to have an impact upon students' motivation to engage with learning activities. These potential influences and impact led to the consideration of the extent to which autonomous motivation is an outcome within SDT rather than a basic need (see Section 5.5). For example, Sneddon (2013) argues that the greater the awareness of one's competence, the more autonomous an individual is likely to be motivated to be. For example, where an individual's self-concept is positively enhanced, one may more reliably predict the enhancement of motivation and an increased likelihood of such intentions being translated into engagement behaviours (p. 50). Within the current research, where there are positive perceptions of the teacher-student interpersonal relationship, there are corresponding positive perceptions of competence and autonomy, and, in turn, upon a student's motivation for and actual engagement with learning. It may be that students' perceived competence enhances (when viewed positively) or undermines (when viewed negatively) their receptiveness to a teacher's autonomy-supportive behaviours, both prior to and during learning activities, and that perceived competence mediates and is predictive of the quality of students' manifested autonomy during learning activities. The extent to which the student has a positive or a negative perspective of competence and autonomy also appears to be predictive of the student's perceived quality of the teacher-student relationship (De Naeghel et al., 2012; Mouratidis et al., 2008; Painter, 2011; Ryan et al., 1994).

Perceived competence is a 'feeling of competence', in that the student believes that they have the competence, and self-efficacy, in place to be able to complete tasks successfully (Bandura, 1977; Brophy, 2004; Fredricks et al., 2004; Jimerson et al., 2003; NRC, 2004). It may be that a teacher can be autonomy supportive during an activity where students exercise their autonomy *and* autonomy supportive through the impact of teachers' behaviours and methods upon students' perceived competence and subsequent positive impact upon students' motivation to be autonomous. It is suggested that teachers, therefore, should be both autonomy-supportive during an activity where students actively exercise their autonomy *and* before autonomy-rich activities by means of the cumulative influences of teachers' relatedness and competence-based behaviours and methods having a positive impact upon students' autonomous motivation. Within Figure 5.1 (below), two motivational pathways to engagement are proposed which may function simultaneously. Alternatively, the student may not have the opportunity during a lesson to satisfy their desire for autonomy based upon the cumulative impact of teacher-student relationship quality and perceived competence. Therefore, the pathway from competence motivation to self-determined motivation is more likely to be influential upon engagement. These relationships between the different forms of motivation informing engagement with learning are illustrated in Figure 5.2. The development of these are based upon the evidence informing the Figure 5.1 pathway.

Such findings and theory-informed conclusions, from the intuitive perspective of teachers, may be regarded as ‘common sense’, in that the findings will appeal to the intuitive experience of teachers, as it did with me. Two objectives of the current research have been achieved: the first was to outline key common behaviours and characteristics of teachers that students regard as being most influential upon their engagement with learning activities. The second was to present the findings obtained in such a way that they can be applied by teachers within their own classrooms as a means of improving and developing both their evidence-informed professional practice and further in-school research. Therefore, the findings of the current research help to highlight areas that teachers may wish to focus their energies upon: that is, enhancing the quality of the teacher-student relationship and the students’ perceived competence through, for example, a focus upon feedback. As an experienced teacher, such conclusions make intuitive common sense in that students are more likely to feel autonomously motivated to engage in the self-regulation of their own learning when they perceive that they have both the competence to achieve success within a learning activity and the support of a teacher that will help make such success more likely. With each learning activity, such perceived competence would need to be in place if a student was to fully exercise their desire for autonomy, with further autonomy support being provided by the teacher during the activity through feedback and guidance. This, in turn, is more likely to result in sustained engagement. By being autonomy-supportive prior to learning activities within which students are afforded opportunities to exercise their autonomy, the cumulative impact of the teacher-student relationship and perceived competence are more likely to motivate students to make the most of such opportunities (Boud, 1988; Higgs, 1988). For example, within the main study, positive performance feedback given to students was affirmed as enhancing their self-efficacy during science lessons. For example, where students were given regular positive feedback about their performance, including how they could correct and improve upon poor performance, there was a self-reported increase in their motivation to engage further in the learning activities (Brophy, 2004). This recognition of both effort and progress, as acknowledged through a teacher’s feedback, also helped to improve students’ perceptions of the quality of the teacher-student relationship through the students’ understanding of the role of the teacher in enhancing their perceived competence.

The emergent findings of the MER were represented diagrammatically as a potential motivational pathway. The objective of this pathway was to inform teachers' understanding of the behaviours and methods that can have an optimum influence upon students' motivation to engage with learning activities (see Figure 2.6). This was used as a conceptual framework for the main study (Chapters 3 and 4) in conjunction with the conceptual framework for the MER (see Figure 2.3). This pathway model has, in turn, evolved on the basis of the findings of the main study (see Figure 5.2).

Figure 5.1 *A potential reciprocal motivational pathways model outlining the two proposed forms of autonomy support by teachers*

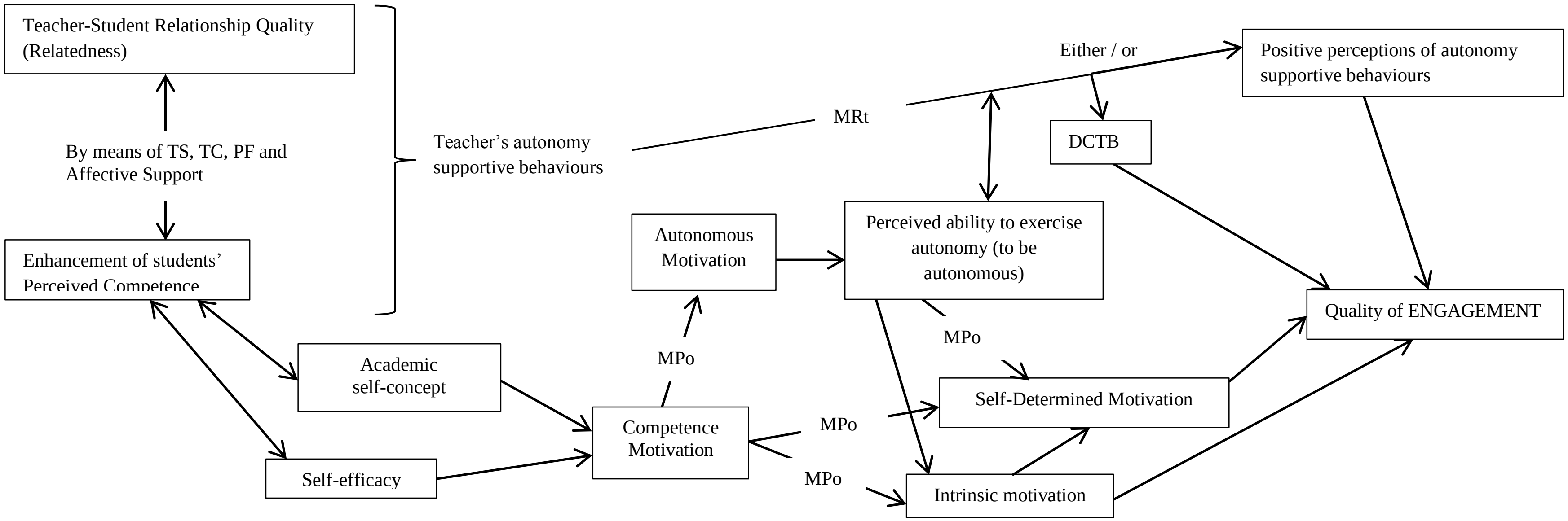


5.10. Conclusion

From the evidence harvested across the four methods utilised within the current research, the common findings were that the engaging learning environment is based upon the development of positive teacher-student relationships through learning activities that enhance students' perceived competence and self-efficacy in relation to applying their mastery and understanding of knowledge during learning activities. When students regard such learning activities as positive and challenging, they will exercise autonomy, having been motivated by the opportunity to pursue their own ideas and curiosity driven-interests in relation to content and subject (Darby, 2005; Engel, 2011; Hattie, 2009; Renninger et al, 2014) and perceived competence (Sneddon, 2013).

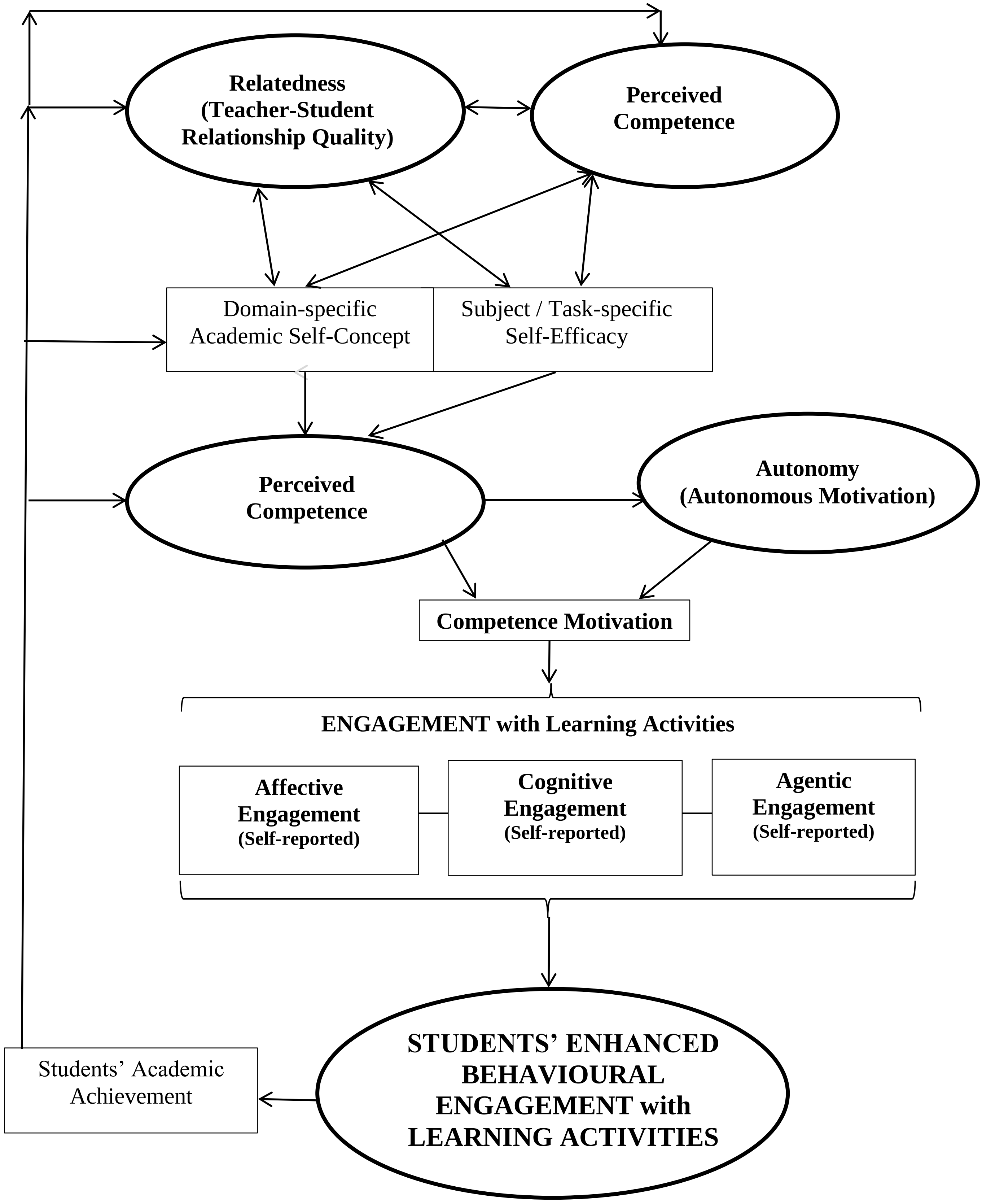
The confirmed impact of reciprocal influences between the teacher-afforded behaviours and methods upon which the teacher-student relationship quality is based and students' perceived competence / self-efficacy inform the quality and persistence of autonomous motivation across the MER and main study has been encompassed within the final version of the proposed SDT-based motivational pathway (see Figure 5.3). For consideration and testing through further research, the puzzle remains as to whether autonomous motivation and self-determined motivation are separate constructs or are indeed synonymous (see Section 6.4). In order to achieve a level of conceptual clarification with regards to the potential pathways between the different types of motivation that influence students' engagement with learning, a pathway model was developed based upon the conclusions drawn from the MER (Figure 3.5). This was modified on the basis of the evidence from the main study (Figure 4.2) and the online survey (Figure 5.2) as a means of seeking to inform our understanding of the behaviours and methods that have an optimum influence upon students' motivated engagement with learning activities (Figures 5.1 and 5.2). Within the proposed model, autonomous motivation has been posited as an outcome that is predicted by and predictive of the quality of intrinsic and self-determined motivation, both of which are predicted by competence motivation. The proposed model has been developed as a 'net of causation' with outcomes and their benefits being reliant upon conditional probability (Morrison, 2009, pp. 13, 45).

Figure 5.2 *Proposed motivational pathway between the three SDT constructs, with autonomy / autonomous motivation as outcomes that are dependent upon the perceived cumulative quality of relatedness and competence (Final Version based upon cumulative evidence)*



Key: MRt – Mediates Receptiveness to
MPo – Mediates Perceptions of
DCTB – Directly Controlling Teacher Behaviours
TS – Teacher Support
TC – Teacher Care
PF – Performance Feedback (Positive / Negative)

Figure 5.3 *Proposed Conceptual Framework of Students' Motivated Engagement with Learning based upon the research findings*



CHAPTER SIX

CONCLUSIONS

6.1 Ensuring the rigour and validity of the current research

Rigour refers to the extent that the data has been analysed through means such as comparison and generalisation to theory, or by comparison with the findings and conclusions of similar research undertaken in similar settings (Denscombe, 2010; Freebody, 2003). Within the boundaries of the current research, the assurance of rigour involved making sure that the data collected was appropriate to the research questions, and had been collected using methods that promoted data accuracy sufficient for answering the research questions posed (Biggs and Buchler, 2007). In order to establish the reliability and depth (rigour) of the data, the instruments and measures used were able to accurately measure the constructs that were of direct interest within this research being undertaken in a real-world setting (Robson, 2011; Yin, 2008). In addition, the questionnaires, FGIs and online survey were utilised as triangulated sources of evidence in order to determine congruity across the gained results relating to variables that influence students' perceptions of being motivated by and engaged in learning.

Internal validity is defined as ensuring that the quality of the data collected is precise and detailed enough for analysis to take place through selected theoretical and conceptual frameworks (Denscombe, 2010). One of the keys to ensuring the internal validity of the data was the reliability of the methods used to collect it. In addition, I have, therefore, sought to make clear, for benefit of other educators who may wish to replicate the current research within a different setting, the means by which data has been collected and analysed in order to test the focal theory, especially the units of analysis, as well as the proposed modification to the SDT meta-theory that has arisen through the analysis of the data, (Cresswell, 2009; Robson, 2002). The first difficulty with ensuring any form of internal validity when collecting data in the form of students' perceptions was that there are a myriad of mediating variables that are either unobserved or that have not been specifically considered that are also likely to have a probabilistic influence upon how students' engagement is both perceived and self-reported. The second difficulty, therefore, was isolating which SDT-related mediating variables were having the strongest potential motivational influence upon engagement. One means of addressing this was ensuring that the data would be regarded as both reliable and relevant through the repeated use of the pre-tested and pre-validated instruments specifically based upon SDT on, in this case, three occasions. These questionnaires and constituent statements were selected on the basis of the key mediating variables and motivational interplay between SDT basic needs that emerged from the MER. This use of pre-tested and pre-validated instruments was a means of ensuring as much consistency as possible and to limit as many confounding variables as possible (Keeble, 1995). The questionnaires, once adapted from existing questionnaires, were tested for internal consistency and reliability using Cronbach's alpha tests. There was, in addition, the recognised need to have clear descriptions of the constructs upon investigation to ensure construct validity; that is, making sure that the chosen research methods, and measures therein, actually measure the constructs that the researcher is investigating (Cook and Campbell, 1979).

As this research builds upon similar previous studies, uses similar measures and instruments, and compares and contrasts their findings with those of the current research, claims to external validity may be asserted as reliable and informative (Mitchell and Jolley, 1992). As such, the generalisability of the findings and conclusions of this research has greater potential for being applied and holding true beyond the individual school where the research has taken place (Maxwell, 1992; Robson, 2011).

Theory may equally be applied to a unique educational context, as whilst the humans who teach or learn within a school are unique, there still remain generally accepted views regarding basic psychological needs and social norms. Using a single theory or a combination of theories as a lens can inform an individual's interpretations of their experiences and how this informs their view of themselves, of others on an individual and group basis, and of their ontological views. Simons (2009) states that relating the findings from research in educational settings to published theoretical frameworks is an important means of determining which elements of the setting (or case) may be regarded as 'unique' and which may be seen to be similar, and therefore generalisable, to the conclusions drawn from similar cases. Therefore, the current research has been related to a wider context by means of analysis through the lens of SDT and similar prior research (Keeble, 1995; Robson, 2011).

Given that all single-case settings are unique but are regarded as valid and reliable contexts for data collection, then, as Freebody (2003) argues, one may therefore justify the studying of a research context as a contribution to knowledge as it follows that new and unique data will be generated. Therefore, the study of a single educational setting does not prevent generalisations to theories and similar research in educational research or motivation and engagement research, or comparability (to similar settings) or translatability (to common human reactions and motivational norms) (Denscombe, 2010).

6.2. Limitations of the Research

The limitations of this research primarily relate to practical constraints. These were time constraints and the practicality of the range and depth of research that may be undertaken by a teacher-researcher working within their own school setting. The research was both cross-sectional and longitudinal but was limited in its time frame. Ideally, the research would have taken place over the course of several years as the students developed through childhood and adolescence. This would enable a further insight into the potential variance in the influence of the three SDT basic psychological needs upon motivation by age and by developmental stage. Whilst retaining a multicohort focus, replication of the research could include measurements of changes to individual academic achievements over time. This would be a means of investigating the potential reciprocal relationship between engagement and achievement. A limitation of the main study was the sample size which was necessarily small due to convenience sampling as the research was undertaken with the teacher-researcher’s students. The original sample size was 92 (March 2013), and was reduced to 70 as the final year students unable to participate further due to being involved in national examinations (June 2013). Given the small sample size, the correlations and descriptive statistics calculated from the students’ collective responses created a potential limitation in the generalisability (or transferability) of the findings to other similar settings. Although questionnaires were used across three data waves enabling sample-specific correlations to be gained, the implications of the small sample size were that a second research method was needed in order to form a more in-depth understanding of the students’ reasoning behind their responses. To this end, seven focus group interviews were conducted. These focus group interviews helped to overcome the initial limitation in that evidence was harvested in the form of students’ perceptions, including the experiences and inferences that had shaped these, regarding the contextual factors and teacher behaviours that encouraged their motivated engagement with learning.The questionnaires still proved to be a viable means of collecting data relating to the perceptions and feelings of the majority of students within a single school setting, as it was procedurally possible to administer them during timetabled lessons. The findings of the questionnaires allowed insights into the quality of teacher-student relationships and other variables that were regarded as engaging and / or disengaging during science lessons. Although the questionnaires within this research were pre-tested and pre-validated within the original studies from which they were drawn, and their internal consistency determined through Cronbach's consistency tests, limited time was available for the administration of the questionnaires. This meant that the questionnaires relied more upon the breadth of areas surveyed than their depth. Repetition of the study by teachers undertaking action research within their own contexts would enable the extension of each questionnaire to explore each area in greater depth. In addition, allowing more time to conduct FGIs may lead to greater insights regarding factors, experiences and perceptions that inform and influence students' self-perceptions. Also, rather than administering two or three questionnaires within a single sitting, more time could be allowed for the administration of single questionnaires. In this way, students would have time to focus upon a single questionnaire and, therefore, have more time for reflection and to discuss any ambiguities they are experiencing in the reading of the statements.

Finally, the presence of the researcher undoubtedly has an influence upon the behaviour of the people being studied, a phenomenon known as 'observer effect' (Cohen et al., 2007). Just asking people to take the time to complete a questionnaire under certain conditions may well have an impact upon their behaviour and how these are manifested (Kelly and Lesh, 2000; Robson, 2002). Within some research designs, the researcher may be external to the setting and the dynamics therein. Within most research designs, it is acknowledged that the researcher will never eliminate all of their effects upon the people and settings they are studying and seeking to understand. With both research designs, there is the potential for a huge amount of variation in data concerning, for example, perceptions, reactions, interactions, what motivates people, and their manifested behaviours. Therefore, it was vital that the evidence collected has been of a depth and detail that demonstrates that all relevant variables have been defined, observed and recorded to ensure an account that is both unbiased and persuasive (Hakim, 2000, p. 67).

The above limitations had been anticipated. Therefore, an MER was undertaken prior to the main study in order to compare and contrast SDT-embedded motivational and engagement variables within similar school-based studies. The first advantage of the MER was that the translation and synthesis of a number of SDT research studies embedded in the classroom ensured that patterns between and within variables were recognised. The MER utilised a Best-Evidence Synthesis methodology (Slavin, 1986): this enabled a much larger sample size (n = 20,949) than was feasible within a single school as a research setting (Noblit and Hare, 1988; Slavin, 1986, 1987, 1995). As well as revealing common emergent patterns amongst the variables between the included studies, the MER was used as a means of identifying disagreement between variables and other motivational relationships that might not have been considered within the majority of the individual research studies.

As the research was retrospective in design, collecting the evolving perceptions of the students with regards to their relationship with their science teacher, their competence and opportunities for autonomy within science lessons, definitive causal pathways or directions cannot be asserted between the three SDT constructs. Marsh and Martin (2011) propose that longitudinal data provides a stronger basis for causal inferences than cross-sectional data (p. 72). There is the potential for experimental research to gain a more informed perspective about the causal relationships and their directionality. However, given the difficulties of undertaking experimental studies in-situ within classrooms, it may only ever be able to form probabilistic causal inferences based upon teachers' action research.

Whilst retrospective research designs have been used within prior research studies, there still remains the question of generalisability (external validity) through the transferability of findings. This transferability could be more reliably achieved through the adaptation of specific teaching and learning methods, and measurement of observable indicators, students' self-reported perceptions, and changes to academic achievement, engagement and teacher-student relationship quality levels using an action research approach (McNiff and Whitehead, 2010; Somekh, 2008) (see section 6.4). Generalisability to similar contexts and classroom-based motivational dynamics may also be difficult due to the unique social-fluid dynamics within every school and classroom (Fredricks et al., 2004; Jimerson et al., 2003). However, given the understanding that no two classrooms are truly alike, for the collected data and conclusions drawn to be of benefit to the professional community within which it is based, the researcher needs to bear a number of factors in mind. These include, for example, that no two observers will see the same thing in the same situation; situations, contexts, unfolding circumstances and the people therein are complex and continually interacting and dynamic; the perceptions that are self-reported will be unique and individual to the extent that they take into account the viewpoint of students as insiders, and; research should enable the application of the findings within the next stage of the research as a means to improving the effectiveness of practice in line with identified outcomes (Koshy, 2010; Laing et al., 1966). In addition, to achieve a level of generalisability, Waterman et al. (2001) stated that there is a need to collect specific types of data if it is to benefit the teacher seeking to understand and improves their own professional practice within their own unique school and classroom, with the insights gained often being context-specific, objective specific and future oriented. Such data should be descriptive, interpretive, helps to explain social situations, and can lead to interventions for improvement.

Whilst some researchers have stated that an experimental research design is the only true approach that can claim true causal effects and outcomes (Morrison, 2009; Smith, 1991) and others have argued that such designs are not the only means of drawing causal conclusions (for example, Goldstein, 2002), there are certain limitations that need to be considered when investigating the real-world variables that affect the engagement of children within school settings (Robson, 2002). That is, the detached objectivity that is central to pure experimental research cannot adequately explain the complex interactions, both seen and unseen, at the heart of social contexts such as schools and classrooms (Freebody, 2003). This is made particularly complex within the setting for this study, an independent school where there is a high academic emphasis and all parents expect their children to be provided with the best possible opportunities (Walford, 1991), as parents ultimately "… invest in their child's education in this way if they saw fit as it was their responsibility to raise their children with social expectations of educational success as a central factor in their development" (Salter and Tapper, 1985, p.139).

The use of single motivational theory may be regarded as a potential limitation, in that the research questions, design, methods and the analysis of the evidence are approached from one theoretical perspective. Gorard (2013) notes, for example, that whilst any "theory is a tentative explanation … [a] …reasonable theory is one that provides a simple, plausible explanation of what has been observed via research" (p. 31). SDT was selectd as it is a wide-ranging motivational theory that has evolved from and shares similarities with other motivational theories, and has been shown to be applicable within a variety of educational settings regardless of the students' prior achievements, ability, gender, culture or socioeconomic status. Therefore, to enhance the generalizability of the current research, the use of SDT has been "…be useful in the transfer of research findings to new settings …[and]…allow us to consider alternative positions simultaneously" (Gorard, 2013, p. 30). SDT has also been selected as a lens as it draws together conceptual and theoretical understanding from many theories has evolved on the basis of five mini-theories, rather than being an entirely stand-alone motivational theory. Clearly, by using SDT as a single motivational theory, there is the adoption, unwitting or otherwise, of its underlying philosophical assertions. It is prudent to actively address this potential limitation in terms of the more positive implications for advising evidence-informed practice in classrooms. The use of SDT has enabled a focus for filtering the emergent data, its collection and its analysis, and when reporting the findings and inferred conclusions. Consequentially, objectivity, whilst desirable in educational research, is not feasible when one is attempting to study and understand human perceptions, including the underlying motivations, expectations, inferences and responses that underpin these, particularly when objectivity may be defined as the elimination of bias (Eisner, 1993). Therefore, any form of research that seeks to understand human reactions and perceptions within a worldview setting cannot assert either procedural objectivity or ontological objectivity (Eisner, 1993). For example, procedural subjectivity is manifested as soon as the researcher selects a particular aspect of human behaviour to study, methods that will be used, the questionnaires and statements therein, and the selection of human participants. Equally, whilst SDT has proved to be a useful framework within this research, the use of SDT exerts ontological subjectivity in that it influences and guides the researcher, the research design, and the understanding drawn from the emergent evidence. Indeed, by seeking to create ontological and procedural objectivity, the researcher will inadvertently be applying a form of subjective selectivity through making such choices, as the knowledge gained is epistemologically subjective (Eisner, 1993).

On the basis of the above, the embedding of SDT within this research has been approached as a means of enabling an evidence-based understanding of some of the key variables that inform students' motivated engagement within classrooms, regardless of the age, gender, ability and culture of the students (Reeve, 2002, 2012; Reeve and Tseng, 2011; Ryan and Deci, 2000, 2009). The use of prior SDT research has also enabled the development of interpretations via inductive thinking which are further informed through reflection based upon professional experience (Gorard, 2013; Thomas, 2007, 2009; Thomas and Pring, 2004) In addition, SDT has not been used herein to the extent that it has inhibited intellectual creativity. Instead, it has been used as a form of bricolage in that other theoretical perspectives are drawn in as they prove useful, creating emergent syntheses or eclectic compromises that could help to explain phenomena (Kincheloe and Berry, 2004). This has been used as a basis for judging the suitability of SDT as a means of informing teachers' professional decisions in the light of a combination of professional experience / craft knowledge and evidence-based thinking, reflection, conjecture, and, through application within classrooms, the evolution of living theories (Gordon, 2013; Thomas, 2007, pp. 146-147; Whitehead, 2008, 2009). Living theory is defined as "an explanation produced by an individual for their educational influence in their own learning, in the learning of others and in the learning of the social formation in which they live and work …[through] …the creation and legitimation of valid forms of educational theory and knowledge" (Whitehead, 2008, pp. 104-105).

In summary, the current research has been undertaken and presented in such a way that its findings have the ability to be effectively generalised: the school studied herein being considered as an example of an entity and not as a sample (Payne and Payne, 2004). Whilst there will be limits in terms of the generalisability of this research, these need to be balanced alongside a considered view of the strengths of the research: that is, the potential contribution that is made to educational practitioner knowledge and theory. This modest contribution to knowledge includes the proposed conceptual and theoretical motivational pathway model applying SDT to an understanding of students' engagement with learning (Figure 5.2), and the embedding of SDT within science education in a British school (Chapters 3 and 4).

6.3 Implications of the research for evidence-informed professional practice

The implications of this research are discussed herein in terms of the significance of the findings and their applicability as epistemological contributions to the substantive field of SDT within educational research. The findings have practical implications for teachers in their own classrooms, as well as school leaders and others involved in the formulation of educational policy based upon research-led teaching. The current research has been approached throughout with the objective of enhancing teacher-researchers' contextual understanding of students' motivation to engage with learning activities. This has been achieved through the harvesting of students' self-reported views as to what motivates their engagement, and the analysis of these views through the lens of SDT (McClaughlin, 2004; Thomas, 2004). This includes the use of research methods that other teacher-researchers could utilise within their own sociocultural contexts. This is further to the assertion in section 1.3., that the outcomes of this research would be presented in a format that may be used as the starting point for further research involving teachers within their own schools. A few suggestions for the next stages of this research are given later in this chapter (Section 6.4), including the testing and modification of the proposed motivational model (Figure 5.2). Equally as important, the findings within the current research are discussed in terms of implications for how teachers may motivate their students' engagement at the local level through the use of evidence-informed interventions based upon the three SDT constructs.

Six implications are suggested, based upon the conclusions drawn from the main study and their discussion within Chapters 4 and 5. The first is the proposal of specific teacher behaviours and methods that may enhance their students' motivated engagement and achievement within learning activities. That is, if teachers are to enhance and promote students' motivation to engage with learning, they need to focus upon the active promotion of students' perceived competence, and the development of students' self-determined motivation within a supportive learning environment (Hardre, 2006). This may be achieved through autonomy-supportive behaviours (for example, offering direction to ensure success and enhanced competence, and giving regular and informative feedback) that reinforce and are reciprocally reinforced by students' enhanced perceived competence and self-efficacy (Vanseteenkiste et al., 2012). In addition, students' opportunities to exercise their desire for autonomy during lessons are at the behest of the individual teacher, through afforded learning activities (Hipkins, 2012): within the current research, autonomy within science lessons was the only one of the three SDT constructs that the students regarded to be entirely under the control of the science teacher.

Secondly, there should be an emphasis upon teacher relational behaviours and methods which may foster and develop students' perceived competence, academic self-concept and self-efficacy within learning tasks. The teacher may support and develop students' strategies for internalising standards necessary for recognising and celebrating their competence within current learning activities and as a basis for positive self-efficacious decisions during future learning activities. To achieve this, it is suggested that teachers provide work that challenges students to proceed to the next stage in their mastery and understanding of school-desired knowledge, as opposed to presenting learning activities that students regard as too easy or that inhibits sustained positive progress.

Thirdly, the importance of the teacher-student relationship quality has been revealed within the current research: students' positive perceptions of the teacher-student relationship appear to motivate the students' motivation to engage with teacher-afforded learning activities. Positive teachers' behaviours and methods include feedback and responses from the teacher that result in the student's sense of pride and ego-enhancement; verbal and non-verbal communication of teacher expectations of the student's capability for positive achievement within current and future learning activities, and; teacher-afforded opportunities for students to exercise their own autonomy when planning and / or undertaking learning activities. As a result of these and other behaviours and methods, "…students who experience an accepting and warm relationship with their teachers will be more capable and motivated to comply with classroom rules and teacher expectations" (Hughes et al., 2008). The use of interpersonal behaviours that students regarded as motivating within the classroom depend upon the observations that students make and the inferences they draw about the teacher, in addition to expectations informed by their prior experiences. Positive interpersonal behaviours that motivational teachers demonstrate include friendliness, being approachable, cooperativeness, assisting and encouraging, sense of humour, listening and display interest in what the student is saying, empathising during challenges and difficulties, and demonstrating approval of students' efforts, self-regulated work, and constructive contributions to learning activities (den Brok et al., 2004, 2006, 2009, 2010; Opdenakker et al., 2012). Students' positive responses include engagement with activities through positive learning behaviours (persistence of efforts to accomplish goals during learning activities, resilience in the face of challenges) as well as demonstrating that they are proficient at applying prior knowledge and understanding to problem-solving. In addition, students are more likely to exhibit positive affect in relation to learning new skills and concepts, successes, interest and curiosity.

For students to make the optimum transition from being dependent learners to becoming increasingly independent learners, the fourth suggestion is that teachers should provide learning activities that enable students to undertake learning activities that result in positive perceptions of competence. In order to assure students' perceived competence from one learning activity to the next, the teacher may provide realistic but positive performance feedback that makes the students increasingly aware of their developing competencies and the self-regulation they bring to their own learning. The provision of teacher support and learning activities that reinforce students' increasing awareness of their competence should lead to positive self-efficacy. Although the nature of the interpersonal relationship between the teacher and student may vary across developmental stages (see section 5.6) there appears to be the consistent need for teachers to help students to develop positive perceptions of competence and self-efficacy. Such positive perceptions have the potential to enhance students' autonomous motivation (Bong and Clark, 1999).

Fourthly, teachers who are enthusiastic about enabling their students to become increasingly independent are more likely to help their students to develop higher-order learning strategies such as analysing, evaluating and applying concepts and ideas within such learning approaches as inquiry-based and problem-based learning (NRC, 1987, 2004; Parsons and Taylor, 2011). These approaches appear to support students in developing mastery of concepts. This should lead to them becoming less dependent upon their teacher when undertaking learning tasks.

Within education, there has become an increasing emphasis upon teachers to provide learning activities that focus upon ensuring that students undertake learning activities which lead to the attainment of desired achievement goals. In order to develop students' cumulative perceptions of successful learning experiences, the teacher should provide positive but realistic performance feedback that helps the students to become increasingly aware of their developing competencies and the part that learning strategies have played in enhancing their perceived competence. The provision of teacher support during learning activities that enhance students' increasing awareness of their competence, together with the part that their efforts have played in this, should result in positive self-efficacy (Harter, 1992, 2012ab). This appears to lead to students' optimum development as independent learners: extensive research has shown that such approaches have a reciprocal causal influence upon students' perceived competence and academic achievement (Klem and Connell, 2004; Marsh and Martin, 2011; Reyes et al., 2012; Ryan and Deci, 1992, 2009).

In addition, teachers need to be aware of the impact that students' developmental maturation has upon their functioning and adjustment within the classroom. For example, two similar studies, published 20 years apart, have reported an ongoing mismatch between the satisfaction of students' developmental needs, the educational practices prevalent within most schools, and the corresponding teacher behaviours and accountabilities related to these (Eccles and Midgley, 1989; Eccles and Roeser, 2009; Eccles et al., 1998). During the late pre-adolescent and adolescent stages (the age range surveyed within the current research), there has been reported an increasing psychological need to exercise autonomy and perceive themselves as competent at a time when they are increasingly self-conscious (Harter, 2012ab). Teachers should, therefore, ensure there are numerous opportunities for students to exercise their autonomy through decision-making and problem-solving within their learning activities.

Stenhouse (1981) asserted that, "It is teachers who in the end will change the world of the school by understanding it' (p. 104). That is, that, ultimately, educational research should build upon the central objective of enabling teachers to understand how they may improve the quality of students' learning experiences and achievements through self-determined engagement with learning activities in schools. The current research has acted as one such example of a teacher collecting and analysing evidence based within his own professional setting, with the cooperation of the students that he taught. This evidence has, subsequently, been used as a basis for evidence-informed professional practices that were pertinent to the students' needs (Cordingley, 2004; Thomas and Pring, 2004). This thesis draws attention to the specific demands upon teacher-researchers' time, in terms of the learning processes involved in pursuing an evidence-based approach to improving their professional practice, adapting and testing new strategies based upon evidence (particularly when they have been generalised from another setting / context), and ensuring that they are changing their practice on the basis of credible evidence that will enhance their students' learning and achievement (Cordingley, 2004, p. 79). These have been addressed within this thesis as my emphasis has been upon approaching the research process from the perspective of the busy teacher-researcher who has similar professional demands, challenges and issues to those experienced by other teachers within ever-busy classrooms and schools.

The final implication is that the findings herein may be applied at the immediate level of a school and classrooms therein, as a means of addressing the reported wider concerns regarding students' (aged 10 to 15 years in particular) disengagement with science at a global level (Martin et al., 2012; Tymms et al., 2008), and the resultant decline in the percentages of students choosing to study science beyond compulsory schooling (Abrahams, 2007; House of Commons Science Technology Committee, 2002; OECD, 2007; Osborne et al., 2003; Royal Society, 2006, 2008, 2010). That is, where teachers focus upon satisfying their students' needs for positive teacher-student relationships and perceived competence, there should be positive impacts upon their affective and cognition motivational perceptions for science. These include enjoyment, enthusiasm, confidence, curiosity, engagement and perceived value of science (Martin et al., 2012). The resultant forms of motivation that develop as a result, including competence, autonomous, intrinsic and self-determined motivation, should reinforce students' positive perceptions of the longer-term value of studying science through the development of inclinational traits.

6.4. Next Steps and Future Directions in the Research

Educational research involves the systematic questioning of professional practices, such as teaching methods and behaviours, as a basis for on-going professional development and incentives to question and test theory in practice (McClaughlin, 2004, p. 128, citing Stenhouse, 1975). Within schools, Stenhouse (1975) argued, "It is not enough that teachers' work should be studied; they need to study it themselves" (p. 143). He proposed that the unique nature of each classroom meant that the findings of others' research should be applied, verified and adapted by teachers in their own classroom. On this basis, teachers should, therefore, play a central, highly important role in implementing interventions and initiatives designed to improve the students' quality of learning. This includes teacher-driven research that has arisen from the teacher systematically questioning their own practice and their students' responses, in a variety of forms. Ultimately, teacher-researchers' classroom-based research relies upon interpretations and understanding gleaned from a mixture of evidence and experiential intuition. These can evolve from teachers' professional knowledge, supplemented by data or evidence informally and informally gathered, and the implementation of informed interventions as a basis for evidence-informed practice (Thomas, 2004). Whilst engaging in such educational research based upon the current thesis, teachers could take into account characteristics such as prior academic achievement by students, and parental background such as profession and qualifications. Evidence-informed educational research within classrooms by teachers relies upon situations where teacher-researchers develop a "…sense of self as agents within their own enquiries [which] gives them 'permission' to engage more actively with the research methods and the products of others' research" (Hall, 2009, p. 677).

Action research is one such evidence-informed approach that enables teachers to be involved in designing and developing reforms within their own classrooms that are focused upon their current students, through "…the collection of information that is designed to bring about social change" (Bogdan and Biklen, 1992, p. 223). However, there are often obstacles to the process of such evidence-informed research either being initiated or sustained within teachers' classrooms (Hall. 2009). This leads to a key challenge for teachers: that is, overcoming the perception that they not have either the time or confidence needed to undertake research within their own classrooms. These obstacles extend to teachers' perceptions that they have to acquire a 'research skills set' before they can undertake classroom-based research (p. 674), and, therefore, that the process of research training will be lengthy and / or challenging when considered alongside the demands and obligations within teachers' professional contexts (Stenhouse, 1983, p. 20). Whilst it has not been within the remit of this thesis to discuss potential solutions extensively, one solution is the use of evidence-informed action research that enables teachers to draw upon prior research and theoretical models as a basis for their professional practice (Thomas and Pring, 2004). This is particularly apt as action research processes reflect "…the way in which that research knowledge is constructed …in relation to the context, generalizability and validity of the research" (Hemsley-Brown and Sharp, 2003, p. 449). The value of action research designs is affirmed by Elliott (2001), who argues that "*Educational* research … will involve teachers in its construction and execution and not simply in *applying its findings*. Teachers *engage* in *educational* research and not simply with it" (p. 565: author's original emphases). In addition, through the recognition of such challenges by, for example, researchers within university schools of education, there remain opportunities for school-university research partnerships through an emphasis upon collaboration. Such collaboration enables a focus on contextually and professionally meaningful research and support (Hall, 2009; McLaughlin, 2004, p. 131), as well as evolving a means of enhancing practitioners' understanding of and enthusiasm for the connections between teacher inquiry, ongoing professional development and the improvement of students' educational experiences at the classroom level (Hall, 2009, p. 669).

Given that 69 studies were originally accessed during the first stages of the MER, but only 32 were reviewed further to the applied inclusion and exclusion criteria, a more extensive MER of SDT-embedded classroom-based research should be undertaken. The inclusion of all such studies covering a greater range of mediating variables would reveal if the same motivational associations between relatedness, competence and autonomy emerge as within the current research, or if different conclusions are drawn. It may also go some way towards solving the puzzle as to whether autonomous motivation and self-determined motivation are separate constructs or are indeed synonymous (see later in this section). The aforementioned mediating variables could include value-expectancy (Eccles et al., 1983, 1991; Eccles and Wigfield, 2002), goal orientation (Dweck, 1986; Dweck and Elliott, 1983, 1988; Elliot and Dweck, 2005) and achievement goals (Ames, 1992), task value (Wigfield, 1994) and situational interest (Hidi, 1990; Krapp et al, 1992; Renninger and Hidi, 2001).

An outcome of this research is a proposed theoretical model of students' engagement with learning based upon the common findings across the main study and MER (Figure 5.2, informed by Figures 5.1 and 5.3). The basis of this model is the posited interaction between the students' perceived relationship with their teacher and the enhancement of students' domain-specific competence, and the methods that may enhance students' sense of relatedness and competence within an autonomy supportive learning environment. Therefore, it is proposed that the model is tested through classroom-based research as a means of helping "…to identify the general feedback components that contribute specifically to autonomy need support" (Koka and Hagger, 2010, p. 83). It is envisaged that such testing may enhance teachers' informed use of professional practices and relational behaviours that enhance students' self-determined engagement with learning through the enhancement of students' perceived competence. Further research of the motivational pathway should also investigate potential links between feedback, enjoyment, motivation and engagement.

Whilst it has not been explored within the boundaries of this research, it is interesting to note that autonomy and self-determination are typically considered together within prior

SDT-embedded research. For example, Stone et al. (2009) state that within SDT, autonomous motivation is an enduring “sustainable motivation … because it emerges from one‘s sense of self and is accompanied by feelings of willingness and engagement” (p. 4). However, this definition is similar to that of self-determined motivation: a motivated desire to participate willingly in activities through the exercise of self-regulating, self-directing and self-controlling approaches to learning (Reeve et al., 2008; Ryan and Deci, 2009). Stone et al. (2009) propose that there are six key approaches to enhancing students’ autonomous motivation: asking open questions including inviting participation in solving important problems; active listening which includes acknowledging the others’ perspective; offering choices including the clarification of responsibilities; providing sincere, positive feedback that acknowledges initiative and effort, and factual, non-judgmental feedback about problems; minimising coercive controls such as rewards and comparisons with others, and; developing capabilities and sharing knowledge to enhance competence and autonomy (Stone et al., 2009, pp. 8-14). Interestingly, these bear similarities to the approaches suggested within prior research focusing upon enhancing students’ self-determined motivation, specifically teachers’ support of students’ self-determined autonomy during learning (for example, Black and Deci, 2000; Chirkov and Ryan, 2001; Cordova and Lepper, 1996; Reeve, 2002). Within individual classrooms, these approaches clearly rely upon teacher behaviours that ultimately draw upon and lead to the enhancement of students’ perceived competence. The positive development of perceived competence, together with the multiple variables that this reciprocally influences, relies upon a positive sense of self-belief that is sustained and made more resilient within each new learning experience as they are encountered. This self-belief will, in part, be informed by the students’ abilities to accurately self-appraise their capabilities, by the extent of the reliance upon the teacher to inform these perceptions, and the influence of affect upon cognition and the motivation to learn (Pintrich, 2003ab). As such, although autonomous and self-determined forms of motivation appear to be synonymous, the similarities and contrasts between the two may only exist as far as agreement upon definitions allow. Therefore, although the two forms of motivation are usually treated as separate mediating variables between competence and engagement, further research may lead to them being ultimately regarded as one and the same. Finally, the actual impact of developmental differences upon the proposed motivational pathways and mediating variables therein, including the impact of the quality of the teacher-student relationship and students’ perceived competence, provides a further impetus for school-based research.

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APPENDICES

APPENDIX 2.1 **Summary of studies used within the Meta-Ethnographic Review: Study One**

Study	Type of publication	Study Design	Context	N	Age range	Gender	SDT constructs / mediating variables
Arnone, Reynolds and Marshall 2008	J	Ques	Education Research USA	1272	13	Mixed	PAS, PCom, IM
Assor et al 2005	J	Ques	Education Israel	319	9-11	Mixed	TCon, AMot, ExMot, DisENG, ENG
Conroy et al 2005	J	Ques	Swimming	165	7-18	Mixed	ANS, CNS, RNS, IM SE, PCom, ExtMot(IdR), Amot, ExtMot(ExR)
Cox and Williams 2008	J	Ques	Education PE – US	508	10-12	Mixed	R(TS) and IM
De Naeghel et al 2012	J	Ques	Elementary Education Belgium	1260	10-11	Mixed	AutMot, ConMot, ENG and SE
Gillet, Vallerand and Lafreniere 2012	J	Ques	Schools Canada	1600	9-17	Mixed	IM, SDEM, NSDEM, T(AS), AMot

Study	Type of publication	Study Design	Context	N	Age range	Gender	SDT constructs / mediating variables
Guay, Boggiano and Vallerand 2001	J	Ques / Long	School	215	10-11	Mixed	PCom, IM, T(AS)
Hagenauer and Hascher 2010	J	L / Ques	G6-G7 classrooms Austria	356	11-13	Mixed	Rel, AS, Com, Enj
Hardre et al 2006	J	Ques	Education USA	6539	11-14	Mixed	IM, R(TS), PCom,
Jaakkola, Washington and Yli-Piipari 2013	J	Ques	Education Finland PE	237	13	Mixed	IM, PCom, ExtReg
Jang, Kim and Reeve 2012	J	L / Ques	School Korea	500	13-14	Mixed	PAS, ANS, ENG, ACH
Kajala et al 2009	J	Ques	School PE Finland	370	12-13	Mixed	PCom, PAS, SDM
Kaplan and Assor 2012	J	Ques	Classroom Israel	420	12-13	Mixed	T – PPF and AffecEng
Koka and Hagger 2010	J	Ques	School PE Estonia	498	12-17	Mixed	R(TC/TS), SDM

Study	Type of publication	Study Design	Context	N	Age range	Gender	SDT constructs / mediating variables
Liu et al 2009	J	Ques	School USA	767	12-13	Mixed	IM, IdReg, IntReg, ExtReg, AMot, Rel, PEnj, PCom, Aut
Ntoumanis 2005	J	Ques	School PE Britain	460	11-16	Mixed	AS, CNS, ANS, RNS, Amot, ExtReg, IntReg , IdReg, IM, NegAffec,
Park et al 2012	J	L 3 yr / Ques	Education US Schools	94	14-15	Mixed	Rel, AffEng
Pat El Tellima and van Koppen 2012	J	Ques	School Netherlands	1008	12-18	Mixed	Aut, Com, Rel, PPF, IM
Ryan, Stiller and Lynch 1994	J	Ques	Schools USA / NY	606	12-14	Mixed	AutMot, ENG, Aut
Sakiz, Pape and Hoy 2012	J	Ques	Maths USA	317	12-14	Mixed	T(AS), AcaEnj, SE AcaENG
Savard 2012	DT	Ques Pre/Post Test	Education Rehab Canada	115	12 - 17	Mixed	PT(AS), PT(Com), R(TC), IM, IdReg, IntReg, ExtReg, AMot, SDM, AffENG, SRL

Study	Type of publication	Study Design	Context	N	Age range	Gender	SDT constructs / mediating variables
Shen et al 2009	J	Ques	Education USA	253	12-14	Mixed	AM and TAS upon NS and ACH
Shih 2008	J	Ques	Education Taiwan	343	13-15	Mixed	R(TS), R(AS), AffEng
Shih 2009	J	Ques	Education Taiwan	461	13-14	Mixed	R(TS), PAS, AutMot, ExtReg
Skinner et al 2012	J	Ques	Education US Schools	310	11-13	Mixed	AffEng, BehEng Com
Soric 2009	J	Ques	School Croatia	127	12-13	Mixed	ExtReg, IntReg, IdReg, IM, ContMot
Standage, Duda and Ntoumanis 2006	J	Ques	British Senior PE	394	11-14	Mixed	AS, AutMot, Com, Rel, IM, IdReg, IntReg, ExtReg, Amot
Van Ryzin 2011	J	Ques	Education General / USA	395	11-19	Mixed	R and AS upon LeaEng
Vansteenkiste et al 2005 Study 3	J	Ques	Education Belgium	80	11-12	Mixed	PAut, ENG

Study	Type of publication	Study Design	Context	N	Age range	Gender	SDT constructs / mediating variables
Vansteenkiste et al 2012	J	Ques	Education Belgium	1036	12-21	Mixed	PAS, PCE, AutMot, ConMot, Conc, Pers, TestAnx
Zhang, Solmon and Gu 2012	J	Ques	Middle Sch PE lessons USA	273	11-14	Mixed	Rel, Com, AS, SE ENG
Zhou, Lam and Chan 2012	J	Ques	China / US Education	273	10.11	Mixed	Rel(TS/TC), Affect

Key to SDT constructs and mediating variables – see Appendix 2.3

APPENDIX 2.2 **Descriptive statistics: Characteristics and results of the individual studies (n = 20,949)**

Study	SDT constructs / mediating variables	Study Design	Study population Intervention and / or Focus	Primary Outcome
Arnone, Reynolds and Marshall (2008)	Perceived Autonomy Support Perceived Competence Intrinsic Motivation	1272 13 year olds 47 schools Single survey (8 scales)	No intervention. Focus: Contextual factors in the school library: enhancement of students' perceived competence in use of positive Information skills (Focus)	Students' perceptions of adults' autonomy supportive behaviours was predictive of students' enhanced perceived competence and intrinsic motivation
Assor et al (2005)	Autonomy (Teacher Control) (Affective)Motivation to Engage	319 9 – 11 yo Survey	The influence of directly-controlling teacher behaviours (DCTB), as opposed to being autonomously supportive, upon students' affective responses to learning	Students reported restricted academic engagement where teachers were regarded as exhibiting DCTB. By contrast, teachers who were regarded as autonomy supportive reported enhanced feelings of intensive academic engagement Gender not an influence
Conroy et al (2005)	All three – satisfaction of basic psychological needs, Perceived Competence (self-efficacy), forms of extrinsic motivation	165 7 -18 yo (M = 11) Swimming (USA) Multi-cohort, 6 week swim season Surveys – beginning, middle and end	No intervention. Focus: Assessment of perceived competence, fear of failure (FF), basic psychological need satisfaction, self-esteem – all through the influence of influence of adult feedback	Perceived competence was predictive of sustained engagement, high levels of intrinsic motivation and higher levels of self-esteem, and predictive of satisfaction of SDT basic needs

Study	SDT constructs / mediating variables	Study Design	Study population Intervention and / or Focus	Primary Outcome
Cox and Williams (2008)	Relatedness (through Teacher Support) (Intrinsic Motivation)	508 10 – 12 yo PE (USA Schools) Survey	No intervention. Focus: mediating roles of the three SDT constructs upon the provision of motivational climate	The three SDT constructs partially mediate an association between relatedness, through teacher support, and self-determined motivation to engage within a mastery social context. Weak relationship between perceived autonomy and self-determined motivation. The strength of social relationship with the teacher is more important to feelings of relatedness than autonomy or competence.
De Naeghel et al (2012)	Autonomy, Controlled Motivation, Engagement, Self-Efficacy	1260 10 – 11 yo Belgium Elementary Schools Questionnaire and reading comprehension test	No intervention. Focus: SDT as the basis for defining contextual factors that enhance children's engagement with autonomous reading / controlled (academic) reading and performance in reading	Controlled reading motivation was not significantly related to reading engagement. Autonomous motivation was positively related to reading frequency, engagement and performance
Gillet et al (2012)	Self-Determined Motivation, Autonomy Support by Teacher, Intrinsic Motivation, Amotivation	1600 9 – 17 yo Schools Canada Single snapshot questionnaire	No intervention. Focus: influence of teacher autonomy support upon relationship between student's age and SDM, intrinsic motivation and extrinsic motivation / amotivation (Motivation as a function of age)	Decline in self-determined motivation between 9 and 12, stabilization from 12 to 15, and an increase in SDM between 15 and 17. Extrinsic motivation showed a decline to 12 and stabilization after 12. Amotivation remained low and stable between 9 and 17. Teacher autonomy support mediated age-school motivational influences.

Study	SDT constructs / mediating variables	Study Design	Study population Intervention and / or Focus	Primary Outcome
Guay et al (2001)	Perceived Competence, Teacher Autonomy Support, Intrinsic motivation	215 10 – 11 yo School Longitudinal, Prospective study Two data points	No intervention. Focus: mediating relationships between teacher autonomy support, and students' intrinsic motivation to engage in learning activities Testing of three SDT models	Of the three models, the CET model of the influence of teachers' autonomy supportive behaviours have an influence upon intrinsic motivation via the mediating influence of perceived competence. In addition, changes in intrinsic motivation mediate between teacher autonomy support and perceived competence. Perceived competence is presented as the most influential mediating construct.
Hagenauer and Hascher (2010)	All three SDT constructs (Enjoyment)	356 11 – 13 yo Longitudinal study Surveys and daily Diaries (Austria)	No intervention. Focus: to determine if there was a decline in positive affect and motivation to engage in learning activities at the young adolescent stage. To focus upon teachers' practices that influence students' enjoyment of learning (Changes in the learning enjoyment emotion and its determinants)	Learning enjoyment and motivating classroom practices declined between the ages of 10 and 11. Classroom practices are the source of students' enjoyment of learning: a teacher's neglect of a student's need for relatedness and competence were significant predictors of impeded enjoyment of learning. Self-efficacy is a partial mediator of enjoyment (IM).

Study	SDT constructs / mediating variables	Study Design	Study population Intervention and / or Focus	Primary Outcome
Hardre et al (2006)	Relatedness (Teacher Support), Perceived Competence, Intrinsic Motivation	6539 11 – 14 yo Taiwan schools Survey (Non-Western sample)	No intervention. Focus: predictive relationships amongst student characteristics that influence motivation for learning and achievement.	Students' classroom-based perceptions of teacher support and the influence upon perceived competence were predictive of students' motivation for learning. A student's individual motivation and subsequent engagement with learning is based upon their perceptions of the classroom environment and goal orientations.
Jaakkola et al (2013)	Perceived Competence, External Regulation (AS), Intrinsic Motivation	237 13 yo Finland PE Survey Longitudinal (3 yrs) Three data points	No intervention. Focus: role of the motivational climate, perceived competence and motivational regulators as predictive antecedents of engagement in physical activity	A task-involving climate was predictive of and predicted by perceived competence and intrinsic motivation. This pathway was predictive of and predicted by students' engagement levels.
Jang, Kim and Reeve (2012)	Autonomy Support, Autonomy Need Satisfaction, Engagement and Achievement	500 13-14 yo South Korea Longitudinal, 3 wave	No intervention. Focus: the influence of perceived autonomy support upon autonomy need satisfaction, the quality and strength of which may be predictive of engagement behaviours and, in turn, academic achievement. (Testing of motivation mediation model)	Perceived autonomy support (frequency and strength) was predictive of autonomy need satisfaction, and thus engagement and academic achievement. Effect of formative feedback on student motivation is related to teachers' classroom behaviours

Study	SDT constructs / mediating variables	Study Design	Study population Intervention and / or Focus	Primary Outcome
Kajala et al (2009)	Perceived Competence, Perceived Autonomy Support, Self-Determined Motivation	370 12 – 13 yo Finland / Schools PE Survey – single data point	No intervention. Focus: the relationship between motivational climate, perceived competence and self-determined motivation	A task-involving climate influences perceived competence, which, in turn, affects the development of self-determined motivation / need for autonomy. Part of a proposed sequential motivational model that includes intrinsically regulated motivation.
Kaplan and Assor 2012	Positive Performance Feedback (PPF) by Teacher, and emotional (affective) engagement	420 12 – 13 yo Classroom dialogue Israel Longitudinal (2 yrs) Two data points: same survey	Intervention: the use of I-Thou to influence the autonomy supportive dialogue between teachers and students (SDT does not specifically focus on dialogue)	Making clear the relevance of learning activities led to an increase in students' positive affect. There was a decrease in negative affect and classroom violence Classroom dialogue as a predictive basis for positive / negative relatedness with the teacher: relevance, choice and criticism. Increase in classroom-related positive feelings between 7th and 8th grade, rather than norm age-related decrease in positive affect.
Koka and Hagger (2010)	Relatedness through Teacher Care (TC) and Teacher Support (TS). Self-Determined Motivation	498 12 – 17 yo Estonia, PE Survey	No intervention. Focus: the influence of perceived teachers' behaviours upon students' perceptions of self-determined motivation.	A positive, indirect effect of perceived positive feedback from the teacher upon students' self-determined motivation. Perceptions of teachers' negative behaviours / feedback had a direct, negative influence upon students' motivation for learning.

Study	SDT constructs / mediating variables	Study Design	Study population Intervention and / or Focus	Primary Outcome
Liu et al (2009)	Relatedness, Perceived competence, autonomy, enjoyment, extrinsic motivation (SDT continuum)	767 12 – 13 yo Singapore schools Surveys – two data points (pre- and post-survey) 8 weeks apart. Students assigned to one of four cluster groups, based upon responses to pre-survey	No intervention. Focus: to test if SDT may be utilised to provide insights into the motivational processes underlying students' participation in project work.	Affirmed that SDT can provide insights into motivational processes underlying emotions, psychological needs, metacognition and perceived skills during project work.
Ntoumanis (2005)	Autonomy support, Needs satisfaction (all SDT constructs, External regulation (SDT continuum), amotivation, intrinsic motivation, negative affect	460 11 – 16 yo Britain, school PE Survey (subsample of 302 students)	No intervention. Focus: to determine if contextual / personal motivational variables (central to SDT) predict students' cognitive and affective experiences	Autonomy support and feedback provided by the teacher predicted students' need satisfaction and, in turn, their self-determined motivation. Students choosing to engage further in PE, compared with those who did not, self-reported more positive motivational experiences in the previous school year.
Park et al (2012)	Relatedness, Affective Engagement	94 13 – 15 yo US Schools Longitudinal (3 yrs) Survey – feedback re SDT need satisfaction across various data points	No intervention. Focus: emotional engagement as a basis for enhancing adolescents' academic performance and overall well-being. Through three psychological predictors of emotional engagement within specific learning contexts.	Need fulfilment and emotional engagement fluctuated temporally and across contexts. Fulfilment was directly related to emotional engagement within a specific context. Need to experience and perceive relatedness, autonomy and competence within learning contexts through the mediating influence of teacher behaviours.

Study	SDT constructs / mediating variables	Study Design	Study population Intervention and / or Focus	Primary Outcome
Pat El Tellima and van Koppen (2012)	All three SDT constructs, Positive performance feedback, Intrinsic motivation	1008 12 – 18 yo Netherlands Survey	No intervention. Focus: influence of ethnicity on student motivation when learning via performance feedback from the teacher. Teacher interpersonal behaviours and student motivation needs were used as two mediating variables informing intrinsic motivation.	Modes of feedback and teachers' interpersonal behaviours were predictive of student motivation. Competence and Relatedness mediate the effect of feedback upon students' motivation but autonomy does not. Teacher behaviours that predict student motivation are a combination of interpersonal (relatedness) and instructional (competence) behaviours
Ryan, Stiller and Lynch (1994)	Autonomy, autonomous motivation, Engagement	606 12 – 14 yo US schools / NY Survey	No intervention. Focus: the influence of teacher relationships upon students' academic motivation and self-esteem. Perceived autonomy and engagement is enhanced by positive representations of relatedness with the teacher.	Girls reported higher levels of relatedness than boys. There were correlations between positive representations of teacher-student relatedness, and resulting perceptions of competence, enjoyment and autonomy as outcomes.
Sakiz, Pape and Hoy (2012)	Affective support by teachers (Relatedness), Self-Efficacy, Academic Engagement and Perceived enjoyment	317 12 – 14 yo US schools Maths Survey: single data point	No intervention. Focus: the importance of perceived teacher affective support in relation to sense of belonging (relatedness), academic enjoyment, academic hopelessness, academic self-efficacy (perceived competence), and academic effort.	Significant associations between perceived teacher affective support and students' motivational, affective and engagement behaviour outcomes. Relatedness is a significant predictor of positive student functioning: Including perceived competence and self-efficacy, motivation for learning, and engagement with learning activities including self-regulated / autonomous learning.

Study	SDT constructs / mediating variables	Study Design	Study population Intervention and / or Focus	Primary Outcome
Savard (2012) Ph.D. unpublished Thesis	Perceived Autonomy Support and Competence Support by teacher, Relatedness (Teacher Care), intrinsic motivation, extrinsic motivation (SDT continuum), Self-Determined Motivation, Affective Engagement and Self-Regulated Learning	115 12 – 17 yo Special schools and rehab Surveys: pre- and post-test (two data points) (Study One)	Intervention: improve relations between teachers' interpersonal styles and the support of students' needs for relatedness, autonomy and competence as the basis of academic adjustment: motivation, dropout / engagement intentions, and subjective academic perceptions.	An improvement in teachers' autonomy support and relatedness behaviours led to students' enhanced perceptions of higher need satisfaction, engagement and self- determined motivation. This influence was not recorded with improvements in teachers' competence-related behaviours.
Shen et al (2009)	Autonomous motivation and Autonomy Support by Teachers upon SDT need satisfaction and achievement	253 12 – 14 yo US schools, PE Surveys: two data points – 4 months apart.	Focus: to investigate the effect of students' autonomous motivation and perceptions of teacher satisfaction autonomy support upon students' need satisfaction and learning achievement. Intervention: use of the EPEC (Michigan Exemplary Physical Education Curriculum) Module 'Personal Conditioning' (p. 46)	Perceived autonomy support by teachers predicted students' need adjustment to contextual influences and led to learning achievement, especially for students who did not previously perceive themselves to be autonomously motivated to learn.

Study	SDT constructs / mediating variables	Study Design	Study population Intervention and / or Focus	Primary Outcome
Shih (2008)	Relatedness through Teacher Support, Relatedness through Autonomy Support, Affective Engagement	343 13 – 15 yo Taiwan Survey	No intervention. Focus: how students' perceptions of autonomy support are related to motivational characteristics, and to what extent these are predictive of students' academic engagement.	When students learn out of personal interest and personal relevance, they are more fully affectively and behaviourally engaged in learning activities. Students who perceived higher levels of autonomy support provided by teachers also reported more adaptive patterns of learning. Behaviourally engaged students with higher levels of affective engagement reported higher perceptions of autonomy support from teachers, identified regulation, intrinsic motivation and mastery-goal orientation.
Shih (2009)	Relatedness through Teacher Support, Perceived Autonomy Support, Autonomous Motivation, Affective Engagement	461 13 – 14 yo Taiwan Survey	No intervention. Focus: how students' perceptions of autonomy support from teachers, as well as autonomous and controlled motivations, were related to engagement with as opposed to avoidance of learning activities.	The applicability of SDT was supported: students who perceived higher levels of autonomy support from their teachers displayed higher levels of engagement (in the form of adaptive achievement striving) than their counterparts perceiving lower levels of autonomy support by teachers within the classroom.

Study	SDT constructs / mediating variables	Study Design	Study population Intervention and / or Focus	Primary Outcome
Skinner et al (2012)	Affective Engagement, Behavioural Engagement, Competence	310 11 – 13 yo US schools Garden-based Education Surveys – teacher and students	No intervention. Focus: testing of a model of intrinsic motivation and engagement as 'active ingredients' in guiding motivational processes.	Support provided for SDT-based model of motivation: perceived autonomy, competence and intrinsic motivation predict the engagement, learning and achievement of students.
Soric (2009)	Intrinsic motivation, Extrinsic motivation (SDT Continuum), Controlled Motivation	127 12 – 13 yo School, Croatia Survey	No intervention. Focus: to investigate the interplay between the motivational assertions central to SDT and attributional theory (Weiner, 1985, 1992). The specific focus is upon four regulatory styles of motivation within the classroom, and how students causally attribute these to engagement and subsequent academic achievement.	Intrinsically motivated, successful students who feel autonomous and self-determined, as opposed to controlled, attributed their success to internalised and classroom variables that they had control over.
Standage et al (2006)	Relatedness, Competence, Autonomy Support, Autonomous motivation, Extrinsic motivation (SDT Continuum), Amotivation	394 11 – 14 yo British schools PE Surveys - students and teachers	No intervention. Focus: use of a model of motivation grounded in SDT to examine the relationship between students' motivational processes and their effort and persistence (engagement).	Students who perceived an autonomy supportive environment experienced high levels of autonomy, competence, and relatedness, intrinsic motivation, and had higher scores on an index of self-determined motivation.

Study	SDT constructs / mediating variables	Study Design	Study population Intervention and / or Focus	Primary Outcome
Van Ryzin (2011)	Relatedness and Autonomy Support upon Learning Engagement	395 11 – 19 yo US Schools General education Surveys	No intervention. Focus: reciprocal effects among adolescent perceptions of the motivating school environment, engagement with learning, hope, and academic achievement.	Students' perceptions of the engaging classroom and engagement with learning was linked, in turn, with changes to academic achievement and hope over the course of 1 year. Reciprocal effects were found between earlier perceptions of engagement and hope and later perceptions of the motivating / engaging nature of the classroom.
Vansteenkiste et al (2005) Study 3	Perceived Autonomy, Engagement	80 11 – 12 yo Belgium Survey	No intervention. Focus: framing early adolescents' learning activities in terms of the attainment of Intrinsic versus extrinsic goals, and Determining the influence of these upon perceptions of controlling versus autonomy supportive environments and, in turn, how this influences students' engagement and performance.	The positive effect of intrinsic goal framing on conceptual learning was mediated by task involvement, whereas the positive effect of a teacher's autonomy-supportive communication style was mediated by autonomous motivation.
Vansteenkiste et al (2012)	Perceived Autonomy Support, Autonomous motivation, Controlled motivation, Concentration, persistence, Perceived expectations.	1036 12 – 21 yo Belgium Survey	No intervention. Focus: examination of naturally occurring configurations of perceived teacher autonomy support and clear expectations, as a basis of assessing competence. Investigation associations between academic motivation, problem behaviour and self-regulated learning.	Teaching characterized by clear expectations and autonomy supportive behaviours was predictive of positive outcomes, whereas unclear expectations and controlling behaviours by the teacher was related to more negative outcomes.

Study	SDT constructs / mediating variables	Study Design	Study population Intervention and / or Focus	Primary Outcome
Zhang, Solomon and Gu (2012)	Relatedness, Competence, Autonomy Support, Self-efficacy and Engagement.	273 11 – 14 yo USA schools, PE Survey	No intervention. Focus: examination of how teachers' beliefs and key behaviours predict students' motivation and achievement outcomes in PE. To examine the predictive strength of teachers' autonomy, competence and Relatedness support towards students' expectancy-related beliefs, subjective task values, and engagement (concentration, effort, persistence) during activities.	The importance of teachers' competence support and autonomy support upon fostering students' motivational constructs and achievement outcomes in PE. A supportive learning environment and high levels of expectancy-related beliefs are positively associated with positive achievement outcomes.
Zhou, Lam and Chan (2012)	Relatedness through Teacher Care and Teacher Support, Affect	273 10 – 11 yo China / US	No intervention. Focus: investigation of the paradox between high academic achievement by Chinese students and teachers who appear to be controlling. High achievement by students is usually associated with autonomous learning approaches / environments. Included measures of students' affective perceptions regarding teachers' autonomy supportive / controlling behaviours. Comparative with the perceptions of American students.	Chinese students reported a higher level of social-emotional relatedness with teachers than US students in contexts where teachers' were regarded as controlling. Chinese students perceived teachers' behaviours as less controlling than US students, and reported that they were more motivated in controlling teachers' classrooms comparative with US students. Children with reported high levels of social-emotional relatedness towards their teachers perceived the behaviors as less controlling than children with low social–emotional relatedness with teachers. Relation between social–emotional relatedness and children's learning motivation in both cultures.

APPENDIX 2.3 Summary of the initial 69 studies accessed for the Meta-Ethnographic Review (Study One)

Study	Type of publication	Study Design	Context	N	Age range	Gender	SDT constructs
Alivernini and Lucidi 2011	J	L / Ques	Senior Education Italy	426	14-19	Mixed	R(TS) on SE and AS
Arnone, Reynolds and Marshall 2008	J	Ques	Education Research USA	1272	13	Mixed	BPNS, PAS, PCom, IM
Assor et al (2005)	J	Ques	Education Israel	319	9-11	Mixed	TCon, NegAffec, AMot, ExMot, DisENG, ENG
Black and Deci 2000	J	Ques	College Chem / Sci USA	137	18-20	Mixed	R(TAS), Int, AutMot, ContMot, PCom, Anx, PAS
Ciani et al 2011	J	Ques	UG Teaches USA	169	18-29	Mixed	Rel, Com, AS, SDM, MApp, MAvo, PApp, PAvo
Close and Solberg 2008	J	Ques	Education High Sch	427	14-16	Mixed	AutMot, ConMot, ACH SE, Rel

Study	Type of publication	Study Design	Context	N	Age range	Gender	SDT constructs
Conroy et al 2005	J	Ques	Swimming	165	7-18	Mixed	ANS, CNS, RNS, IM SE, MaAppG, MaAvoG, PCom, PAppG, PAvoG, ExtMot(IdR), Amot, ExtMot(ExR), FoF
Cox and Williams 2008	J	Ques	Education PE – US	508	10-12	Mixed	R(TS) and IM
De Bilde, Vansteenkiste and Lens 2011	J	Ques	Education Belgium	275	14-21	Mixed	ExtReg, IntReg, IdReg, IM, Pers, Conc
De Naeghel et al 2012	J	Ques	Elementary Education Belgium	1260	10-11	Mixed	AutMot, ConMot, ENG and SE
Dupont et al 2009	J	Ques	Education Senior PE Belgium	549	18 M	Mixed	Aut, Com, Rel
Filak and Sheldon 2008	J	Ques	Education USA (Journ)	220	18+	Mixed	T(AS), SDM, NS

Study	Type of publication	Study Design	Context	N	Age range	Gender	SDT constructs
Gillett, Vallerand and Lafreniere 2012	J	Ques	Schools Canada	1600	9-17	Mixed	IM, SDEM, NSDEM, T(AS), Amot, Age
Guay, Boggiano and Vallerand 2001	J	Ques / Long	School	215	10-11	Mixed	PCom, IM, T(AS)
Hagenauer and Hascher 2010	J	L / Ques	G6-G7 classrooms Austria	356	11-13	Mixed	Rel, AS, Com, Enj
Hanze and Berger 2007	J	Quasi-exp Pre/post test	**Physics** Germany	137	17-18	Mixed	IM, Com, AS, Rel ENG
Hardre et al 2006	J	Ques	Education USA	6539	11-14	Mixed	IM, PAppG, PAvoG, R(TS), PCom, LGO
Jaakkola, Washington and Yli-Piipari 2013	J	Ques	Education Finland PE	237	13	Mixed	EgoCl, TaskCl, IM, PCom, ExtReg
Jang et al 2009	J	Ques	School South Korea	144	14-15	Mixed	All three with ENG
Jang, Kim and Reeve 2012	J	L / Ques	School Korea	500	13-14	Mixed	PAS, ANS, ENG, ACH

Study	Type of publication	Study Design	Context	N	Age range	Gender	SDT constructs
Jang, Reeve, Ryan and Kim 2009 – Study 2	J	Ques	School South Korea	256	15-16	Mixed	AS, Aut, Com, Rel, ACH, ENG IM
Jang, Reeve, Ryan and Kim 2009 – Study 3	J	Ques	School Extension	272	15-16	Mixed	AS, Aut, Com, Rel, ACH, ENG IM
Kajala et al 2009	J	Ques	School PE Finland	370	12-13	Mixed	PCom, PAS, SDM
Kaplan and Assor 2012	J	Ques	Classroom Israel	420	12-13	Mixed	T – PPF and AffecEng
Koka and Hagger 2010	J	Ques	School PE Estonia	498	12-17	Mixed	R(TC/TS), SDM
Kusurkar et al 2013	J	Ques / 3 x Interventions	Medical Netherlands	383	19+	Mixed	AutMot, ContMot RAM, Amot
Lavigne et al 2007	J	Ques	School **Science** Canada	728	15	Mixed	R(TS), PAS, PCom, SDM
Liu et al 2009	J	Ques	School USA	767	12-13	Mixed	IM, IdReg, IntReg, ExtReg, AMot, Rel, PEnj, PCom, Aut

Study	Type of publication	Study Design	Context	N	Age range	Gender	SDT constructs
Mouratidis and Michou 2011	J	Ques	Athletics Greece	333	14.4 M	Mixed	PCom, AutMot, ContMot, Conc, AchMot, PerStan
Mouratidis et al 2008	J	Exp / Ques	School Greece	238	12-15	Mixed	PerCom, AM
Nie and Lau 2009	J	Ques	School Singapore	3196	14-15	Mixed	ENG, SchSatisf
Ntoumanis 2001	J	Ques	School PE Britain	428	14-16	Mixed	CoopLearn, Imp, Com, Aut, Rel, AMot, ExtReg, IntReg, IdReg, IM, Effort, Choice
Ntoumanis 2005	J	Ques	School PE Britain	460	11-16	Mixed	AS, CNS, ANS, RNS, Amot, ExtReg, IntReg , IdReg, IM, NegAffec, Conc
Ommundsen et al 2007	J	Ques	School PE Norway	194	15-16	Mixed	Enj/Int, MasApp, PerfApp, T(AS), PAut, PCom, AMot, IM, ASNS

Study	Type of publication	Study Design	Context	N	Age range	Gender	SDT constructs
Painter 2011	DT	DS TIMSS 2007	Education US schools	6,946	13-14	Mixed	AS, Com, IM
Park et al 2012	J	L 3 yr / Ques	Education US Schools	94	14-15	Mixed	Rel, AffEng
Pat El Tellima and van Koppen 2012	J	Ques	School Netherlands	558	12-18	Mixed	Aut, Com, Rel, PPF, IM
Reeve et al 2002	J	Exp / 4 groups	College	141	18+	Mixed	Incen, Value, SDM, Effort
Reeve and Tseng 2011	J	Ques	School Taiwan	365	15-18	Mixed	AgenENG, BehENG, CogENG, AffENG, PAS, PCom, Rel, ACH
Robertson 2010	DT	Ques / Interv	Schools US and China	201	11-16	Mixed	PerCom, Amot, PerEnj, ACH
Ryan, Stiller and Lynch 1994	J	Ques	Schools USA / NY	606	12-14	Mixed	Sec, WB, AutMot, ENG, Aut, SEst, SchConn
Sakiz, Pape and Hoy 2012	J	Ques	Maths USA	317	12-14	Mixed	T(AS), SenBel, AcaEnj, SE, AcaENG, AcHelpl

Study	Type of publication	Study Design	Context	N	Age range	Gender	SDT constructs
Savard 2012	DT	Ques Pre/Post Test	Education Rehab Canada	115	12 - 17	Mixed	PT(AS), PT(Com), R(TC), SNS, IM, IdReg, IntReg, ExtReg, Amot, SDM, AffENG, SRL
Shen et al 2009	J	Ques	Education USA	253	12-14	Mixed	AM and TAS upon NS and ACH
Shen at al 2010	J	Ques	Education US High Sch	566	14-16	Mixed	R(TS), Amot, ENG
Shih 2008	J	Ques	Education Taiwan	343	13-15	Mixed	R(TS), R(AS), AffEng
Shih 2009	J	Ques	Education Taiwan	461	13-14	Mixed	R(TS), PAS, AutMot, ExtReg
Sierens et al 2009	J	Ques	Education Belgium	526	15-27	Mixed	PT(AS), PCom, SRL
Simon 2007	DT	Ques	Science Canada	1309	17 M	Mixed	AS, Rel, SE, IM, PosAff NegAff. MasGoal, PerfGoal, AvoGoal, ACH

Study	Type of publication	Study Design	Context	N	Age range	Gender	SDT constructs
Skinner et al 2012	J	Ques	Education US Schools	310	11-13	Mixed	AffEng, BehEng Com
Smith 2006	DT	Ques Retrosepective	US Native High / College	76	18 – 20	Mixed	ASNS, ComNS, RelNS, LS, WB
Soenens and Vansteenkiste 2005 Study 1	J	Ques	School Belgium	328	15-21	Mixed	PT(AS), Aut, ACH, PCom
Soenens and Vansteenkiste 2005 Study 2	J	Ques	School Belgium	285	17-22	Mixed	PT(AS), Aut, ACH
Soric 2009	J	Ques	School Croatia	127	12-13	Mixed	ExtReg, IntReg, IdReg, IM, ContMot
Standage, Duda and Ntoumanis 2006	J	Ques	British Senior PE	394	11-14	Mixed	AS, AutMot, Com, Rel, IM, IdReg, IntReg, ExtReg, Amot
Stiglbauer et al 2013	J	L / Ques 5 collection points	Education General Austria	393	16	Mixed	All three upon positive perceptions / happiness

Study	Type of publication	Study Design	Context	N	Age range	Gender	SDT constructs
Um, Corter and Tatsuoka 2005	J	Ques	Education Maths / USA	9072	13-14	Mixed	AS, IM, ExtReg, IntReg, Subj SC,
Van Ryzin 2011	J	Ques	Education General / USA	395	11-19	Mixed	R and AS upon LeaEng
Van Ryzin, Gravely and Roseth 2009	J	L / Ques	Education General / USA	231	15 (M)	Mixed	R and AS upon ENG
Vansteenkiste et al 2004 Study 3	J	Ques ACH	Education Belgium	224	15-17	Mixed	AutMot, ACH, ENG
Vansteenkiste et al 2005 Study 3	J	Ques	Education Belgium	80	11-12	Mixed	PAut, ENG
Vansteenkiste et al 2012	J	Ques	Education Belgium	1036	12-21	Mixed	PAS, PCE, AutMot, ConMot, Conc, Pers, TestAnx
Zhang, Solmon and Gu 2012	J	Ques	Middle Sch PE lessons USA	273	11-14	Mixed	Rel, Com, AS, SE ENG
Zhou, Lam and Chan 2012	J	Ques	China / US Education	273	10.11	Mixed	Rel(TS/TC), Affect

Study	Type of publication	Study Design	Context	N	Age range	Gender	SDT constructs
Zimmer-Gembeck et al 2006	J	Ques	School Australia	324	15-17	Mixed	Rel, Com, ENG, ACH
Zomermaand 2012	DT	Ques	School PE USA	342	14-18	Mixed	Aut, Rel, Com, AutMot, ContMot, Amot, ACH, LS, Task, Ego

APPENDIX 2.4 Key to abbreviations used in Appendices 2.1 and 2.2 (MER)

J = journal article; DT = doctoral thesis; DS = data sampling; CS = cross-sectional; P = perspective / prospective; E = experimental; I = interventional; L = Longitudinal; Ques = Questionnaires

- AcaConf = Academic Confidence
- AcaENG = Academic Engagement
- AcaEnj = Academic (Learning) Enjoyment
- ACH – Academic Achievement
- AcHelpl = Academic Helplessness
- AchMot = Achievement Motivation
- AffEng = Affective (Emotional Engagement)
- AffENG = Affective (Emotional) Engagement
- AgeENG = Agentic Engagement
- Amot = Amotivation
- ANS = Autonomy Needs Satisfaction
- Anx = Anxiety (other than testing)
- AS = autonomy supportive context
- ASNS = Autonomy Support Need Satisfaction
- Att = Attitude
- Aut = Autonomy
- AutMot = Autonomous Motivation
- AutReg = autonomous self-regulation
- AvoGoal = Avoidance Goal
- BehEng = Behavioural Engagement
- BehENG = Behavioural Engagement
- BPNS = Basic Psychological Needs Satisfaction
- CNS = Competence need satisfaction
- CogENG = Cognitive Engagement
- Com = Competence
- ComNS = Competence Need Satisfaction
- ComS = Competence Support
- Conc = Concentration
- ConCli = controlling climate
- ConMot = Controlled Motivation
- ConOri = controlled orientation
- ConReg = controlled regulation
- CoopLearn = Cooperative Learning
- Cur = Curiosity
- DisENG = Disengagement
- EgoCl = Ego Involving Climate
- ENG – Engagement
- ENG = Engagement (persistence)
- ENGInt = Engagement Intention
- Enj – Enjoyment;
- Enj / Int = Combined Enjoyment and Interest
- ExtG = extrinsic life goals
- ExtMot (ExR) = External Motivation (External Regulation)
- ExtMot (IdR) = External Motivation (Identified Regulation)
- ExtReg = External Regulation
- FoF = Fear of Failure
- Hap = Happiness
- IdReg = Identified Regulation
- IM = intrinsic motivation
- IM(ACH) = Intrinsic Motivation for Achievement
- IM(K) = Intrinsic Motivation to Know
- IM(S) = Intrinsic Motivation for Stimulation
- Imp = Improvement of Performance
- ImpOri = impersonal orientation
- Incen = Incentive to work / study
- Int = Interest in the subject matter
- Intern = Internalization (Affective / Cognitive Processing)
- IntG = intrinsic life goals

- IntReg = Introjected Regulation
- IPR = Interpersonal Relationship
- LeaEng = Learning Engagement;
- LGO = Learning Goal Orientation
- LS – Life satisfaction
- MaAppG = Mastery-Approach Goals
- MaAvoG = Mastery-Avoidance Goals
- MApp = Mastery Approach
- MasGoal = Mastery Goal
- MAvo = Mastery Avoidance
- MC = Mastery Climate
- NegAffec = Negative Affect
- NNVF = Negative Non-Verbal Feedback
- NS = Need Satisfaction
- NSDEM = Non Self-Determined Extrinsic Motivation
- PAppG = Performance-Approach Goals
- PAS = Perceived Autonomy Support
- PAut = Perceived Autonomy
- PAvoG = Performance-Avoidance Goals
- PCE = Perceived Clear Expectations
- PCom = Perceived Competence
- PEnj = Perceived Enjoyment of Learning
- PerfGoal = Performance Goal
- Pers = Persistence
- PerStan = Personal Standards
- PLAch = Perceived Learning Achievement
- PNVF = Positive Non-Verbal Feedback
- Pos = Positive experiences
- PosAffec = Positive Affect
- PPF = Perceived positive feedback
- PT(AS) = Perceptions of Teacher's Autonomy Supportive Behaviours
- PT(Com) = Perceptions of Teacher's Competence Supportive Behaviours
- R (TS) = Relatedness (Teacher Support)
- R(TC) = Relatedness (Teacher Care)
- RAM = Relative Autonomous Motivation
- Rel = relatedness
- RelNS = Relatedness Need Satisfaction
- RNS = Relatedness Needs Satisfaction
- SchConn = Connection with School
- SchSatisf = School Satisfaction
- SCon = Student Control
- SDEM = Self-Determined Extrinsic Motivation
- SDM = Self-Determined Motivation
- SE – Self-Efficacy
- Sec = Security
- SenBel = Sense of Belonging
- SEst = Self-Esteem
- ShNeg = Shared Negotiation between teacher and student
- SNS = Students' Need Satisfaction
- SocConf = Social Confidence
- SRL = Self-Regulated Learning
- Subj SC = Subject Self-Concept
- T(AffS) = Teacher Affective Support
- T(AS) = Teacher Autonomy Support of student
- TAS = Teacher Autonomy Supportive;
- TaskCl = Task engaging Climate
- TCon = Teacher Control
- TestAnx = Test Anxiety
- TS = Teacher Support (where presented in results as separate to Relatedness)
- TSIPR = Teacher-Student Interpersonal Relationship
- Value = Value / Perceived Importance of activities and / or goals
- WB = Perceived Well Being

APPENDIX 2.5 *Summary of characteristics of students' SDT-grounded motivation and engagement with learning emerging from the reviewed studies*

The influence of the interplay between the three SDT basic needs

1. The satisfaction of SDT basic needs has a positive influence upon the enhancement of students' feelings of intrinsic motivation and, as either a direct or mediating effect, upon, in accordance with the teacher's positive or negative behaviours, students' positive or negative perceptions of autonomy support and perceived competence;
2. There is an emerging important relationship, in terms of the influence that relatedness, in the form of teachers' support behaviours, has upon students' perceived competence, intrinsic motivation, and motivation for engagement and achievement.
3. Students' classroom-based perceptions of teacher support (relatedness) influenced student's perceived competence, with both being predictive of students' motivation to engage in learning: a student's individual affect and motivation to engage with learning activities are based upon his/her perceptions of the classroom environment.
4. Motivation for learning takes many forms, including intrinsic, self-determined, extrinsic and amotivation, and are functions of and dependent upon age, mediated by students' perceptions of the teacher and teacher-provided support;
5. Regardless of age, perceived competence and the perceived satisfaction of competence emerged as the strongest mediators between the teacher-student relationship (relatedness) and self-determined motivation and engagement in learning;
6. Perceived competence was based upon performance feedback provided by the teacher, which, in turn, informed students' need for autonomy;
7. Both relatedness and competence, but not autonomy, mediate the effect of feedback upon students' motivation: the extent to which a student regarded feedback as either positive or negative was dependent upon the perceived quality of the interpersonal relationship with the teacher and the extent to which the teacher's feedback informs a student's positive perceived competence;

Perceived competence and the influence upon self-efficacy

8. Common across the age range cohorts was the association between higher levels of perceived competence and higher self-efficacy, higher self-esteem, and higher competence need satisfaction: this was equally associated with higher levels of self-determined motivation and intrinsic motivation;
9. Key factors which were asserted as mediating between social contextual factors provided the teacher and students' sustained engagement were the provision of learning activities which promote students' positive perceptions of competence and self-efficacy
10. Competence support by the teacher was central to students' expectancy-related and self-efficacious beliefs;

11. Perceived competence has the potential to inform students' self-efficacy, and, in consequence, impact upon their engagement within learning activities;
12. Relatedness and competence have a mediational influence upon students' motivational perceptions and reactions predictive of engagement;
13. Prior academic self-concept significantly predicted academic achievement, which is potentially mediated by students' perceived competence.

Relatedness through the quality of the teacher-student interpersonal relationship

14. There was an emphasis upon the importance of the teacher's role in ensuring that all of these factors are sustained through their interpersonal and instructional styles;
15. The strength of the social relationship with the teacher was more influential upon students' motivation for and engagement with learning, comparative to the students' perceptions of autonomy and competence:
    a. All three SDT constructs were found to partially mediate self-determined engagement with learning through the quality of the teacher-student relationship.
    b. A teacher's interpersonal style and associated behaviours had a long-term impact upon students' SDT basic need satisfaction, adjustment to learning within a formal context, and an enhanced sense of the desire to engage in learning;
    c. Relatedness through teacher support was the basis of the teacher-student relationship quality;
    d. Social-contextual factors afforded by the teacher within the classroom enable students to satisfy their basic needs for relatedness, competence and autonomy;
    e. Affective support by teachers is a sound basis for enhancing feelings of belonging, academic enjoyment, academic optimism and self-efficacy (perceived competence) and engagement (academic effort).
    f. Significant associations were reported between perceived teacher affective support and students' motivational, affective and engagement behaviour outcomes.
    g. Teachers' positive affective support behaviours include caring for and interest in students, demonstrating respect and concern as appropriate, listening and responding to students' ideas, recognition of effort, and fair treatment: these are argued to be positive predictors of students' optimistic self-concept, academic effort, academic achievement, and the pursuit and practise of prosocial behaviours.
    h. Relatedness-enhancing behaviours were the basis of the development of higher expectations of students, and were associated together: that is, a teacher who felt a stronger affective / relational bond with a student had higher expectations of the student than, conversely, where the teacher felt a weaker affective / relational bond.
    i. The positive teacher-student interpersonal relationship develops through frequent interactions with teachers during collaborative projects, focus upon relationship enhancement, modelling enthusiasm for and confidence in students' ideas, providing academic and emotional support which result in regular opportunities to achieve success, and provide informative feedback in a

positive manner, including what was done well, and what may be done next to achieve further competence and success.

16. There were positive associations between teacher support, enhanced feelings of relatedness towards the teacher, and students' feelings of self-determined motivation;

The need for autonomy and factors informing perceptions of autonomy supportive behaviours

17. Autonomy support and engagement may be enhanced over time, mediated by relatedness enacted as teacher support. Reciprocal effects were found between earlier perceptions of engagement and later perceptions of the motivating and engaging nature of the classroom.
18. Students who perceived a higher level of autonomous self-determination, as opposed to feeling controlled by their teacher, were more likely to feel that all of their SDT basic needs were being satisfied as a direct result of their teacher's behaviours;
19. There is a positive relationship between students' subject-specific science achievement, intrinsic motivation for and engagement with learning in science lessons, which are influenced by perceptions of autonomy support and perceived subject-specific competence in science;
20. Intrinsic motivation has a positive influence upon subject-specific self-concept, such as perceived competence and self-efficacy, and, in turn, achievement, and further enhanced perceptions of autonomous motivation, engagement and achievement over time;
21. The need to be autonomous may be a motivational outcome of the combination of teachers' relational-enhancing behaviours and the extent to which teachers' competence-based feedback enhances students' perceived competence.
22. Teachers' autonomy supportive behaviours have a positive mediating influence upon intrinsic motivation via the influence of perceived competence;
23. Students' perceptions of teachers' autonomy supportive behaviours was predicted by autonomous motivation, dependent upon whether goals are perceived by students as intrinsic or extrinsic
24. Relatedness and autonomy support can enhance students' enhanced positive perceptions of higher need satisfaction, self-determined motivation and engagement;

Goal orientation and framing

25. Key motivating factors in the classroom were a learning goal orientation (as opposed to a performance goal orientation), the enhancement of students' perceived competence within a specific subject / domain, and relatedness through teacher support;
26. Students' intrinsic goal framing – the extent to which goals, and related learning activities, were regarded as enjoyable, interesting and enjoyable – informed the effort, persistence and task involvement central to their engagement with learning activities

Teachers' behaviours supportive of enhancing students' positive engagement with learning

27. Teachers should afford and create an optimal learning context which enhances students' affective perceptions of well-being and the motivation to persistently engage in learning;
28. Teachers who deliberately increase the frequency of behaviours regarded as being central to the three SDT constructs can enhanced their students' quality of motivation and their subsequent wish to engage further in learning;
29. Teacher-student interactive dialogue supports students' sense of autonomy and competence:
    a. Teachers' performance feedback had an impact upon students' sense of relatedness and intrinsic motivation for engaging in learning activities;
    b. Key mediating variables that have an impact upon intrinsic motivation and subsequent engagement were the teachers' interpersonal style and instructional behaviours during lessons, and the influence of these upon students' motivational needs;
30. Perceptions of relatedness are enhanced by teachers' supportive dialogue that is meaningful to the student;
    a. allowing students to take leadership roles within the classroom;
    b. involving students in decision making;
    c. affording a motivational climate that emphasises the competence of students;
    d. encouraging students to develop their perceived competence as the basis for becoming more self-efficacious when approaching new learning activities, and;
    e. positive, autonomy-encouraging phrases, such as "You could" and "You might", as opposed to "You should" and "You must", when used by teachers will be regarded as more autonomy supportive, and therefore more motivating and predictive of engagement, than controlling.
31. Teacher support manifested as autonomy supportive behaviours were positively predictive of intrinsic motivation and self-determined motivation to engage with learning activities.

Appendix 3.1 OVERALL MEANS AND VARIANCES for age groups and genders

TEACHER-STUDENT INTERPERSONAL RELATIONSHIP QUALITY (TSIRQ)

DATA WAVE	SQ	AGE / GENDER	TOTAL	MEAN	VARIANCE	RANGE +	RANGE -	ITEMS
March 2013	1	10	68.225	2.729	2.071 (51.775)	1.714	3.786	25
June 2013	1	10	67.325	2.693	1.889 (47.225)	1.667	3.556	25
	6	10	146.015	2.755	1.000 (53)	2.250	3.250	53
September 2013	1	11 (10)	72.925	2.917	0.982 (24.55)	2.426	3.408	25
	6	11 (10)	131.31	2.478	0.596 (31.577)	2.18	2.776	53
March 2013	1	11	72.15	2.886	1.286 (32.15)	2.214	3.500	25
June 2013	1	11	76.25	3.050	1.875 (46.875)	2.063	3.938	25
	6	11	167.692	3.164	1.467 (77.751)	2.400	3.867	53
September 2013	1	12 (11)	73.025	2.921	0.891 (22.275)	2.475	3.367	25
	6	12 (11)	127.86	2.412	0.57 (30.198)	2.127	2.697	53

DATA WAVE	SQ	AGE / GENDER	TOTAL	MEAN	VARIANCE	RANGE +	-	ITEMS
March 2013	1	12	71.45	2.858	1.591 (39.775)	2.091	3.682	25
June 2013	1	12	72.75	2.910	1.708 (42.7)	2.208	3.917	25
	6	12	147.817	2.789	1.053 (55.809)	2.368	3.421	53
September 2013	1	13 (12)	76.07	3.043	1.009 (25.221)	2.538	3.548	25
	6	13 (12)	127.05	2.397	0.887 (47.024)	1.953	2.841	53
March 2013	1	M	70.6	2.824	1.444 (36.1)	2.044	3.489	25
June 2013	1	M	72.8	2.912	1.385 (34.625)	2.256	3.641	25
	6	M	156.933	2.961	1.121 (59.413)	2.364	3.485	53
September 2013	1	M	73.56	2.942	1.142 (28.551)	2.371	3.513	25
	6	M	131.84	2.488	0.768 (40.697)	2.104	2.872	53
March 2013	1	F	73.225	2.929	1.818 (45.45)	2.091	3.909	25
June 2013	1	F	73.25	2.930	2.000 (50)	1.938	3.938	25
	6	F	144.637	2.729	1.286 (68.158)	2.214	3.500	53
September 2013	1	F	73.55	2.942	0.803 (20.080)	2.54	3.344	25
	6	F	127.00	2.396	0.696 (36.863)	2.048	2.744	53

COMPETENCE

DATA WAVE	SQ	AGE / GENDER	TOTAL	MEAN	VARIANCE	RANGE +	-	ITEMS
March / April 2013	**2**	10 yo	6.33	2.11	0.444 (1.33)	1.888	2.332	3
		11 yo	7.13	2.377	0.780 (2.339)	1.987	2.767	3
		12 yo	7.36	2.453	0.973 (2.918)	1.966	2.94	3
		M	6.64	2.213	0.968 (2.905)	1.729	2.697	3
		F	8.05	2.683	0.711 (2.134)	2.327	3.039	3
	3	10 yo	10.82	2.705	1.072 (4.287)	2.169	3.241	4
		11 yo	13.14	3.285	0.926 (3.703)	2.822	3.748	4
		12 yo	11.35	2.838	1.814 (7.254)	1.931	3.745	4
		M	12.31	3.078	1.400 (5.587)	2.378	3.778	4
		F	10.47	2.618	1.269 (5.076)	1.983	3.253	4
June 2013	**6**	10 yo	51.75	2.464	0.891 (18.714)	2.018	2.91	21
		11 yo	47.13	2.244	1.047 (21.981)	1.720	2.768	21
		12 yo	43.18	2.056	0.857 (17.993)	1.627	2.485	21
		M	45.85	2.183	2.156 (45.266)	1.105	3.261	21

DATA WAVE	SQ	AGE / GENDER	TOTAL	MEAN	VARIANCE	RANGE +	-	ITEMS
	6	F	47.21	2.248	0.835 (17.533)	1.830	2.666	21
	7	10 yo	19.80	2.475	1.275 (10.2)	1.837	3.113	8
		11 yo	22.58	2.823	0.976 (7.811)	2.335	3.311	8
		12 yo	22.00	2.75	1.239 (9.914)	2.130	3.370	8
		M	21.33	2.667	1.249 (9.989)	2.042	3.292	8
		F	23.73	2.966	1.064 (8.509)	2.434	3.398	8
September 2013	**6**	11 yo	45.38	2.161	0.563 (11.833)	1.879	2.443	21
		12 yo	43.93	2.092	0.397 (8.335)	1.893	2.291	21
		13 yo	39.53	1.882	0.657 (13.801)	1.553	2.211	21
		M	44.20	2.105	0.551 (11.563)	1.829	2.381	21
		F	41.80	1.990	0.636 (13.363)	1.672	2.308	21
	7	11 yo	19.25	2.406	0.675 (5.402)	2.068	2.744	8
		12 yo	20.00	2.500	0.598 (4.787)	2.201	2.799	8
		13 yo	19.23	2.404	0.650 (5.201)	2.079	2.729	8
		M	19.09	2.386	0.528 (4.225)	2.122	2.650	8
		F	21.43	2.679	0.758 (6.062)	2.300	3.058	8

AUTONOMY SUPPORT
10 SUBSCALES, 57 items

MEAN RANGES

DATA WAVE	SQ	AGE / GENDER	TOTAL	MEAN	VARIANCE	RANGE +	-	ITEMS
March 2013	**2**	**10 yo**	25.33	2.533	1.869 (18.694)	1.598	3.468	10
		11 yo	30.75	3.075	0.975 (9.75)	2.585	3.565	10
		12 yo	27.647	2.765	1.315 (13.154)	2.107	3.423	10
		M	25.806	2.581	1.339 (13.385)	1.911	3.251	10
		F	29.55	2.955	1.109 (11.092)	2.400	3.510	10
	3	**10 yo**	20.41	2.916	1.054 (7.375)	2.389	3.443	7
		11 yo	21.571	3.082	0.779 (5.451)	2.692	3.472	7
		12 yo	20.769	2.967	1.232 (8.625)	2.351	3.583	7
		M	21.222	3.032	1.141 (7.990)	2.461	3.603	7
		F	20.238	2.891	0.990 (6.929)	2.396	3.386	7
June 2013	**6**	**10 yo**	42.270	2.818	0.795 (11.929)	2.420	3.216	15
		11 yo	43.930	2.929	1.093 (16.400)	2.382	3.476	15
		12 yo	39.820	2.655	1.215 (18.228)	2.047	3.263	15

DATA WAVE	SQ	AGE / GENDER	TOTAL	MEAN	VARIANCE	RANGE +	-	ITEMS
June 2013	**6**	**M**	41.940	2.796	1.133 (16.988)	2.229	3.363	15
		F	40.29	2.686	0.788 (11.813)	2.292	3.080	15
	7	**10 yo**	54.80	2.283	1.142 (27.40)	1.712	2.854	24
		11 yo	62.33	2.597	0.992 (23.803)	2.101	3.093	24
		12 yo	58.87	2.453	0.912 (21.876)	1.997	2.909	24
		M	59.48	2.478	1.038 (24.903)	1.959	2.997	24
		F	84.91	3.538	1.120 (26.873)	2.978	4.098	24
September 2013	**6**	**11 yo**	38.46	2.564	0.621 (9.308)	2.253	2.875	15
		12 yo	38.21	2.547	0.562 (8.423)	2.266	2.828	15
		13 yo	39.32	2.621	0.943 (14.146)	2.149	3.093	15
		M	38.88	2.592	0.759 (11.383)	2.212	2.972	15
		F	38.48	2.565	0.682 (10.237)	2.224	2.906	15
	7	**11 yo**	59.00	2.458	0.722 (17.333)	2.097	2.819	24
		12 yo	56.25	2.344	0.814 (19.532)	1.937	2.751	24
		13 yo	54.45	2.269	0.635 (15.238)	1.951	2.587	24

DATA WAVE	SQ	AGE / GENDER	TOTAL	MEAN	VARIANCE	RANGE +	-	ITEMS
September 2013	**7**	**M**	54.18	2.258	0.704 (16.892)	1.906	2.610	24
		F	58.20	2.425	0.662 (15.879)	2.094	2.756	24

Notes

The lower the Total and Mean, the more positive the results (Maximum Total = 125; 25 statements x 5)

Positive = Nearer to 1 and 2

Neutral = 2.5

Negative = 3 and 4, nearer to 5

METHOD OF CALCULATION

Total of Mean per statement divided by the number of statements

Range = Total of Mean Variance per statement divided by the number of statements

Calculation of Highest and Lowest = Range Variance divided by 2. Highest = Mean minus halved Variance Range. Lowest = Mean plus halved Variance Range.

The lower the Mean, the more positive the self-reported perception, i.e. 1 = highly positive, 4 or 5 = highly negative

APPENDIX 3.2 CONTINUOUS VARIABLESFOR Bivariate Correlates

TEACHER-STUDENT INTERPERSONAL RELATIONSHIP QUALITY

SQ1, subscale 1	Warm, trusting relationship - 1, 8, 21, 27, 29
SQ1, subscale 2	Reactions of science teacher as perceived by the student - 3, 11, 13, 15, 17, 25, 28
SQ1, subscale 3	Responses of student to teacher's key interpersonal behaviours - 2, 4, 7, 9, 10, 12, 14, 16, 19, 20, 22, 24, 26

STUDENTS' ENGAGEMENT WITH SCIENCE

SQ2, subscale 1	Student's perception of science teacher's role and behaviour - 1, 4, 5, 7, 9, 12, 15, 17, 19, 21, 25, 28
SQ2, subscale 2	Student's perceptions of the value / importance of science - 2, 8, 10, 13, 20, 27
SQ2, subscale 3	Student's Enjoyment of science - 3, 14, 24
SQ2, subscale 4	Student's contribution to own learning in science - 6, 16, 26
SQ2, subscale 5	Perceptions re science investigations – 23
SQ2, subscale 6	Relationship with Perception of other students - 11, 18, 22

WHAT IS HAPPENING WITHIN SCIENCE LESSONS?

SQ6, subscale 1	Student Cohesiveness (Student – Peer Relationships): 1 - 6
SQ6, subscale 2	Teacher Support: 7 – 14
SQ6, subscale 3	Involvement (Relatedness / TSIR): 15 - 22
SQ6, subscale 4	Investigations: 23 – 30
SQ6, subscale 5	Task Orientation (Achievement-expectancy): 31 – 37
SQ6, Subscale 6	Cooperation: 38 – 45
SQ6, Subscale 7	Equity: 46 - 53

KEY TEACHER BEHAVIOURS and METHODS IN SCIENCE

SQ3, subscale 1	Science Teacher characteristics and traits - 1, 7, 12, 16, 20, 21
SQ3, subscale 2	Science teacher effectiveness - 3, 5
SQ3, subscale 3	Involvement of student by science teacher within science lessons - 6, 10, 17
SQ3, subscale 4	Student's science self-confidence; teacher actions - 4, 13, 15, 18

SQ3, subscale 5	Science investigations - 2, 8, 11, 14, 19	

STUDENTS' ACTIVE ENGAGEMENT IN SCIENCE

SQ7, Subscale 1	Learning Goal Orientation 1	8
SQ7, Subscale 2	Task Value	9 – 16
SQ7, Subscale 3	Self-Efficacy	17 – 24
SQ7, Subscale 4	Self-Regulation	25 - 32

The statements used within the SQ6 questionnaire have been adapted from Aldridge, Fraser and Huang (1999). The WHIC questionnaire was developed initially by Fraser, McRobbie and Fisher (1996). WHIC – What is Happening Inside this Classroom?

The statements used within the SQ7 questionnaire have been adapted from the Students' Adaptive Learning Engagement in Science (SALES) Questionnaire (Velayathum, Aldridge and Fraser, 2011)

APPENDIX 3.3 Descriptive Statistics of All Measured Variables

Variable	Cycle	N	M	Cronbach's α
TSIRQ SQ1	March 2013	69	2.86	0.833
	June 2013	55	2.96	0.843
	September 2013	62	2.95	0.85
TSIRQ SQ2	March 2013	51	2.62	0.919
TSIRQ SQ3	March / April 2013	57	2.8	0.904
TSIRQ SQ6	June 2013	48	2.89	0.888
	September 2013	50	2.65	0.916
	COMBINED MEAN TSIRQ		**2.82**	
AUTONOMY SUPPORT SQ2	March 2013	51	2.49	0.919
AUTONOMY SUPPORT SQ6	June 2013	48	2.57	0.888
	September 2013	50	2.27	0.916
AUTONOMY SUPPORT SQ7	June 2013	38	2.5	0.892
	September 2013	43	2.32	0.817
	COMBINED MEAN		**2.43**	

Variable	Cycle	N	M	Cronbach's α
COMPETENCE SQ2	March / April 2013	51	2.43	0.919
COMPETENCE SQ3	April 2013	57	2.91	0.904
COMPETENCE SQ6	June 2013	48	2.55	0.888
	September 2013	50	2.48	0.916
COMPETENCE SQ7	June 2013	38	2.65	0.892
	September 2013	43	2.49	0.817
	COMBINED MEAN		**2.59**	

- Means added up according to statement grouping / number of statements

Key: N Number of subjects
M Mean

APPENDIX 3.4

DESCRIPTIVE STATISTICS – Relatedness (Teacher-Student Relationship Quality) – SQ1 – Snapshot: 13 yo Leavers

Qu. / No.	Statement in Questionnaire	PERCENTAGES			MALE			FEMALE		
	STATEMENT	A	D	N	A	D	N	A	D	N
SQ1, 1	I have a trusting, positive relationship with my science teacher	**29**	**36**	**35**	**39**	**15**	**46**	**0**	**100**	**0**
SQ1, 2R	My science teacher and I always seem to be struggling with each other.	**35**	**41**	**24**	**39**	**38**	**23**	**25**	**25**	**50**
SQ1, 3	My science teacher can tell how I am feeling during the lesson.	**23**	**36**	**41**	**23**	**31**	**46**	**25**	**50**	**25**
SQ1, 4	I feel more confident after I have been corrected by my science teacher	**41**	**41**	**18**	**54**	**31**	**15**	**0**	**75**	**25**
SQ1, 7	When I am praised by this teacher, I respond with pride.	**65**	**23**	**12**	**69**	**24**	**7**	**50**	**25**	**25**
SQ1, 8	I feel happy with my science teacher	**35**	**30**	**35**	**46**	**31**	**23**	**0**	**25**	**75**
SQ1, 9	I share information about myself with my science teacher	**12**	**64**	**24**	**15**	**62**	**23**	**0**	**75**	**25**
SQ1, 10	I often copy the science teacher's way of doing things within science lessons	**59**	**29**	**12**	**62**	**31**	**7**	**50**	**25**	**25**
SQ1, 11R	My science teacher easily becomes angry with me.	**47**	**29**	**24**	**54**	**31**	**15**	**25**	**25**	**50**
SQ1, 12	I openly share my science-based ideas with my science teacher	**47**	**35**	**18**	**54**	**23**	**23**	**25**	**75**	**0**

Qu. / No.	Statement in Questionnaire	PERCENTAGES			MALE			FEMALE		
	STATEMENT	A	D	N	A	D	N	A	D	N
SQ1, 13R	My science teacher seems to find it hard to determine how I am feeling.	**53**	**12**	**35**	**46**	**39**	**15**	**75**	**0**	**25**
SQ1, 14R	I feel angry after being corrected by my teacher.	**36**	**40**	**24**	**23**	**46**	**31**	**75**	**25**	**0**
SQ1, 15R	My science teacher displays signs of impatience with me when I do not understand something	**71**	**17**	**12**	**69**	**24**	**7**	**75**	**0**	**25**
SQ1, 16	I always try to please my science teacher	**71**	**17**	**12**	**85**	**15**	**0**	**25**	**25**	**50**
SQ1, 17	My science teacher's reactions toward me can change suddenly.	**47**	**24**	**29**	**46**	**31**	**23**	**50**	**0**	**50**
SQ1, 19R	I do not easily share my ideas with my science teacher.	**41**	**35**	**24**	**54**	**23**	**23**	**75**	**0**	**25**
SQ1, 20	My interactions with my science teacher make me feel confident within science lessons	**47**	**41**	**12**	**54**	**39**	**7**	**25**	**50**	**25**
SQ1, 21R	Despite my best efforts, I am not happy with how my science teacher and I get along	**24**	**58**	**18**	**31**	**46**	**23**	**100**	**0**	**0**
SQ1, 22	When I am praised by my teacher, I feel embarrassed	**29**	**59**	**12**	**23**	**62**	**15**	**50**	**50**	**0**
SQ1, 24	I like to try my own way of doing things within science lessons	**53**	**29**	**18**	**54**	**31**	**15**	**50**	**25**	**25**
SQ1, 25	My science teacher is patient with me when I do not understand something	**29**	**36**	**35**	**39**	**30**	**31**	**0**	**50**	**50**
SQ1, 26R	I do not share any personal information about myself with my science teacher	**29**	**59**	**12**	**39**	**46**	**15**	**100**	**0**	**0**

Qu. / No.	Statement in Questionnaire	PERCENTAGES			MALE			FEMALE		
	STATEMENT	A	D	N	A	D	N	A	D	N
SQ1, 27	I openly share my science-based experiences with my science teacher.	**47**	**41**	**12**	**62**	**23**	**15**	**0**	**100**	**0**
SQ1, 28	My science teacher remains patient with me within science lessons	**29**	**53**	**18**	**31**	**54**	**15**	**25**	**50**	**25**
SQ1, 29	I have a positive relationship with my science teacher outside science lessons	**35**	**41**	**24**	**46**	**39**	**15**	**0**	**50**	**50**
SQ2, 1	Overall my science teacher treats me fairly	**64**	**7**	**29**	**80**	**10**	**10**	**25**	**0**	**75**
SQ2, 4	My science teacher will help me when I need help	**64**	**22**	**14**	**70**	**10**	**20**	**50**	**50**	**0**
SQ2, 7	When I do well within my science lessons, it is because my science teacher has made my lessons interesting	**57**	**29**	**14**	**80**	**10**	**10**	**0**	**75**	**25**
SQ2, 9	My science teacher listens to me	**64**	**15**	**21**	**80**	**10**	**10**	**25**	**0**	**75**
SQ2, 12	My science teacher has been important for how well I understand science	**50**	**14**	**36**	**60**	**10**	**30**	**25**	**25**	**50**
SQ2, 15	I enjoy talking to my science teacher	**21**	**58**	**21**	**30**	**40**	**30**	**0**	**100**	**0**
SQ2, 17	When I have a difficulty within a science lesson, my science teacher is willing to help me	**57**	**29**	**14**	**70**	**20**	**10**	**25**	**50**	**25**
SQ2, 19	My science teacher is important for how much self-confidence I have in my science work	**57**	**22**	**21**	**60**	**20**	**20**	**50**	**25**	**25**

Qu. / No.	Statement in Questionnaire	PERCENTAGES			MALE			FEMALE		
	STATEMENT	A	D	N	A	D	N	A	D	N
SQ2, 21	When something good happens within a science lesson, my science teacher wants to know about it	**43**	**36**	**21**	**60**	**20**	**20**	**0**	**75**	**25**
SQ2, 25	My science teacher cares about me	**36**	**43**	**21**	**50**	**40**	**10**	**0**	**50**	**50**
SQ2, 28	My science teacher is interested in me as a person, not just as a student	**43**	**43**	**14**	**60**	**30**	**10**	**0**	**75**	**25**
SQ3, 1	My science teacher is confident and knowledgeable within science lessons	**100**	**0**	**0**	**100**	**0**	**0**	**100**	**0**	**0**
SQ3, 7	My science teacher is a positive role model informing my enjoyment of science	**36**	**37**	**27**	**50**	**25**	**25**	**0**	**66.7**	**33.3**
SQ3, 12	I work within science lessons in such ways that I please my science teacher	**64**	**27**	**9**	**75**	**25**	**0**	**33.3**	**33.3**	**33.3**
SQ3, 16	My science teacher has a sense of humour within my science lessons	**46**	**36**	**18**	**50**	**37**	**13**	**33.3**	**33.3**	**33.3**
SQ3, 20	My science teacher is patient with me within my science lessons	**27**	**46**	**25**	**38**	**37**	**25**	**0**	**66.7**	**33.3**
SQ3, 21	My science teacher's sense of humour increases my enjoyment of science lessons	**NIPQ**	**NIPQ**	**NIPQ**	**NIPQ**	**NIPQ**	**NIPQ**	**NIPQ**	**NIPQ**	**NIPQ**
SQ3, 6	My science teacher encourages me to contribute to lessons and share my scientific ideas	**64**	**18**	**18**	**63**	**12**	**25**	**66.7**	**33.3**	**0**

Qu. / No.	Statement in Questionnaire	PERCENTAGES			MALE			FEMALE		
	STATEMENT	A	D	N	A	D	N	A	D	N
SQ3, 10	My science teacher challenges me to work hard	**82**	**0**	**18**	**100**	**0**	**0**	**33.3**	**0**	**66.7**
SQ3, 17	My science teacher allows me to explore my own ideas and make suggestions within discussions	**55**	**27**	**18**	**75**	**12**	**13**	**0**	**66.7**	**33.3**

Key :

Qu. = Questionnaire (e.g. SQ1)

M = March; J = June; S = September

A = Agree (Strongly Agree, Agree); D = Disagree (Disagree, Strongly Disagree); N = Neutral

NIPQ = Not in Pilot Questionnaire

Sample sizes:

SQ1: n = 17; Male n = 13, Female n = 4 (1 person = 25%)

SQ2: n = 14; Male n = 10, Female n = 4

SQ3: n = 11; Male n = 8, Female n = 3 (1 person = 33.3%)

APPENDIX 3.5

TEACHER-STUDENT INTERPERSONAL RELATIONSHIP QUALITY (TSIRQ): 12 subscales, 94 items
MEAN RANGES

DATE	QUESTIONNAIRE	Age	n	Mean	Highest	Lowest	Range
March / April 2013	**SQ1 – subscales 1, 2, 3**	**10 yo**	14	2.729	1.714	3.786	2.071
		11 yo	14	2.886	2.214	3.500	1.286
		12 yo	22	2.858	2.091	3.682	1.591
		13 yo	17	2.944	2.118	3.706	1.588
		10 and 11 yo	28	2.807	2.107	3.607	1.500
		12 and 13 yo	39	2.895	2.103	3.692	1.756
		Male	45	2.824	2.044	3.489	1.444
		Female	22	2.929	2.091	3.909	1.818
	SQ2 – subscale 2	**10 yo**	12	2.174	1.833	2.500	0.667
		11 yo	8	2.682	1.875	3.000	1.125
		12 yo	17	2.647	2.294	3.529	1.235

DATE	QUESTIONNAIRE	Age	n	Mean	Highest	Lowest	Range
		13 yo	14	2.695	2.357	3.571	1.214
		10 and 11 yo	20	2.377	1.950	2.650	0.700
		12 and 13 yo	31	2.669	2.355	3.258	0.903
		Male	31	2.563	2.226	3.065	0.839
		Female	20	2.541	1.900	3.100	1.200
	SQ3 – subscales 1, 3	**10 yo**	27	2.536	2.118	3.059	0.941
		11 yo	14	3.024	2.571	4.000	1.429
		12 yo	26	2.791	2.269	3.346	1.077
		10 and 11 yo	31	2.756	2.387	3.365	0.968
		Over 11 yo	26	2.791	2.269	3.346	1.077
		Male	36	2.895	2.417	3.472	1.056
		Female	21	2.561	2.417	3.472	1.056

DATE	QUESTIONNAIRE	Age	n	Mean	Highest	Lowest	Range
June 2013	SQ1 – subscales 1, 2, 3	**10 yo**	9	2.693	1.667	3.556	1.889
		11 yo	16	3.050	2.063	3.938	1.875
		12 yo	24	2.910	2.208	3.917	1.708
		10 and 11 yo	25	2.922	2.160	3.560	1.400
		12 and 13 yo	30	2.913	2.200	3.867	1.667
		Male	39	2.912	2.256	3.641	1.385
		Female	16	2.930	1.938	3.938	2.000
	SQ6 – subscales 2, 3 7	**10 yo**	8	2.755	2.250	3.250	1.000
		11 yo	15	3.164	2.400	3.867	1.467
		12 yo	19	2.789	2.368	3.421	1.053
		10 and 11 yo	23	3.022	2.478	3.652	1.174
		12 and 13 yo	25	2.778	2.360	3.480	1.120
		Male	33	2.961	2.364	3.485	1.121
		Female	14	2.729	2.214	3.500	1.286

DATE	QUESTIONNAIRE	Age	n	Mean	Highest	Lowest	Range
September 2013	**SQ1 – subscales 1, 2, 3**	**11 yo**	14	2.917	2.426	3.408	0.982
		12 yo	16	2.921	2.475	3.367	0.891
		13 yo	24	3.043	2.538	3.548	1.009
		Male	36	2.942	2.371	3.513	1.142
		Female	26	2.942	2.54	3.344	0.803
	SQ6 – subscales 2, 3 7	**11 yo**	13	2.478	2.18	2.776	0.596
		12 yo	14	2.412	2.127	2.697	0.570
		13 yo	19	2.397	1.953	2.841	0.887
		Male	25	2.488	2.104	2.872	0.768
		Female	25	2.396	2.048	2.744	0.696

<u>METHOD OF CALCULATION</u>

Total of Mean per statement divided by the number of statements
Range = Total of Mean Variance per statement divided by the number of statements
Calculation of Highest and Lowest = Range Variance divided by 2. Highest = Mean minus halved Variance Range. Lowest = Mean plus halved Variance Range.
The lower the Mean, the more positive the self-reported perception, i.e. 1 = highly positive, 4 or 5 = highly negative

APPENDIX 3.6

AUTONOMY SUPPORT: MEAN RANGES

DATE	QUESTIONNAIRE	Age	n	Mean	Highest	Lowest	Range
March / April 2013	SQ2 – subscales 2, 3, 5	**10 yo**	9	2.533	1.598	3.468	1.869
		11 yo	8	3.075	2.585	3.565	0.975
		12 yo	17	2.765	2.107	3.423	1.315
		Male	31	2.581	1.911	3.251	1.339
		Female	20	2.955	2.400	3.510	1.109
	SQ3 – subscales 2, 5	**10 yo**	17	2.916	2.389	3.443	1.054
		11 yo	14	3.082	2.692	3.472	0.779
		12 yo	26	2.967	2.351	3.583	1.232
		Male	36	3.032	2.461	3.603	1.141
		Female	21	2.891	2.396	3.386	0.990

DATE	QUESTIONNAIRE	Age	n	Mean	Highest	Lowest	Range
June 2013	SQ6 – subscales 4, 5	**10 yo**	8	2.818	2.420	3.216	0.795
		11 yo	15	2.929	2.382	3.476	1.093
		12 yo	17	2.655	2.047	3.263	1.215
		Male	34	2.796	2.229	3.363	1.133
		Female	14	2.686	2.292	3.080	0.788
	SQ7 – subscales 1, 2, 4	**10 yo**	5	2.283	1.712	2.854	1.142
		11 yo	12	2.597	2.101	3.093	0.992
		12 yo	15	2.453	1.997	2.909	0.912
		Male	27	2.478	1.959	2.997	1.038
		Female	11	3.538	2.978	4.098	1.120
September 2013	SQ6 – subscales 4, 5	**11 yo**	13	2.564	2.253	2.875	0.621
		12 yo	14	2.547	2.266	2.828	0.562

DATE	QUESTIONNAIRE	Age	n	Mean	Highest	Lowest	Range
September 2013	SQ6 – subscales 4, 5	**13 yo**	19	2.621	2.149	3.093	0.943
		Male	25	2.592	2.212	2.972	0.759
		Female	25	2.565	2.224	2.906	0.682
	SQ7 – subscales 1, 2, 4	**11 yo**	12	2.458	2.097	2.819	0.722
		12 yo	8	2.344	1.937	2.751	0.814
		13 yo	22	2.269	1.951	2.587	0.635
		Male	22	2.258	1.906	2.610	0.704
		Female	20	2.425	2.094	2.756	0.662

METHOD OF CALCULATION

- **Total of Mean per statement divided by the number of statements**
- **Range =** Total of Mean Variance per statement divided by the number of statements
- **Calculation of Highest and Lowest =** Range Variance divided by 2. Highest = Mean minus halved Variance Range. Lowest = Mean plus halved Variance Range.
- **The lower the Mean, the more positive the self-reported perception, i.e. 1 = highly positive, 4 or 5 = highly negative**

APPENDIX 3.7

COMPETENCE: 6 subscales, 36 items
MEAN RANGES

DATE	QUESTIONNAIRE	Age	n	Mean	Highest	Lowest	Range
March / April 2013	SQ2 – subscale 4	**10 yo**	9	2.11	1.888	2.332	0.444
		11 yo	8	2.377	1.987	2.767	0.780
		12 yo	17	2.453	1.966	2.94	0.973
		Male	31	2.213	1.729	2.697	0.968
		Female	20	2.683	2.327	3.039	0.711
	SQ3 – subscale 4	**10 yo**	17	2.705	2.169	3.241	1.072
		11 yo	14	3.285	2.822	3.748	0.926
		12 yo	26	2.838	1.931	3.745	1.814
		Male	36	3.078	2.378	3.778	1.400
		Female	21	2.618	1.983	3.253	1.269

DATE	QUESTIONNAIRE	Age	n	Mean	Highest	Lowest	Range
June 2013	SQ6 – subscales 1, 5, 6	**10 yo**	8	2.464	2.018	2.91	0.891
		11 yo	15	2.244	1.720	2.768	1.047
		12 yo	17	2.056	1.627	2.485	0.857
		Male	34	2.183	1.105	3.261	2.156
		Female	14	2.248	1.830	2.666	0.835
	SQ7 – subscale 3	**10 yo**	5	2.475	1.837	3.113	1.275
		11 yo	12	2.823	2.335	3.311	0.976
		12 yo	15	2.75	2.130	3.370	1.239
		Male	27	2.667	2.042	3.292	1.249
		Female	11	2.966	2.434	3.398	1.064
September 2013	SQ6 – subscales 1, 5, 6	**11 yo**	13	2.161	1.879	2.443	0.563
		12 yo	14	2.092	1.893	2.291	0.397
		13 yo	19	1.882	1.553	2.211	0.657

DATE	QUESTIONNAIRE	Age	n	Mean	Highest	Lowest	Range
September 2013	SQ6 – subscales 1, 5, 6	**Male**	25	2.105	1.829	2.381	0.551
		Female	25	1.990	1.672	2.308	0.636
	SQ7 – subscale 3	**11 yo**	12	2.406	2.068	2.744	0.675
		12 yo	8	2.500	2.201	2.799	0.598
		13 yo	22	2.404	2.079	2.729	0.650
		Male	22	2.386	2.122	2.650	0.528
		Female	21	2.679	2.300	3.058	0.758

METHOD OF CALCULATION

Total of Mean per statement divided by the number of statements

Range = Total of Mean Variance per statement divided by the number of statements

Calculation of Highest and Lowest = Range Variance divided by 2. Highest = Mean minus halved Variance Range. Lowest = Mean plus halved Variance Range.

The lower the Mean, the more positive the self-reported perception, i.e. 1 = highly positive, 4 or 5 = highly negative

APPENDIX 3.8 DESCRIPTIVE STATISTICS – Autonomy Support

Qu. / No.	Statement in Questionnaire	10 yo to 11 yo									11 yo to 12 yo									12 yo to 13 yo								
	STATEMENT	M			J			S			M			J			S			M			J			S		
		A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
SQ2, 8	What I learn in science is important to me	67	22	11	[redacted]						13	37	50	[redacted]						53	6	41	[redacted]					
SQ2, 10	School science lessons are important for ensuring that I achieve my future science-based goals	78	11	11	[redacted]						25	25	50	[redacted]						41	18	41	[redacted]					
SQ2, 13	I plan to continue my science studies when I do my A Levels	33	11	56	[redacted]						50	25	25	[redacted]						18	23	59	[redacted]					
SQ2, 20	What I am learning in my science lessons will be important to me in my future	78	0	22	[redacted]						63	0	37	[redacted]						65	12	23	[redacted]					
SQ2, 27	My learning within science lessons will create many future opportunities for me	67	11	22	[redacted]						63	25	12	[redacted]						41	6	53	[redacted]					
SQ2, 3	The science teacher makes my learning within science enjoyable	67	11	22	[redacted]						25	50	25	[redacted]						35	41	24	[redacted]					
SQ2, 14	My science teacher has been important for how much I enjoy doing science	44	12	44	[redacted]						13	50	37	[redacted]						59	23	18	[redacted]					
SQ2, 24	Learning is fun in science because I am improving my understanding of science	67	22	11	[redacted]						63	0	37	[redacted]						65	17	18	[redacted]					
SQ2, 23	We do a lot of investigations in science	56	22	22	[redacted]						13	62	25	[redacted]						59	6	35	[redacted]					
SQ3, 3	My science teacher presents ideas in a way that I can understand	41	12	47	[redacted]						36	21	43	[redacted]						54	34	12	[redacted]					

Qu. / No.	Statement in Questionnaire	10 yo to 11 yo									11 yo to 12 yo									12 yo to 13 yo								
	STATEMENT	**M**			**J**			**S**			**M**			**J**			**S**			**M**			**J**			**S**		
		A	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**
SQ3, 5	My science teacher presents science lessons in an exciting and inspirational way	**53**	**18**	**29**							**14**	**50**	**36**							**27**	**42**	**31**						
SQ3, 2	We undertake science investigations that have been planned entirely by the science teacher	**41**	**12**	**47**							**50**	**7**	**43**							**42**	**12**	**46**						
SQ3, 8	My science teacher encourages me to plan and carry out my own investigations	**41**	**24**	**35**							**29**	**28**	**43**							**46**	**35**	**19**						
SQ3, 11	We undertake science investigations that have been planned entirely by students	**12**	**41**	**47**							**14**	**50**	**36**							**12**	**61**	**27**						
SQ3, 14	We undertake science investigations that have been planned jointly by the science teacher and students	**18**	**35**	**47**							**43**	**21**	**36**							**54**	**15**	**31**						
SQ3, 19	Science lessons are organized so that we are able to investigate our own science questions	**18**	**47**	**35**							**0**	**57**	**43**							**31**	**38**	**31**						
SQ6, 23	I carry out investigations to test my scientific ideas.				**13**	**37**	**50**	**39**	**30**	**31**				**33**	**40**	**27**	**29**	**35**	**36**				**29**	**42**	**29**	**32**	**21**	**47**
SQ6, 24	I am asked to think about the evidence for statements.				**38**	**12**	**50**	**39**	**22**	**39**				**40**	**33**	**27**	**21**	**15**	**64**				**35**	**30**	**35**	**26**	**16**	**58**
SQ6, 25	I carry out investigations to answer questions coming from discussions.				**13**	**12**	**75**	**39**	**15**	**46**				**7**	**47**	**47**	**21**	**22**	**57**				**41**	**30**	**29**	**32**	**21**	**47**
SQ6, 26	I get the opportunity to explain the meaning of statements, diagrams and graphs.				**38**	**25**	**37**	**15**	**0**	**85**				**13**	**60**	**27**	**43**	**14**	**43**				**35**	**30**	**35**	**26**	**27**	**47**

Qu. / No.	Statement in Questionnaire	10 yo to 11 yo									11 yo to 12 yo									12 yo to 13 yo								
	STATEMENT	M			J			S			M			J			S			M			J			S		
		A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
SQ6, 27	I carry out investigations to answer questions which puzzle me.				38	25	37	39	7	54				20	67	13	29	21	50				24	47	29	42	26	32
SQ6, 28	I carry out investigations to answer the teacher's questions.				63	25	12	39	22	39				27	33	40	71	7	22				35	18	47	42	37	21
SQ6, 29	I find out answers to questions by doing investigations.				38	25	37	46	8	46				47	33	20	50	14	36				41	24	35	37	21	42
SQ6, 30	I solve problems by using information obtained from my own investigations.				25	12	63	46	0	54				27	33	40	36	28	36				47	18	35	42	32	26
SQ6, 38	I cooperate with other students when doing assignment work.				38	12	50	54	8	38				47	33	20	43	7	50				71	0	29	63	0	37
SQ6, 39	I share my books and resources with other students when doing assignments.				13	12	75	62	7	31				60	27	13	93	0	7				88	0	12	90	0	10
SQ6, 40	When I work in groups in this class, there is teamwork.				63	0	37	77	0	23				87	13	0	71	8	21				88	6	6	74	5	21
SQ6, 41	I work with other students on projects in this class.				50	0	50	77	15	8				60	7	33	64	7	29				71	0	29	90	5	5
SQ6, 42	I learn from other students in this class.				50	25	25	54	0	46				67	13	20	86	0	14				71	0	29	84	0	16
SQ6, 43	I work with other students in this class.				63	0	37	85	0	15				73	13	14	86	0	14				88	6	6	84	16	0
SQ6, 44	I cooperate with other students on class activities.				75	0	25	69	8	23				80	13	7	57	0	43				77	11	12	84	6	10
SQ6, 45	Students work with me to achieve class goals.				50	0	50	54	8	38				53	27	20	57	0	43				65	11	24	79	0	21
SQ7, 1	One of my goals is to learn as much as I can within Science lessons.													67	16	17	63	12	25				80	7	13	82	0	18
SQ7, 2	One of my goals is to learn new scientific content.													67	16	17	63	12	25				60	7	33	82	0	18
SQ7, 3	One of my goals is to master new scientific skills.													58	9	33	75	12	13				80	0	20	82	0	18

Qu. / No.	Statement in Questionnaire	10 yo to 11 yo									11 yo to 12 yo									12 yo to 13 yo								
[redacted]	STATEMENT	M			J			S			M			J			S			M			J			S		
	[redacted]	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
SQ7, 4	It is important that I understand my work within Science.	[redacted]												67	16	17	50	0	50	[redacted]			67	6	27	91	0	9
SQ7, 5	It is important for me to learn the scientific content that is taught.													33	9	58	38	0	62				60	0	40	82	0	18
SQ7, 6	It is important to me that I improve my science skills.													67	8	25	63	12	25				73	0	27	64	0	36
SQ7, 7	It is important that I understand what is being taught to me within Science lessons.													75	0	25	63	0	37				73	14	13	82	9	9
SQ7, 8	Understanding scientific ideas is important to me.													50	17	33	75	0	25				80	7	13	63	5	32
SQ7, 9	What I learn within Science lessons can be used in my daily life.													42	41	17	63	12	25				47	20	33	41	13	46
SQ7, 10	What I learn within Science lessons is interesting.													17	16	67	75	0	25				33	14	53	55	22	23
SQ7, 11	What I learn within Science lessons is useful for me to know.													42	33	25	88	0	12				47	13	40	68	9	23
SQ7, 12	What I learn within Science lessons is helpful to me.													42	41	17	63	12	25				47	13	40	50	0	50
SQ7, 13	What I learn within Science lessons is relevant to me.													50	25	25	38	25	37				20	7	73	32	13	55
SQ7, 14	What I learn within Science lessons is of practical value.													33	34	33	50	25	25				20	20	60	59	5	36
SQ7, 15	What I learn within Science lessons satisfies my curiosity.													25	17	58	63	12	25				40	20	40	55	9	36
SQ7, 16	What I learn within Science lessons encourages me to think.													42	25	33	63	12	25				33	27	40	59	5	36

Qu. / No.	Statement in Questionnaire	10 yo to 11 yo									11 yo to 12 yo									12 yo to 13 yo								
	STATEMENT	M			J			S			M			J			S			M			J			S		
		A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
SQ7, 25	Even when tasks are uninteresting within Science lessons, I keep working.													50	25	25	38	12	50				33	40	27	59	14	27
SQ7, 26	I work hard within Science lessons even if I do not like what I am doing.													50	17	33	75	0	25				47	6	47	59	5	36
SQ7, 27	I continue working even if there are better things to do.													50	25	25	38	12	50				40	33	27	50	9	41
SQ7, 28	I concentrate within Science lessons so that I won't miss important points.													58	34	8	63	12	25				67	6	27	32	0	68
SQ7, 29	I finish my work and assignments on time.													33	42	25	38	24	38				60	13	27	64	9	27
SQ7, 30	I don't give up even when the work within Science lessons is difficult.													67	8	25	75	0	25				87	0	13	55	9	36
SQ7, 31	I concentrate within Science lessons.													33	9	58	63	0	37				40	20	40	64	4	32
SQ7, 32	I keep working until I finish what I am supposed to do.													58	17	25	50	13	37				53	20	27	73	4	23

Qu. / No.	Statement in Questionnaire	MALE									FEMALE								
	STATEMENT	M			J			S			M			J			S		
		A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
SQ2, 8	What I learn in science is important to me	55	19	26							35	25	40						
SQ2, 10	School science lessons are important for ensuring that I achieve my future science-based goals	57	10	33							40	5	55						
SQ2, 13	I plan to continue my science studies when I do my A Levels	35	16	49							15	25	60						

Qu. / No.	Statement in Questionnaire	MALE									FEMALE								
	STATEMENT	M			J			S			M			J			S		
		A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
SQ2, 20	What I am learning in my science lessons will be important to me in my future	67	7	26							55	15	30						
SQ2, 27	My learning within science lessons will create many future opportunities for me	55	10	35							45	5	50						
SQ2, 3	The science teacher makes my learning within science enjoyable	43	37	20							45	35	20						
SQ2, 14	My science teacher has been important for how much I enjoy doing science	55	27	18							45	30	25						
SQ2, 24	Learning is fun in science because I am improving my understanding of science	57	17	26							55	25	20						
SQ2, 23	We do a lot of investigations in science	53	19	28							70	10	20						
SQ3, 3	My science teacher presents ideas in a way that I can understand	50	25	25							38	24	38						
SQ3, 5	My science teacher presents science lessons in an exciting and inspirational way	28	44	28							38	24	38						
SQ3, 2	We undertake science investigations that have been planned entirely by the science teacher	50	14	36							33	5	62						
SQ3, 8	My science teacher encourages me to plan and carry out my own investigations	36	36	28							48	19	33						
SQ3, 11	We undertake science investigations that have been planned entirely by students	14	50	36							10	57	33						
SQ3, 14	We undertake science investigations that have been planned jointly by the science teacher and students	42	27	31							38	14	48						
SQ3, 19	Science lessons are organized so that we are able to investigate our own science questions	22	53	25							14	34	52						
SQ6, 23	I carry out investigations to test my scientific ideas.				29	36	35	28	28	44				29	42	29	36	24	40
SQ6, 24	I am asked to think about the evidence for statements.				41	30	29	36	20	44				29	21	50	24	16	60

Qu. / No.	Statement in Questionnaire	MALE									FEMALE								
	STATEMENT	**M**			**J**			**S**			**M**			**J**			**S**		
		A	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**
SQ6, 25	I carry out investigations to answer questions coming from discussions.				**21**	**32**	**47**	**24**	**16**	**60**				**36**	**28**	**36**	**32**	**24**	**44**
SQ6, 26	I get the opportunity to explain the meaning of statements, diagrams and graphs.				**24**	**49**	**27**	**36**	**24**	**40**				**29**	**28**	**43**	**24**	**4**	**72**
SQ6, 27	I carry out investigations to answer questions which puzzle me.				**27**	**49**	**24**	**36**	**24**	**40**				**21**	**43**	**36**	**32**	**16**	**52**
SQ6, 28	I carry out investigations to answer the teacher's questions.				**41**	**30**	**29**	**60**	**16**	**24**				**43**	**7**	**50**	**32**	**32**	**36**
SQ6, 29	I find out answers to questions by doing investigations.				**41**	**35**	**24**	**44**	**20**	**36**				**57**	**0**	**43**	**40**	**12**	**48**
SQ6, 30	I solve problems by using information obtained from my own investigations.				**32**	**21**	**47**	**40**	**20**	**40**				**43**	**14**	**43**	**40**	**24**	**36**
SQ6, 38	I cooperate with other students when doing assignment work.				**56**	**9**	**35**	**52**	**8**	**40**				**64**	**22**	**14**	**48**	**8**	**44**
SQ6, 39	I share my books and resources with other students when doing assignments.				**68**	**11**	**21**	**76**	**4**	**20**				**64**	**15**	**21**	**80**	**4**	**16**
SQ6, 40	When I work in groups in this class, there is teamwork.				**82**	**6**	**12**	**72**	**4**	**24**				**86**	**7**	**7**	**76**	**4**	**20**
SQ6, 41	I work with other students on projects in this class.				**71**	**5**	**24**	**76**	**12**	**12**				**57**	**0**	**43**	**80**	**4**	**16**
SQ6, 42	I learn from other students in this class.				**68**	**8**	**24**	**72**	**4**	**24**				**79**	**7**	**14**	**76**	**0**	**24**
SQ6, 43	I work with other students in this class.				**79**	**3**	**18**	**80**	**4**	**16**				**79**	**14**	**7**	**84**	**8**	**8**
SQ6, 44	I cooperate with other students on class activities.				**79**	**12**	**9**	**68**	**8**	**24**				**79**	**0**	**21**	**72**	**0**	**28**
SQ6, 45	Students work with me to achieve class goals.				**62**	**17**	**21**	**68**	**0**	**32**				**57**	**7**	**36**	**56**	**8**	**36**
SQ7, 1	One of my goals is to learn as much as I can within Science lessons.				**67**	**7**	**26**	**68**	**5**	**27**				**91**	**9**	**0**	**81**	**5**	**14**
SQ7, 2	One of my goals is to learn new scientific content.				**67**	**11**	**22**	**82**	**0**	**18**				**46**	**8**	**46**	**52**	**5**	**43**
SQ7, 3	One of my goals is to master new scientific skills.				**63**	**7**	**30**	**86**	**0**	**14**				**82**	**0**	**18**	**57**	**5**	**38**

Qu. / No.	Statement in Questionnaire	MALE									FEMALE								
	STATEMENT	M			J			S			M			J			S		
		A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
SQ7, 4	It is important that I understand my work within Science.				**67**	**11**	**22**	**73**	**4**	**23**				**82**	**9**	**9**	**81**	**5**	**14**
SQ7, 5	It is important for me to learn the scientific content that is taught.				**56**	**7**	**37**	**64**	**0**	**36**				**55**	**9**	**36**	**57**	**5**	**38**
SQ7, 6	It is important to me that I improve my science skills.				**74**	**4**	**22**	**77**	**0**	**23**				**64**	**9**	**27**	**57**	**5**	**38**
SQ7, 7	It is important that I understand what is being taught to me within Science lessons.				**70**	**4**	**26**	**68**	**9**	**23**				**82**	**9**	**9**	**71**	**0**	**29**
SQ7, 8	Understanding scientific ideas is important to me.				**70**	**8**	**22**	**82**	**0**	**18**				**64**	**9**	**27**	**38**	**5**	**57**
SQ7, 9	What I learn within Science lessons can be used in my daily life.				**48**	**22**	**30**	**50**	**14**	**36**				**36**	**28**	**36**	**38**	**14**	**48**
SQ7, 10	What I learn within Science lessons is interesting.				**33**	**23**	**44**	**68**	**10**	**22**				**36**	**18**	**46**	**52**	**24**	**24**
SQ7, 11	What I learn within Science lessons is useful for me to know.				**56**	**18**	**26**	**82**	**4**	**14**				**36**	**18**	**46**	**48**	**9**	**43**
SQ7, 12	What I learn within Science lessons is helpful to me.				**59**	**22**	**19**	**55**	**4**	**41**				**36**	**28**	**36**	**48**	**9**	**43**
SQ7, 13	What I learn within Science lessons is relevant to me.				**41**	**18**	**41**	**36**	**14**	**50**				**18**	**9**	**73**	**29**	**19**	**52**
SQ7, 14	What I learn within Science lessons is of practical value.				**33**	**26**	**41**	**59**	**18**	**23**				**27**	**18**	**55**	**33**	**10**	**57**
SQ7, 15	What I learn within Science lessons satisfies my curiosity.				**52**	**22**	**26**	**64**	**9**	**27**				**27**	**18**	**55**	**43**	**24**	**33**
SQ7, 16	What I learn within Science lessons encourages me to think.				**48**	**30**	**22**	**64**	**4**	**32**				**27**	**18**	**55**	**52**	**5**	**43**
SQ7, 25	Even when tasks are uninteresting within Science lessons, I keep working.				**37**	**37**	**26**	**59**	**9**	**32**				**46**	**18**	**36**	**43**	**14**	**43**
SQ7, 26	I work hard within Science lessons even if I do not like what I am doing.				**52**	**22**	**26**	**68**	**5**	**27**				**36**	**19**	**55**	**57**	**5**	**38**
SQ7, 27	I continue working even if there are better things to do.				**52**	**26**	**22**	**36**	**18**	**46**				**36**	**37**	**27**	**52**	**5**	**43**

Qu. / No.	Statement in Questionnaire	MALE									FEMALE								
	STATEMENT	**M**			**J**			**S**			**M**			**J**			**S**		
		A	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**
SQ7, 28	I concentrate within Science lessons so that I won’t miss important points.				**59**	**22**	**19**	**50**	**4**	**46**				**55**	**9**	**36**	**48**	**0**	**52**
SQ7, 29	I finish my work and assignments on time.				**44**	**30**	**26**	**64**	**22**	**14**				**46**	**8**	**46**	**43**	**5**	**52**
SQ7, 30	I don’t give up even when the work within Science lessons is difficult.				**74**	**7**	**19**	**73**	**9**	**18**				**91**	**0**	**9**	**33**	**10**	**57**
SQ7, 31	I concentrate within Science lessons.				**44**	**15**	**41**	**64**	**4**	**32**				**27**	**18**	**55**	**71**	**0**	**29**
SQ7, 32	I keep working until I finish what I am supposed to do.				**59**	**19**	**22**	**64**	**12**	**22**				**64**	**9**	**27**	**57**	**0**	**43**

Key :

Qu. = Questionnaire (e.g. SQ1)

M = March; J = June; S = September

A = Agree (Strongly Agree, Agree); D = Disagree (Disagree, Strongly Disagree); N = Neutral

APPENDIX 3.9 DESCRIPTIVE STATISTICS – Competence

Qu. / No.	Statement in Questionnaire	10 yo to 11 yo									11 yo to 12 yo									12 yo to 13 yo								
	STATEMENT	M			J			S			M			J			S			M			J			S		
		A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
SQ2, 2	The tests and assessments in science do a good job of measuring what I have learnt and am able to do	33	11	56							50	0	50							35	12	53						
SQ2, 6	When I do well within my science lessons, it is because I work hard	56	0	44							88	0	12							53	0	47						
SQ2, 16	When I am involved in science work, I check to see whether I understand what I am doing	78	0	22							50	12	38							59	17	24						
SQ2, 19	My science teacher is important for how much self-confidence I have in my science work	44	0	56							50	25	25							59	18	23						
SQ2, 26	I feel that I am able to make contributions to my own learning within my science lessons	67	0	33							38	24	38							47	6	47						
SQ2, 23	We do a lot of investigations in science	56	22	22							13	24	63							59	6	35						
SQ3, 4	My science teacher's behaviour helps me to feel confident in my own ability within science lessons	35	12	53							36	57	7							39	26	35						
SQ3, 13	My science teacher politely encourages me to discuss and develop my ideas	41	30	29							29	35	36							62	30	8						

Qu. / No.	Statement in Questionnaire	10 yo to 11 yo									11 yo to 12 yo									12 yo to 13 yo								
	STATEMENT	**M**			**J**			**S**			**M**			**J**			**S**			**M**			**J**			**S**		
		A	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**
SQ3, 15	My science teacher is important to my desire to do well within science lessons	**47**	**18**	**35**							**29**	**35**	**36**							**54**	**27**	**19**						
SQ3, 18	My science teacher's behaviour encourages my enjoyment of science	**47**	**24**	**29**							**7**	**50**	**43**							**42**	**35**	**23**						
SQ6, 1	I am friendly with members of this Form.				**88**	**12**	**0**	**100**	**0**	**0**				**100**	**0**	**0**	**100**	**0**	**0**				**94**	**6**	**0**	**100**	**0**	**0**
SQ6, 2	Members of the Form are my friends.				**75**	**12**	**13**	**100**	**0**	**0**				**87**	**6**	**7**	**100**	**0**	**0**				**94**	**6**	**0**	**100**	**0**	**0**
SQ6, 3	I work well with other Form members.				**63**	**12**	**25**	**85**	**0**	**15**				**87**	**0**	**13**	**100**	**0**	**0**				**71**	**11**	**18**	**95**	**0**	**5**
SQ6, 4	I help other class members who are having trouble with their work.				**50**	**12**	**38**	**92**	**0**	**8**				**73**	**7**	**20**	**100**	**0**	**0**				**82**	**0**	**18**	**79**	**0**	**21**
SQ6, 5	Students in this Form like me.				**75**	**12**	**13**	**77**	**0**	**23**				**67**	**6**	**27**	**86**	**0**	**14**				**82**	**6**	**12**	**79**	**0**	**21**
SQ6, 6	In this class, I get help from other students.				**38**	**37**	**25**	**69**	**8**	**23**				**67**	**13**	**20**	**86**	**7**	**7**				**77**	**5**	**18**	**84**	**0**	**16**
SQ6, 31	Getting a certain amount of work done within science lessons is important to me.				**75**	**0**	**25**	**69**	**8**	**23**				**60**	**27**	**13**	**71**	**8**	**21**				**71**	**0**	**29**	**68**	**0**	**32**
SQ6, 32	I know the goals for my science lessons.				**38**	**25**	**37**	**39**	**0**	**61**				**53**	**20**	**27**	**57**	**7**	**36**				**41**	**24**	**35**	**42**	**16**	**42**
SQ6, 33	I am punctual and ready to start my science lessons on time.				**25**	**12**	**63**	**69**	**0**	**31**				**53**	**27**	**20**	**64**	**0**	**36**				**82**	**0**	**18**	**79**	**5**	**16**
SQ6, 34	I know what I am trying to accomplish within my science lessons.				**38**	**0**	**62**	**69**	**8**	**23**				**27**	**20**	**53**	**57**	**7**	**36**				**59**	**12**	**29**	**58**	**10**	**32**
SQ6, 35	I pay attention during science lessons.				**50**	**0**	**50**	**54**	**23**	**23**				**33**	**20**	**47**	**79**	**0**	**21**				**59**	**12**	**29**	**74**	**5**	**21**
SQ6, 36	I try to understand the work within my science lessons.				**50**	**12**	**38**	**69**	**0**	**31**				**80**	**7**	**13**	**93**	**0**	**7**				**71**	**5**	**24**	**68**	**16**	**16**

Qu. / No.	Statement in Questionnaire	10 yo to 11 yo									11 yo to 12 yo									12 yo to 13 yo								
	STATEMENT	M			J			S			M			J			S			M			J			S		
		A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
SQ6, 37	I know how much work I have to do.				25	12	63	69	8	23				33	27	40	57	0	43				53	12	35	63	5	32
SQ6, 38	I cooperate with other students when doing assignment work.				38	12	50	54	7	39				47	33	20	43	7	50				71	0	29	63	0	37
SQ6, 39	I share my books and resources with other students when doing assignments.				13	12	75	62	7	31				60	27	13	93	0	7				88	0	12	90	0	10
SQ6, 40	When I work in groups in this class, there is teamwork.				63	0	37	77	0	23				87	13	0	71	7	22				88	6	6	74	5	21
SQ6, 41	I work with other students on projects in this class.				50	0	50	77	15	8				60	7	33	64	7	29				71	0	29	90	5	5
SQ6, 42	I learn from other students in this class.				50	25	25	54	0	46				67	13	20	86	0	14				71	0	29	84	0	16
SQ6, 43	I work with other students in this class.				63	0	37	85	0	15				73	14	13	86	0	14				88	6	6	84	0	16
SQ6, 44	I cooperate with other students on class activities.				75	0	25	69	8	23				80	13	7	57	0	43				77	12	11	84	5	11
SQ6, 45	Students work with me to achieve class goals.				50	0	50	54	7	39				53	27	20	57	0	43				65	11	24	79	0	21
SQ7, 17	I can master the scientific skills that are taught.													42	16	42	63	0	37				53	20	27	64	4	32
SQ7, 18	I can figure out how to do difficult work within Science lessons.													17	50	33	50	13	37				27	40	33	68	23	9
SQ7, 19	Even if the science work is hard, I can learn it.													34	33	33	38	0	62				40	13	47	50	14	36
SQ7, 20	I can complete difficult work within Science lessons if I try.													58	17	25	63	0	37				60	20	20	59	5	36
SQ7, 21	I will receive good grades within Science.													33	33	34	50	0	50				27	40	33	46	4	50
SQ7, 22	I can learn the work we do within Science lessons.													33	0	67	50	0	50				60	7	33	68	0	32
SQ7, 23	I can understand the content taught within Science lessons.													50	17	33	50	13	37				33	20	47	73	9	18

Qu. / No.	Statement in Questionnaire	10 yo to 11 yo									11 yo to 12 yo									12 yo to 13 yo								
	STATEMENT	**M**			**J**			**S**			**M**			**J**			**S**			**M**			**J**			**S**		
		A	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**
SQ7, 24	I am good at science.													**25**	**25**	**50**	**38**	**37**	**25**				**47**	**20**	**33**	**46**	**22**	**32**

Qu. / No.	Statement in Questionnaire	MALE									FEMALE								
	STATEMENT	**M**			**J**			**S**			**M**			**J**			**S**		
		A	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**
SQ2, 2	The tests and assessments in science do a good job of measuring what I have learnt and am able to do	**45**	**14**	**41**							**20**	**15**	**65**						
SQ2, 6	When I do well within my science lessons, it is because I work hard	**69**	**3**	**28**							**60**	**5**	**35**						
SQ2, 16	When I am involved in science work, I check to see whether I understand what I am doing	**55**	**17**	**28**							**40**	**20**	**40**						
SQ2, 26	I feel that I am able to make contributions to my own learning within my science lessons	**49**	**12**	**39**							**35**	**10**	**55**						
SQ2, 23	We do a lot of investigations in science	**53**	**19**	**28**							**70**	**10**	**20**						
SQ3, 4	My science teacher's behaviour helps me to feel confident in my own ability within science lessons	**33**	**42**	**25**							**43**	**9**	**48**						
SQ3, 13	My science teacher politely encourages me to discuss and develop my ideas	**47**	**34**	**19**							**48**	**28**	**24**						
SQ3, 15	My science teacher is important to my desire to do well within science lessons	**39**	**28**	**33**							**57**	**24**	**19**						
SQ3, 18	My science teacher's behaviour encourages my enjoyment of science	**25**	**42**	**33**							**52**	**24**	**24**						
SQ6, 1	I am friendly with members of this Form.				**94**	**3**	**3**	**100**	**0**	**0**				**93**	**7**	**0**	**100**	**0**	**0**
SQ6, 2	Members of the Form are my friends.				**88**	**6**	**6**	**100**	**0**	**0**				**86**	**7**	**7**	**96**	**0**	**4**
SQ6, 3	I work well with other Form members.				**79**	**6**	**15**	**92**	**0**	**8**				**79**	**7**	**14**	**88**	**0**	**12**

Qu. / No.	Statement in Questionnaire	MALE									FEMALE								
	STATEMENT	M			J			S			M			J			S		
		A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
SQ6, 4	I help other class members who are having trouble with their work.				68	5	27	84	0	16				79	14	7	88	0	12
SQ6, 5	Students in this Form like me.				91	3	6	72	0	28				36	14	50	80	0	20
SQ6, 6	In this class, I get help from other students.				71	14	15	76	4	20				57	14	29	80	4	16
SQ6, 31	Getting a certain amount of work done within science lessons is important to me.				71	11	18	64	4	32				71	0	29	80	4	16
SQ6, 32	I know the goals for my science lessons.				50	18	32	44	8	48				36	35	29	48	12	40
SQ6, 33	I am punctual and ready to start my science lessons on time.				56	15	29	72	0	28				64	15	21	72	4	24
SQ6, 34	I know what I am trying to accomplish within my science lessons.				44	12	44	68	8	24				43	21	36	52	8	40
SQ6, 35	I pay attention during science lessons.				47	21	32	72	8	20				57	0	43	68	8	24
SQ6, 36	I try to understand the work within my science lessons.				74	11	15	80	4	16				71	0	29	68	8	24
SQ6, 37	I know how much work I have to do.				44	18	38	68	8	24				43	7	50	60	0	40
SQ6, 38	I cooperate with other students when doing assignment work.				56	9	35	52	8	40				64	22	14	48	8	44
SQ6, 39	I share my books and resources with other students when doing assignments.				68	11	21	76	4	20				64	15	21	80	4	16
SQ6, 40	When I work in groups in this class, there is teamwork.				82	6	12	72	4	24				86	7	7	76	4	20
SQ6, 41	I work with other students on projects in this class.				71	5	24	76	12	12				57	0	43	80	4	16
SQ6, 42	I learn from other students in this class.				68	8	24	72	4	24				79	7	14	76	0	24
SQ6, 43	I work with other students in this class.				79	3	18	80	4	16				79	14	7	84	8	8
SQ6, 44	I cooperate with other students on class activities.				79	12	9	68	8	24				79	0	21	72	0	28
SQ6, 45	Students work with me to achieve class goals.				67	17	21	68	0	32				57	7	36	56	8	36

Qu. / No.	Statement in Questionnaire	MALE									FEMALE								
	STATEMENT	M			J			S			M			J			S		
		A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
SQ7, 17	I can master the scientific skills that are taught.				48	19	33	64	0	36				46	18	36	48	9	43
SQ7, 18	I can figure out how to do difficult work within Science lessons.				26	37	37	73	9	18				36	46	18	48	28	24
SQ7, 19	Even if the science work is hard, I can learn it.				56	11	33	46	8	46				18	46	36	43	5	52
SQ7, 20	I can complete difficult work within Science lessons if I try.				63	11	26	64	0	36				46	36	18	57	5	38
SQ7, 21	I will receive good grades within Science.				48	30	22	55	0	45				27	27	46	52	5	43
SQ7, 22	I can learn the work we do within Science lessons.				56	11	33	73	5	22				36	9	55	57	0	43
SQ7, 23	I can understand the content taught within Science lessons.				48	22	30	55	9	36				36	18	46	57	5	38
SQ7, 24	I am good at science.				43	23	33	36	14	50				18	27	55	43	28	29

Key :

Qu. = Questionnaire (e.g. SQ1)

M = March; J = June; S = September

A = Agree (Strongly Agree, Agree); D = Disagree (Disagree, Strongly Disagree); N = Neutral

APPENDIX 3.10 DESCRIPTIVE STATISTICS – Relatedness (Teacher-Student Relationship Quality)

Qu. / No.	Statement in Questionnaire	10 yo to 11 yo n = 14, 9, 14									11 yo to 12 yo n = 14, 15, 16									12 yo to 13 yo n = 22, 24, 24								
	STATEMENT	**M**			**J**			**S**			**M**			**J**			**S**			**M**			**J**			**S**		
		A	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**
SQ1, 1	I have a trusting, positive relationship with my science teacher	**71**	**21**	**8**	**67**	**0**	**33**	**43**	**7**	**50**	**21**	**43**	**36**	**13**	**60**	**27**	**38**	**12**	**50**	**32**	**23**	**45**	**42**	**29**	**29**	**17**	**25**	**58**
SQ1, 2R	My science teacher and I always seem to be struggling with each other.	**79**	**0**	**21**	**22**	**67**	**11**	**7**	**72**	**21**	**50**	**21**	**29**	**20**	**40**	**40**	**6**	**88**	**6**	**59**	**9**	**32**	**17**	**58**	**25**	**8**	**63**	**29**
SQ1, 3	My science teacher can tell how I am feeling during the lesson.	**21**	**15**	**64**	**44**	**11**	**45**	**21**	**58**	**21**	**36**	**21**	**43**	**20**	**60**	**20**	**25**	**25**	**50**	**18**	**36**	**44**	**17**	**50**	**33**	**13**	**41**	**46**
SQ1, 4	I feel more confident after I have been corrected by my science teacher	**64**	**15**	**21**	**67**	**11**	**22**	**50**	**29**	**21**	**50**	**29**	**21**	**33**	**40**	**27**	**38**	**19**	**43**	**55**	**23**	**22**	**38**	**29**	**33**	**38**	**37**	**25**
SQ1, 7	When I am praised by this teacher, I respond with pride.	**57**	**22**	**21**	**11**	**22**	**67**	**43**	**21**	**36**	**50**	**21**	**29**	**33**	**27**	**40**	**75**	**6**	**19**	**36**	**23**	**41**	**58**	**21**	**21**	**63**	**12**	**25**
SQ1, 8	I feel happy with my science teacher	**71**	**22**	**7**	**22**	**11**	**67**	**36**	**43**	**21**	**43**	**50**	**7**	**7**	**53**	**40**	**44**	**13**	**43**	**50**	**23**	**27**	**21**	**33**	**46**	**8**	**38**	**54**
SQ1, 9	I share information about myself with my science teacher	**14**	**43**	**43**	**33**	**0**	**67**	**14**	**57**	**29**	**14**	**21**	**65**	**20**	**60**	**20**	**31**	**44**	**25**	**9**	**50**	**41**	**13**	**66**	**21**	**4**	**71**	**25**
SQ1, 10	I often copy the science teacher's way of doing things within science lessons	**43**	**28**	**29**	**44**	**22**	**34**	**57**	**0**	**43**	**43**	**29**	**28**	**33**	**53**	**14**	**31**	**25**	**44**	**50**	**14**	**36**	**50**	**21**	**29**	**42**	**25**	**33**
SQ1, 11R	My science teacher easily becomes angry with me.	50	14	36	**33**	**33**	**34**	**36**	**28**	**36**	**43**	**21**	**36**	**47**	**27**	**26**	**25**	**50**	**25**	**54**	**14**	**32**	**21**	**46**	**33**	**8**	**42**	**50**

Qu. / No.	Statement in Questionnaire	10 yo to 11 yo n = 14, 9, 14									11 yo to 12 yo n = 14, 15, 16									12 yo to 13 yo n = 22, 24, 24								
	STATEMENT	M			J			S			M			J			S			M			J			S		
		A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
SQ1, 12	I openly share my science-based ideas with my science teacher	43	36	21	44	0	56	50	14	36	36	14	50	47	20	33	50	25	25	64	27	9	46	29	25	54	21	25
SQ1, 13R	My science teacher seems to find it hard to determine how I am feeling.	21	21	58	33	22	45	50	14	36	36	36	28	40	13	47	19	18	63	27	27	46	46	13	41	29	13	58
SQ1, 14R	I feel angry after being corrected by my teacher.	50	21	29	22	67	11	29	50	21	57	7	36	40	27	33	13	57	31	55	14	31	13	58	29	8	63	29
SQ1, 15R	My science teacher displays signs of impatience with me when I do not understand something	43	7	50	56	11	33	29	21	50	7	58	35	40	27	33	25	31	44	68	27	5	29	25	46	21	41	38
SQ1, 16	I always try to please my science teacher	86	0	14	89	0	11	86	0	14	50	14	36	53	27	20	81	0	19	68	5	27	71	13	16	67	12	21
SQ1, 17	My science teacher’s reactions toward me can change suddenly.	29	35	36	33	22	45	57	7	36	50	14	36	60	13	27	31	13	56	32	18	50	50	21	29	29	25	46
SQ1, 19R	I do not easily share my ideas with my science teacher.	43	7	50	11	44	45	29	42	29	21	36	43	53	33	14	19	63	18	46	41	13	25	42	33	42	25	33
SQ1, 20	My interactions with my science teacher make me feel confident within science lessons	43	21	36	11	0	89	43	14	43	29	29	42	27	53	20	31	13	56	41	18	41	46	17	37	29	8	63
SQ1, 21R	Despite my best efforts, I am not happy with how my science teacher and I get along	64	14	22	44	12	44	36	43	21	43	50	7	33	20	47	6	38	56	46	27	27	33	50	17	25	37	38
SQ1, 22	When I am praised by my teacher, I feel embarrassed	7	65	29	33	22	45	14	64	22	21	43	36	20	60	20	25	56	19	32	36	32	17	46	37	8	67	25
SQ1, 24	I like to try my own way of doing things within science lessons	50	14	36	56	11	33	57	21	22	57	14	29	73	20	7	56	13	31	41	27	32	50	33	17	29	38	33

Qu. / No.	Statement in Questionnaire	10 yo to 11 yo n = 14, 9, 14									11 yo to 12 yo n = 14, 15, 16									12 yo to 13 yo n = 22, 24, 24								
	STATEMENT	M			J			S			M			J			S			M			J			S		
		A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
SQ1, 25	My science teacher is patient with me when I do not understand something	**64**	**21**	**15**	**22**	**33**	**45**	**29**	**35**	**36**	**43**	**50**	**7**	**13**	**47**	**40**	**44**	**37**	**19**	**59**	**27**	**14**	**63**	**17**	**20**	**46**	**8**	**46**
SQ1, 26R	I do not share any personal information about myself with my science teacher	**29**	**36**	**35**	**33**	**22**	**45**	**43**	**14**	**43**	**21**	**22**	**57**	**53**	**27**	**20**	**38**	**38**	**24**	**18**	**50**	**32**	**54**	**13**	**33**	**67**	**12**	**21**
SQ1, 27	I openly share my science-based experiences with my science teacher.	**43**	**21**	**36**	**33**	**11**	**56**	**43**	**21**	**36**	**14**	**64**	**22**	**40**	**33**	**27**	**38**	**25**	**37**	**41**	**18**	**41**	**29**	**21**	**50**	**46**	**33**	**21**
SQ1, 28	My science teacher remains patient with me within science lessons	**50**	**14**	**36**	**56**	**33**	**11**	**43**	**21**	**36**	**36**	**36**	**28**	**7**	**67**	**26**	**44**	**19**	**37**	**55**	**5**	**40**	**61**	**17**	**37**	**58**	**17**	**25**
SQ1, 29	I have a positive relationship with my science teacher outside science lessons	**36**	**21**	**43**	**44**	**11**	**45**	**21**	**36**	**43**	**21**	**43**	**36**	**7**	**47**	**46**	**56**	**6**	**38**	**50**	**23**	**27**	**46**	**29**	**25**	**25**	**21**	**54**
SQ2, 1	Overall my science teacher treats me fairly	**78**	**0**	**22**							**38**	**24**	**38**							**71**	**17**	**12**						
SQ2, 4	My science teacher will help me when I need help	**67**	**11**	**22**							**88**	**0**	**12**							**65**	**24**	**11**						
SQ2, 7	When I do well within my science lessons, it is because my science teacher has made my lessons interesting	**78**	**0**	**22**							**50**	**25**	**25**							**53**	**18**	**29**						
SQ2, 9	My science teacher listens to me	**78**	**11**	**11**							**38**	**38**	**24**							**59**	**12**	**29**						
SQ2, 12	My science teacher has been important for how well I understand science	**67**	**22**	**11**							**50**	**25**	**25**							**59**	**6**	**35**						
SQ2, 15	I enjoy talking to my science teacher	**44**	**33**	**23**							**50**	**38**	**12**							**47**	**35**	**18**						
SQ2, 17	When I have a difficulty within a science lesson, my science teacher is willing to help me	**56**	**11**	**33**							**38**	**12**	**50**							**71**	**17**	**12**						

Qu. / No.	Statement in Questionnaire	10 yo to 11 yo n = 14, 9, 14									11 yo to 12 yo n = 14, 15, 16									12 yo to 13 yo n = 22, 24, 24								
	STATEMENT	**M**			**J**			**S**			**M**			**J**			**S**			**M**			**J**			**S**		
		A	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**
SQ2, 19	My science teacher is important for how much self-confidence I have in my science work	**44**	**0**	**56**							**50**	**25**	**25**							**59**	**18**	**23**						
SQ2, 21	When something good happens within a science lesson, my science teacher wants to know about it	**78**	**11**	**11**							**38**	**24**	**38**							**53**	**23**	**24**						
SQ2, 25	My science teacher cares about me	**56**	**11**	**33**							**25**	**37**	**38**							**35**	**41**	**24**						
SQ2, 28	My science teacher is interested in me as a person, not just as a student	**44**	**12**	**44**							**50**	**25**	**25**							**18**	**47**	**35**						
SQ3, 1	My science teacher is confident and knowledgeable within science lessons	**71**	**0**	**29**							**29**	**21**	**50**							**65**	**8**	**27**						
SQ3, 7	My science teacher is a positive role model informing my enjoyment of science	**41**	**12**	**47**							**7**	**50**	**43**							**27**	**50**	**23**						
SQ3, 12	I work within science lessons in such ways that I please my science teacher	**35**	**0**	**65**							**50**	**7**	**43**							**46**	**8**	**46**						
SQ3, 16	My science teacher has a sense of humour within my science lessons	**59**	**17**	**24**							**50**	**7**	**43**							**58**	**34**	**8**						
SQ3, 20	My science teacher is patient with me within my science lessons	**53**	**35**	**12**							**7**	**72**	**21**							**27**	**27**	**46**						
SQ3, 21	My science teacher's sense of humour increases my enjoyment of science lessons	**53**	**23**	**24**							**29**	**57**	**14**							**46**	**31**	**23**						
SQ3, 6	My science teacher encourages me to contribute to	**53**	**6**	**41**							**29**	**35**	**36**							**42**	**23**	**35**						

Qu. / No.	Statement in Questionnaire	10 yo to 11 yo n = 14, 9, 14									11 yo to 12 yo n = 14, 15, 16									12 yo to 13 yo n = 22, 24, 24								
	STATEMENT	M			J			S			M			J			S			M			J			S		
		A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
	lessons and share my scientific ideas																											
SQ3, 10	My science teacher challenges me to work hard	65	6	29							57	22	21							58	11	31						
SQ3, 17	My science teacher allows me to explore my own ideas and make suggestions within discussions	35	36	29							36	28	36							50	38	12						
SQ6, 7	The teacher takes a personal interest in me.				13	25	62	23	38	39				13	60	27	36	28	36				29	36	35	11	36	53
SQ6, 8	The teacher makes a lot of effort to help me.				63	25	12	23	23	54				13	40	47	29	14	57				29	36	35	26	27	47
SQ6, 9	The teacher acts upon my feelings.				13	25	62	15	39	46				7	66	27	14	14	72				41	30	29	21	26	53
SQ6, 10	The teacher helps me when I have trouble with the work.				50	25	25	54	0	46				53	34	13	64	15	21				59	35	6	42	16	42
SQ6, 11	The teacher talks with me.				63	0	37	23	23	54				13	40	47	50	21	29				59	35	6	11	26	63
SQ6, 12	The teacher is interested in any difficulties I have within the lesson.				25	38	37	8	8	84				7	60	33	36	14	50				41	35	24	37	26	37
SQ6, 13	The teacher comes to my workspace to talk with me.				25	25	50	39	38	23				47	53	0	21	36	43				29	53	18	32	15	53
SQ6, 14	The teacher's questions help me to understand my science work.				25	12	63	39	8	53				13	40	47	36	28	36				47	29	24	63	14	26
SQ6, 15	I discuss ideas in class.				50	37	13	54	15	31				40	33	27	64	15	21				47	35	18	47	27	26
SQ6, 16	I give my opinions during class discussions.				13	0	87	46	0	54				40	27	33	71	8	21				59	17	24	32	21	47
SQ6, 17	The teacher asks me questions.				25	25	50	46	16	38				33	27	40	79	7	14				47	29	24	58	16	26

Qu. / No.	Statement in Questionnaire	10 yo to 11 yo n = 14, 9, 14									11 yo to 12 yo n = 14, 15, 16									12 yo to 13 yo n = 22, 24, 24								
	STATEMENT	**M**			**J**			**S**			**M**			**J**			**S**			**M**			**J**			**S**		
		A	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**	**A**	**D**	**N**
SQ6, 18	My ideas and suggestions are used during classroom discussions.				**13**	**25**	**62**	**15**	**39**	**46**				**13**	**54**	**33**	**36**	**7**	**57**				**24**	**35**	**41**	**5**	**37**	**58**
SQ6, 19	I ask the teacher questions.				**75**	**13**	**12**	**69**	**0**	**31**				**53**	**27**	**20**	**79**	**7**	**14**				**35**	**30**	**35**	**63**	**16**	**21**
SQ6, 20	I explain my ideas to other students.				**38**	**12**	**50**	**62**	**0**	**38**				**47**	**26**	**27**	**57**	**22**	**21**				**65**	**12**	**23**	**63**	**5**	**32**
SQ6, 21	Students discuss with me how to go about solving problems.				**25**	**25**	**50**	**46**	**16**	**38**				**53**	**20**	**27**	**43**	**28**	**29**				**59**	**17**	**24**	**74**	**0**	**26**
SQ6, 22	I am asked to explain how I solve problems.				**38**	**12**	**50**	**46**	**16**	**38**				**27**	**26**	**47**	**57**	**22**	**21**				**47**	**29**	**24**	**37**	**21**	**42**
SQ6, 46	The teacher gives as much attention to my questions as to other students' questions.				**25**	**0**	**75**	**31**	**23**	**46**				**40**	**40**	**20**	**64**	**7**	**29**				**53**	**35**	**12**	**37**	**16**	**47**
SQ6, 47	I get the same amount of help from the teacher as do other students.				**63**	**12**	**25**	**31**	**23**	**46**				**13**	**54**	**33**	**64**	**7**	**29**				**65**	**17**	**18**	**63**	**16**	**21**
SQ6, 48	I have the same amount of say in this class as other students.				**13**	**0**	**87**	**15**	**15**	**70**				**40**	**27**	**33**	**71**	**0**	**29**				**35**	**18**	**47**	**63**	**11**	**26**
SQ6, 49	I am treated the same as other students in this class.				**75**	**25**	**0**	**54**	**23**	**23**				**20**	**60**	**20**	**64**	**7**	**29**				**59**	**23**	**18**	**47**	**27**	**26**
SQ6, 50	I receive the same encouragement from the teacher as other students do.				**63**	**12**	**25**	**54**	**8**	**38**				**33**	**20**	**47**	**71**	**8**	**21**				**59**	**23**	**18**	**68**	**11**	**21**
SQ6, 51	I get the same opportunity to contribute to class discussions as other students.				**50**	**12**	**38**	**39**	**0**	**61**				**20**	**33**	**47**	**64**	**0**	**36**				**59**	**23**	**18**	**58**	**10**	**32**
SQ6, 52	My work receives as much praise as other students' work.				**50**	**0**	**50**	**23**	**31**	**46**				**27**	**40**	**33**	**57**	**7**	**36**				**47**	**24**	**29**	**74**	**10**	**16**
SQ6, 53	I get the same opportunity to answer questions as other students.				**50**	**12**	**38**	**46**	**0**	**54**				**27**	**26**	**47**	**64**	**7**	**29**				**59**	**17**	**24**	**58**	**16**	**26**

Qu. / No.	Statement in Questionnaire	MALE n = 45, 39, 36 M A	M D	M N	J A	J D	J N	S A	S D	S N	FEMALE n = 24, 16, 26 M A	M D	M N	J A	J D	J N	S A	S D	S N
	STATEMENT																		
SQ1, 1	I have a trusting, positive relationship with my science teacher	**31**	**27**	**42**	**41**	**38**	**21**	**39**	**22**	**39**	**50**	**21**	**29**	**44**	**18**	**38**	**31**	**4**	**65**
SQ1, 2R	My science teacher and I always seem to be struggling with each other.	**44**	**22**	**34**	**23**	**44**	**33**	**11**	**70**	**19**	**79**	**4**	**17**	**6**	**81**	**13**	**0**	**85**	**15**
SQ1, 3	My science teacher can tell how I am feeling during the lesson.	**20**	**33**	**47**	**18**	**46**	**36**	**22**	**34**	**44**	**29**	**33**	**38**	**25**	**44**	**31**	**23**	**23**	**54**
SQ1, 4	I feel more confident after I have been corrected by my science teacher	**58**	**27**	**15**	**31**	**33**	**36**	**36**	**33**	**31**	**46**	**25**	**29**	**56**	**38**	**6**	**58**	**15**	**27**
SQ1, 7	When I am praised by this teacher, I respond with pride.	**56**	**24**	**20**	**56**	**23**	**21**	**67**	**16**	**17**	**42**	**17**	**41**	**56**	**13**	**31**	**62**	**3**	**35**
SQ1, 8	I feel happy with my science teacher	**51**	**36**	**13**	**10**	**44**	**46**	**39**	**36**	**25**	**50**	**17**	**33**	**31**	**19**	**50**	**27**	**15**	**58**
SQ1, 9	I share information about myself with my science teacher	**16**	**47**	**37**	**23**	**56**	**21**	**22**	**47**	**31**	**8**	**46**	**46**	**13**	**50**	**37**	**19**	**62**	**19**
SQ1, 10	I often copy the science teacher’s way of doing things within science lessons	**42**	**29**	**29**	**41**	**41**	**18**	**33**	**25**	**42**	**58**	**17**	**25**	**50**	**12**	**38**	**62**	**7**	**31**
SQ1, 11R	My science teacher easily becomes angry with me.	**38**	**38**	**24**	**44**	**25**	**31**	**28**	**39**	**33**	**75**	**4**	**21**	**0**	**75**	**25**	**4**	**54**	**42**
SQ1, 12	I openly share my science-based ideas with my science teacher	**62**	**18**	**20**	**51**	**21**	**28**	**50**	**19**	**31**	**25**	**38**	**37**	**38**	**24**	**38**	**54**	**15**	**31**
SQ1, 13R	My science teacher seems to find it hard to determine how I am feeling.	**29**	**31**	**40**	**54**	**7**	**39**	**25**	**25**	**50**	**13**	**37**	**50**	**25**	**31**	**44**	**31**	**7**	**62**
SQ1, 14R	I feel angry after being corrected by my teacher.	**51**	**16**	**33**	**33**	**41**	**26**	**19**	**50**	**31**	**50**	**29**	**21**	**6**	**69**	**25**	**12**	**69**	**19**
SQ1, 15R	My science teacher displays signs of impatience with me when I do not understand something	**24**	**58**	**18**	**46**	**18**	**36**	**33**	**25**	**42**	**71**	**13**	**16**	**25**	**31**	**44**	**8**	**46**	**46**
SQ1, 16	I always try to please my science teacher	**73**	**11**	**16**	**62**	**17**	**21**	**72**	**8**	**20**	**63**	**4**	**33**	**81**	**6**	**13**	**89**	**0**	**11**
SQ1, 17	My science teacher’s reactions toward me can change suddenly.	**49**	**16**	**35**	**64**	**13**	**23**	**44**	**20**	**36**	**17**	**42**	**41**	**13**	**37**	**50**	**23**	**12**	**65**
SQ1, 19R	I do not easily share my ideas with my science teacher.	**49**	**27**	**24**	**31**	**36**	**33**	**19**	**48**	**33**	**25**	**38**	**37**	**31**	**44**	**25**	**39**	**34**	**27**

Qu. / No.	Statement in Questionnaire	MALE n = 45, 39, 36									FEMALE n = 24, 16, 26								
	STATEMENT	M			J			S			M			J			S		
		A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
SQ1, 20	My interactions with my science teacher make me feel confident within science lessons	**40**	**29**	**31**	**33**	**28**	**39**	**36**	**6**	**58**	**38**	**21**	**41**	**38**	**12**	**50**	**39**	**15**	**46**
SQ1, 21R	Despite my best efforts, I am not happy with how my science teacher and I get along	**36**	**44**	**20**	**39**	**25**	**36**	**28**	**33**	**39**	**58**	**21**	**21**	**25**	**56**	**19**	**15**	**50**	**35**
SQ1, 22	When I am praised by my teacher, I feel embarrassed	**24**	**51**	**25**	**23**	**44**	**33**	**14**	**64**	**22**	**21**	**46**	**33**	**13**	**56**	**31**	**12**	**65**	**23**
SQ1, 24	I like to try my own way of doing things within science lessons	**56**	**20**	**24**	**62**	**23**	**15**	**42**	**16**	**42**	**33**	**29**	**38**	**44**	**37**	**19**	**46**	**35**	**19**
SQ1, 25	My science teacher is patient with me when I do not understand something	**42**	**40**	**18**	**31**	**38**	**31**	**47**	**25**	**28**	**63**	**21**	**16**	**56**	**25**	**19**	**50**	**15**	**35**
SQ1, 26R	I do not share any personal information about myself with my science teacher	**24**	**40**	**36**	**56**	**21**	**23**	**36**	**31**	**33**	**21**	**46**	**33**	**38**	**18**	**44**	**62**	**15**	**23**
SQ1, 27	I openly share my science-based experiences with my science teacher.	**44**	**31**	**25**	**39**	**22**	**39**	**42**	**30**	**28**	**25**	**42**	**33**	**31**	**31**	**38**	**42**	**16**	**42**
SQ1, 28	My science teacher remains patient with me within science lessons	**33**	**29**	**38**	**26**	**48**	**26**	**39**	**19**	**42**	**63**	**17**	**20**	**50**	**6**	**44**	**62**	**7**	**31**
SQ1, 29	I have a positive relationship with my science teacher outside science lessons	**36**	**35**	**29**	**28**	**39**	**33**	**44**	**17**	**39**	**42**	**21**	**37**	**50**	**6**	**44**	**31**	**15**	**54**
SQ2, 1	Overall my science teacher treats me fairly	**67**	**11**	**22**							**85**	**0**	**15**						
SQ2, 4	My science teacher will help me when I need help	**71**	**16**	**13**							**75**	**15**	**10**						
SQ2, 7	When I do well within my science lessons, it is because my science teacher has made my lessons interesting	**59**	**21**	**20**							**50**	**20**	**30**						
SQ2, 9	My science teacher listens to me	**59**	**13**	**28**							**55**	**0**	**45**						
SQ2, 12	My science teacher has been important for how well I understand science	**51**	**12**	**37**							**50**	**10**	**40**						
SQ2, 15	I enjoy talking to my science teacher	**43**	**39**	**18**							**45**	**40**	**15**						

Qu. / No.	Statement in Questionnaire	MALE n = 45, 39, 36									FEMALE n = 24, 16, 26								
	STATEMENT	M			J			S			M			J			S		
		A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
SQ2, 17	When I have a difficulty within a science lesson, my science teacher is willing to help me	**59**	**17**	**24**							**60**	**15**	**25**						
SQ2, 19	My science teacher is important for how much self-confidence I have in my science work	**55**	**16**	**29**							**45**	**15**	**40**						
SQ2, 21	When something good happens within a science lesson, my science teacher wants to know about it	**51**	**23**	**26**							**40**	**20**	**40**						
SQ2, 25	My science teacher cares about me	**37**	**34**	**29**							**30**	**20**	**50**						
SQ2, 28	My science teacher is interested in me as a person, not just as a student	**35**	**34**	**31**							**20**	**30**	**50**						
SQ3, 1	My science teacher is confident and knowledgeable within science lessons	**53**	**14**	**33**							**67**	**0**	**33**						
SQ3, 7	My science teacher is a positive role model informing my enjoyment of science	**22**	**45**	**33**							**33**	**29**	**38**						
SQ3, 12	I work within science lessons in such ways that I please my science teacher	**44**	**9**	**47**							**43**	**0**	**57**						
SQ3, 16	My science teacher has a sense of humour within my science lessons	**53**	**25**	**22**							**62**	**19**	**19**						
SQ3, 20	My science teacher is patient with me within my science lessons	**31**	**50**	**19**							**29**	**23**	**48**						
SQ3, 21	My science teacher's sense of humour increases my enjoyment of science lessons	**42**	**47**	**11**							**48**	**14**	**38**						
SQ3, 6	My science teacher encourages me to contribute to lessons and share my scientific ideas	**44**	**27**	**33**							**38**	**19**	**43**						
SQ3, 10	My science teacher challenges me to work hard	**58**	**9**	**33**							**62**	**19**	**19**						
SQ3, 17	My science teacher allows me to explore my own ideas and make suggestions within discussions	**36**	**39**	**25**							**52**	**29**	**19**						

Qu. / No.	Statement in Questionnaire	MALE n = 45, 39, 36									FEMALE n = 24, 16, 26								
	STATEMENT	M			J			S			M			J			S		
		A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
SQ6, 7	The teacher takes a personal interest in me.				29	44	27	32	40	28				14	36	50	12	24	64
SQ6, 8	The teacher makes a lot of effort to help me.				29	39	32	24	28	48				36	21	43	32	16	52
SQ6, 9	The teacher acts upon my feelings.				21	52	27	20	32	48				29	14	57	16	20	64
SQ6, 10	The teacher helps me when I have trouble with the work.				56	29	15	44	20	36				79	21	0	60	0	40
SQ6, 11	The teacher talks with me.				47	32	21	28	28	44				50	7	43	28	16	56
SQ6, 12	The teacher is interested in any difficulties I have within the lesson.				12	53	35	40	20	40				57	22	21	16	12	72
SQ6, 13	The teacher comes to my workspace to talk with me.				27	52	21	36	24	40				43	43	14	24	28	48
SQ6, 14	The teacher's questions help me to understand my science work.				27	35	38	40	16	44				36	21	43	52	12	36
SQ6, 15	I discuss ideas in class.				50	32	18	56	24	20				43	43	14	52	20	28
SQ6, 16	I give my opinions during class discussions.				44	18	38	56	4	40				36	28	36	40	16	44
SQ6, 17	The teacher asks me questions.				44	21	35	64	12	24				36	35	29	64	12	24
SQ6, 18	My ideas and suggestions are used during classroom discussions.				24	35	41	32	24	44				14	50	36	12	28	60
SQ6, 19	I ask the teacher questions.				56	23	21	72	8	20				43	36	21	72	8	20
SQ6, 20	I explain my ideas to other students.				53	15	32	64	8	28				50	29	21	56	12	32
SQ6, 21	Students discuss with me how to go about solving problems.				50	26	24	48	20	32				64	7	29	64	4	32
SQ6, 22	I am asked to explain how I solve problems.				38	30	32	52	20	28				36	35	29	40	20	40
SQ6, 46	The teacher gives as much attention to my questions as to other students' questions.				38	33	29	44	20	36				57	22	21	44	12	44
SQ6, 47	I get the same amount of help from the teacher as do other students.				38	35	27	52	24	24				57	22	21	52	4	44

Qu. / No.	Statement in Questionnaire	MALE n = 45, 39, 36									FEMALE n = 24, 16, 26								
	STATEMENT	M			J			S			M			J			S		
		A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
SQ6, 48	I have the same amount of say in this class as other students.				**38**	**24**	**38**	**52**	**8**	**40**				**29**	**14**	**57**	**48**	**4**	**44**
SQ6, 49	I am treated the same as other students in this class.				**44**	**44**	**12**	**52**	**28**	**20**				**71**	**15**	**14**	**56**	**8**	**36**
SQ6, 50	I receive the same encouragement from the teacher as other students do.				**47**	**26**	**27**	**56**	**20**	**24**				**64**	**15**	**21**	**72**	**0**	**28**
SQ6, 51	I get the same opportunity to contribute to class discussions as other students.				**41**	**30**	**29**	**64**	**4**	**32**				**71**	**8**	**21**	**40**	**8**	**52**
SQ6, 52	My work receives as much praise as other students' work.				**35**	**33**	**32**	**48**	**20**	**32**				**50**	**0**	**50**	**60**	**8**	**32**
SQ6, 53	I get the same opportunity to answer questions as other students.				**47**	**21**	**32**	**52**	**16**	**32**				**57**	**14**	**29**	**60**	**0**	**40**

Key :

Qu. = Questionnaire (e.g. SQ1)

M = March; J = June; S = September

A = Agree (Strongly Agree, Agree); D = Disagree (Disagree, Strongly Disagree); N = Neutral

APPENDIX 3.11

Informed Consent Letter 6^{th} January 2013

SCHOOL OF EDUCATION
UNIVERSITY OF BIRMINGHAM

<u>RESEARCH PROJECT TITLE</u>

Children's Perceptions of an Engaging Science Education: Enhancing Students' Engagement with Science through Key Teacher Behaviours and Inquiry-Based Learning.

Doctoral Researcher: Mr. Roger Wood**,** B.Ed. (Hons.), F.R.S.A., F.L.S., C.Biol., F.S.B., F.Coll.T.

e-mail addresses: [redacted]
Research Supervisor: [redacted]

Dear Parents,

The science teachers and children of [NAME] School have been invited to take part in a research study which I shall be conducting as part of my role as a Doctoral Researcher within the School of Education at the University of Birmingham. Before you decide whether you would be happy for your child to take part, it is important for you to understand why the research is being conducted and what will be involved. Please take time to read the following information carefully and please do contact me if you wish to discuss any aspect of the research project in more detail.

Purpose of the Research

The main purpose of the research is to generate knowledge to illustrate how science teachers may use inquiry-based learning, through an action research approach which will inform their decision-making and problem-solving, as a means of helping their students to develop a more positive academic engagement with science.

The key outcome is to develop an increased understanding of the important teaching variables which both research evidence and the children's perceptions assert as being those that teachers may use to support and enhance the full range of students' engagement variables within science education between the ages of 8+ and 13+.

Research evidence has shown that teacher support through specific teacher and student behaviours can have a positive influence upon the development of student engagement within the classroom in general. Within science educational research, in particular, frequent assertions have been made that inquiry-based learning which leads to the enhancement of key teacher and student behaviours is one of the best means by which children may become engaged with science.

The involvement of children and science teachers of [NAME] **School**

I am carrying out a study to explore ways in which science teachers may enable and encourage their students to be and remain engaged with science, through targeting their motivation, interest and engagement using inquiry-based learning as a catalyst. This study involves testing the effects of changes within science lessons, and how science teachers develop the children's learning methods as well as adapting their own teaching methods and perceptions. All that would be involved on your child's part in addition to their usual science lessons is the completion of a number of questionnaires and possible involvement in group-based interviews during the 16 month research period.

My doctoral supervisors and I think that this work is important, and may help researchers and educators to increase children's engagement and interest levels in science.

In addition, we think this research will be of interest to those pupils who do take part. Across a wider field, the findings have potential interest for developing an understanding of the means by which teachers may engage their children with learning across the curricula subject range and within their schooling in general.

Procedure

This research has been approved by the University of Birmingham Ethics Committee. All responses will remain confidential and anonymous; we will not record your child's name on any questionnaire, and all data will be stored in locked cabinets or on password-protected computers.

There are three methods central to the data collection process:

1. Questionnaires
2. Interviews with selected children in small groups
3. Observation of selected children within their science lessons where the focus will be upon engagement behaviours

One of the objectives of the research is to ascertain if the influence of the key engaging teacher behaviours varies with the age and gender of the children under observation. Therefore, the three methods will be used across the four age groups from Form Two to Form Five. The research project period will be from February 2013 to June 2014, and the methods will be used on a number of occasions throughout the research period to determine the effects, if any, of the interventions upon the children's self-reported and on-task engagement levels.

Given that the current Form Six are a little more constrained with preparations for Common Entrance, including Scholarship examinations, their views will be collected by means of questionnaires and interviews only, between March and June 2013.

IMPORTANT – Participation and the right to withdraw

Your child's participation in this research is entirely optional, and your child's schooling will not be affected in any way if they, or you, choose not to take part. Your child will have the option to withdraw at any time, before or during the research, without needing to provide a reason. In order to ensure that informed consent and permission has been given for all children involved in the data collection process through the three outlined methods, I would be grateful if you would please complete and return the form attached. If you have any questions relating to any aspect of this research project, including the methods to be used for collecting data, please do not hesitate to contact me.

Yours sincerely,

Roger Wood

SCHOOL OF EDUCATION
UNIVERSITY OF BIRMINGHAM

University of Birmingham Research Project in collaboration with [NAME] School

Children's Perceptions of an Engaging Science Education: Enhancing Students' Engagement with Science through Key Teacher Behaviours and Inquiry-Based Learning.

I give my permission for my child to take part in the research project through the questionnaires, interviews and observations. I understand that I and / or my child may withdraw from this project at any time without having to give a reason. ☐

I would prefer my child not to take part in the above research project. I understand that although my child will not be participating, they will be within lessons where other children are being observed. ☐

Please tick the appropriate box above or delete the non-appropriate statement

NAME OF CHILD: FORM:

SIGNATURE OF PARENT / GUARDIAN:

DATE:

APPENDIX 4.12

Informed Consent Letter 20th May 2013 UPDATE

SCHOOL OF EDUCATION
UNIVERSITY OF BIRMINGHAM

<u>RESEARCH PROJECT TITLE</u>

Children's Perceptions of an Engaging Science Education: Enhancing Students' Engagement with Science through Key Teacher Behaviours and Inquiry-Based Learning.

Doctoral Researcher: Mr. Roger Wood**,** B.Ed. (Hons.), F.R.S.A., F.L.S., C.Biol., F.S.B., F.Coll.T.

e-mail addresses: [redacted]
Research Supervisor: [redacted]

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The key outcome is to develop an increased understanding of the important teaching variables which both research evidence and the children's perceptions assert as being those that teachers may use to support and enhance the full range of students' engagement variables within science education between the ages of 8+ and 13+.

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The involvement of children and science teachers of [NAME] **School**

I am carrying out a study to explore ways in which science teachers may enable and encourage their students to be and remain engaged with science, through targeting their motivation, interest and engagement using inquiry-based learning as a catalyst. This study involves testing the effects of changes within science lessons, and how science teachers develop the children's learning methods as well as adapting their own teaching methods and perceptions. All that would be involved on your child's part in addition to their usual science lessons is the completion of a number of questionnaires and possible involvement in group-based interviews during the 16 month research period.

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IMPORTANT – Participation and the right to withdraw

Your child's participation in this research is entirely optional, and your child's schooling will not be affected in any way if they, or you, choose not to take part. Your child will have the option to withdraw at any time, before or during the research, without needing to provide a reason. In order to ensure that informed consent and permission has been given for all children involved in the data collection process through the three outlined methods, I would be grateful if you would please complete and return the form attached. If you have any questions relating to any aspect of this research project, including the methods to be used for collecting data, please do not hesitate to contact me.

Yours sincerely,

Roger Wood

SCHOOL OF EDUCATION
UNIVERSITY OF BIRMINGHAM

University of Birmingham Research Project in collaboration with [NAME] School

Children's Perceptions of an Engaging Science Education: Enhancing Students' Engagement with Science through Key Teacher Behaviours and Inquiry-Based Learning.

I give my permission for my child to take part in the research project through the questionnaires, interviews and observations. I understand that I and / or my child may withdraw from this project at any time without having to give a reason. ☐

I would prefer my child not to take part in the above research project. I understand that although my child will not be participating, they will be within lessons where other children are being observed. ☐

Please tick the appropriate box above or delete the non-appropriate statement

NAME OF CHILD: FORM:

SIGNATURE OF PARENT / GUARDIAN:

DATE:

APPENDIX 3.13 15 questionnaires that have been used to measure self-determination on the basis of participants' responses

From the SDT website – first accessed on 10th November 2012 at http://www.selfdeterminationtheory.org/questionnaires

NAME OF QUESTIONNAIRE	MAIN CONSTRUCTS MEASURED	PURPOSE	AUDIENCE / PRIOR USES
General Causality Orientation Scale	Autonomy Support	To determine whether the respondent is more inclined towards intrinsic motivation, controlled motivation or impersonal motivation	Designed for use with individuals who are at least 17 years old
Perceived Autonomy Support: The Climate Questionnaires	Autonomy Support	Respondents' views as to whether a specific social context is autonomous or controlling	There are four Climate questionnaires, for specific use in health care, learning, work or sport
The Learning Climate Questionnaire	Autonomy Support	Respondents' views as to whether a specific social context is autonomous or controlling	The questionnaire only measures one of the three SDT constructs in isolation. Used in 3 out of the 4 published uses in medicine and surgery
Self-Regulation Questionnaires	Autonomous / self-regulation	Late elementary and middle school students' views re their school work and prosocial behaviour	Divided into seven sub-questionnaires, including learning, academic and prosocial.
Perceived Competence Scale	Competence	Four items within the questionnaire	Mainly used within medicine
Intrinsic Motivation Inventory		Multidimensional – responses within a laboratory experiment Measures participants' interest/enjoyment, perceived competence, effort, value/usefulness, anxiety, and perceived choice while performing a given activity. A seventh subscale has been added of relatedness, although the validity of this subscale has yet to be established. (Quote from website)	45 items; 7 subscales Related to a single activity and does not measure Intrinsic Motivation / SDT over a longitudinal timeframe
Health Care SDT Questionnaire	Self-regulation, Autonomy, Competence	Health care settings	Health care settings
Aspirations Index	Non-specific	Intrinsic and extrinsic life goals / aspirations Extent to which people value goal contexts	Use in mental health contexts and evaluation of risk behaviours

NAME OF QUESTIONNAIRE	MAIN CONSTRUCTS MEASURED	PURPOSE	AUDIENCE / PRIOR USES
Basic Psychological Needs Scale	All three SDT constructs	General and work versions have 21 items. The interpersonal scale has 9 items. An adaptation of the scale for assessing need satisfaction in physical education classes was created and used by Ntoumanis (2005). (Quote from website)	Basic Need Satisfaction in Work, Relationships and Life
Self-Determination Scale	Autonomy based upon self-awareness	The extent to which adults feel self-determined within their own lives. Two 5 item subscales.	Used with adults reflecting upon their own lives
Subjective Vitality Scale	Autonomy support related to the subjective feeling of vitality	Self-actualization and self-awareness	7 items and a shorter version of 4 items
Motivators' Orientation	Autonomy Support	Focus upon teachers' orientation towards controlling the behaviour of their students and supporting their autonomy. Designed to be completed by the teachers.	Problems in Schools Questionnaire – whether teachers were controlling or autonomy supportive of students
Perceptions of Parents Scales	Autonomy Support	Provision of an optimal parenting context through the lens of SDT. The scales are completed by children.	The scales were developed for children of up to early adolescence and later adolescence
Treatment Motivation Questionnaire	Autonomy Support	Use within alcohol treatment programmes	Self-regulation assessment within alcohol treatment programmes
Motives for Physical Activity Measure	Autonomy Support Competence	Assessment of the strength of five motives for participating in sports	
Mindful Attention Awareness Scale	Not specified	Used with adult, college student and medical patient population groups	15 items

APPENDIX 3.14 Nine SPSS datasheets for the interrogation of the questionnaire data

Nine SPSS datasheets were formulated that would enable interrogation of the harvested data at the Mean and Standard Deviation levels:

1. TSIRQ March / April 2013
2. TSIRQ June 2013
3. TSIRQ September 2013
4. AUTONOMY SUPPORT March 2013
5. AUTONOMY SUPPORT June 2013
6. AUTONOMY SUPPORT September 2013
7. COMPETENCE April 2013 SQ2 and SQ3 only
8. COMPETENCE June 2013
9. COMPETENCE September 2013

APPENDIX 3.15

The SQ1 Questionnaire

STUDENT-TEACHER RELATIONSHIP SCALE
STUDENT QUESTIONNAIRE 1 (SQ1)

Student ID:

Please reflect on the degree to which each of the following statements currently applies to your relationship with your science teacher. Using the scale below, circle the appropriate number for each item.

Strongly Agree 1	Agree 2	Neither agree nor disagree / Not sure 3	Disagree 4	Strongly disagree 5

1.	I have a trusting, positive relationship with my science teacher	1	2	3	4	5
2.	My science teacher and I always seem to be struggling with each other.	1	2	3	4	5
3.	My science teacher can tell how I am feeling during the lesson.	1	2	3	4	5
4.	I feel more confident after I have been corrected by my science teacher	1	2	3	4	5
7	When I am praised by this teacher, I respond with pride.	1	2	3	4	5
8	I feel happy with my science teacher	1	2	3	4	5
9.	I share information about myself with my science teacher	1	2	3	4	5
10	I often copy the science teacher's way of doing things within science lessons	1	2	3	4	5
11	My science teacher easily becomes angry with me.	1	2	3	4	5
12	I openly share my science-based ideas with my science teacher	1	2	3	4	5
13	My science teacher seems to find it hard to determine how I am feeling.	1	2	3	4	5
14	I feel angry after being corrected by my teacher.	1	2	3	4	5
15	My science teacher displays signs of impatience with me when I do not understand something	1	2	3	4	5
16	I always try to please my science teacher	1	2	3	4	5
17	My science teacher's reactions toward me can change suddenly.	1	2	3	4	5
19.	I do not easily share my ideas with my science teacher.	1	2	3	4	5
20.	My interactions with my science teacher make me feel confident within science lessons	1	2	3	4	5
21.	Despite my best efforts, I am not happy with how my science teacher and I get along	1	2	3	4	5

22.	When I am praised by my teacher, I feel embarrassed	1	2	3	4	5
24.	I like to try my own way of doing things within science lessons	1	2	3	4	5
25	My science teacher is patient with me when I do not understand something	1	2	3	4	5
26	I do not share any personal information about myself with my science teacher	1	2	3	4	5
27	I openly share my science-based experiences with my science teacher.	1	2	3	4	5
28	My science teacher remains patient with me within science lessons	1	2	3	4	5
29	I have a positive relationship with my science teacher outside science lessons	1	2	3	4	5

APPENDIX 3.16

The SQ2 Questionnaire

STUDENT ENGAGEMENT WITH SCIENCE
STUDENT QUESTIONNAIRE 2 (SQ2)

STUDENT ID:

Please reflect on the extent to which each of the following statements currently applies to your perceptions within Science lessons. Using the scale below, please circle the appropriate number for each item. **PLEASE REMEMBER – your responses are confidential to you and the researcher.**

Strongly Agree 1	Agree 2	Neutral / Not sure 3	Disagree 4	Strongly disagree 5

1	Overall my science teacher treats me fairly	1	2	3	4	5
2	The tests and assessments in science do a good job of measuring what I have learnt and am able to do	1	2	3	4	5
3	The science teacher makes my learning within science enjoyable	1	2	3	4	5
4	My science teacher will help me when I need help	1	2	3	4	5
6	When I do well within my science lessons, it is because I work hard	1	2	3	4	5
7	When I do well within my science lessons, it is because my science teacher has made my lessons interesting	1	2	3	4	5
8	What I learn in science is important to me	1	2	3	4	5
9	My science teacher listens to me	1	2	3	4	5
10	School science lessons are important for ensuring that I achieve my future science-based goals	1	2	3	4	5
11	I enjoy talking to the other students within my science group	1	2	3	4	5
12	My science teacher has been important for how well I understand science	1	2	3	4	5
13	I plan to continue my science studies when I do my A Levels	1	2	3	4	5
14	My science teacher has been important for how much I enjoy doing science	1	2	3	4	5
15	I enjoy talking to my science teacher	1	2	3	4	5
16	When I am involved in science work, I check to see whether I understand what I am doing	1	2	3	4	5
17	When I have a difficulty within a science lesson, my science teacher is willing to help me	1	2	3	4	5
18	Students within my science group respect what I have to say	1	2	3	4	5
19	My science teacher is important for how much self-confidence I have in my science work	1	2	3	4	5
20	What I am learning in my science lessons will be important to me in my future	1	2	3	4	5
21	When something good happens within a science lesson, my science teacher wants to know about it	1	2	3	4	5
22	Other students at school care about me	1	2	3	4	5
23	We do a lot of investigations in science	1	2	3	4	5
24	Learning is fun in science because I am improving my understanding of science	1	2	3	4	5
25	My science teacher cares about me	1	2	3	4	5
26	I feel that I am able to make contributions to my own learning within my science lessons	1	2	3	4	5
27	My learning within science lessons will create many future opportunities for me	1	2	3	4	5
28	My science teacher is interested in me as a person, not just as a student	1	2	3	4	5

APPENDIX 3.17

The SQ3 Questionnaire

KEY TEACHER BEHAVIOURS and METHODS IN SCIENCE
STUDENT QUESTIONNAIRE 3 (SQ3)

STUDENT ID:

Please reflect on the degree to which each of the following statements currently applies to your perceptions of your science teacher's behaviour within Science lessons. Using the scale below, please circle the appropriate number for each item. **PLEASE REMEMBER – your responses are confidential to you and the researcher.**

Strongly Agree 1	Agree 2	Neutral / Not sure 3	Disagree 4	Strongly disagree 5

1	My science teacher is confident and knowledgeable within science lessons	1	2	3	4	5
2	We undertake science investigations that have been planned entirely by the science teacher	1	2	3	4	5
3	My science teacher speaks clearly and presents ideas in a way that I can understand	1	2	3	4	5
4	My science teacher's behaviour helps me to feel confident in my own ability within science lessons	1	2	3	4	5
5	My science teacher presents science lessons in an exciting and inspirational way	1	2	3	4	5
6	My science teacher encourages me to contribute to lessons and share my scientific ideas	1	2	3	4	5
7	My science teacher is a positive role model informing my enjoyment of science	1	2	3	4	5
8	My science teacher encourages me to plan and carry out my own investigations	1	2	3	4	5
9	My science teacher's behaviour reveals their belief that I am competent in the planning and carrying out of investigations	1	2	3	4	5
10	My science teacher challenges me to work hard	1	2	3	4	5
11	We undertake science investigations that have been planned entirely by students	1	2	3	4	5
12	I work within science lessons in such ways that I please my science teacher	1	2	3	4	5
13	My science teacher politely encourages me to discuss and develop my ideas	1	2	3	4	5
14	We undertake science investigations that have been planned jointly by the science teacher and students	1	2	3	4	5
15	My science teacher is vital to my desire to do well within science lessons	1	2	3	4	5
16	My science teacher has a sense of humour within my science lessons	1	2	3	4	5
17	My science teacher allows me to explore my own ideas and make suggestions within discussions	1	2	3	4	5
18	My science teacher's behaviour encourages my enjoyment of science	1	2	3	4	5
19	Science lessons are organized so that we are able to investigate our own science questions	1	2	3	4	5
20	My science teacher is patient with me within my science lessons	1	2	3	4	5

APPENDIX 3.18

The SQ6 Questionnaire

WHAT IS HAPPENING WITHIN SCIENCE LESSONS?
STUDENT QUESTIONNAIRE 6 (SQ6)

STUDENT ID: **Date:**

Please reflect on the degree to which each of the following statements currently applies to your perceptions of your Science lessons. Using the scale below, please circle the appropriate number for each item. **PLEASE REMEMBER – your responses are confidential to you and the researcher.**

Strongly Agree 1	Agree 2	Neutral / Not sure 3	Disagree 4	Strongly disagree 5

1	I am friendly with members of this Form.	1	2	3	4	5
2	Members of the Form are my friends.	1	2	3	4	5
3	I work well with other Form members.	1	2	3	4	5
4	I help other class members who are having trouble with their work.	1	2	3	4	5
5	Students in this Form like me.	1	2	3	4	5
6	In this class, I get help from other students.	1	2	3	4	5
7	The teacher takes a personal interest in me.	1	2	3	4	5
8	The teacher makes a lot of effort to help me.	1	2	3	4	5
9	The teacher acts upon my feelings.	1	2	3	4	5
10	The teacher helps me when I have trouble with the work.	1	2	3	4	5
11	The teacher talks with me.	1	2	3	4	5
12	The teacher is interested in any difficulties I have within the lesson.	1	2	3	4	5
13	The teacher comes to my workspace to talk with me.	1	2	3	4	5
14	The teacher's questions help me to understand my science work.	1	2	3	4	5
15	I discuss ideas in class.	1	2	3	4	5
16	I give my opinions during class discussions.	1	2	3	4	5
17	The teacher asks me questions.	1	2	3	4	5
18	My ideas and suggestions are used during classroom discussions.	1	2	3	4	5
19	I ask the teacher questions.	1	2	3	4	5
20	I explain my ideas to other students.	1	2	3	4	5
21	Students discuss with me how to go about solving problems.	1	2	3	4	5
22	I am asked to explain how I solve problems.	1	2	3	4	5
23	I carry out investigations to test my scientific ideas.	1	2	3	4	5
24	I am asked to think about the evidence for statements.	1	2	3	4	5
25	I carry out investigations to answer questions coming from discussions.	1	2	3	4	5
26	I get the opportunity to explain the meaning of statements, diagrams and graphs.	1	2	3	4	5
27	I carry out investigations to answer questions which puzzle me.	1	2	3	4	5
28	I carry out investigations to answer the teacher's questions.	1	2	3	4	5
29	I find out answers to questions by doing investigations.	1	2	3	4	5
30	I solve problems by using information obtained from my own investigations.	1	2	3	4	5
31.	Getting a certain amount of work done within science lessons is important to me.	1	2	3	4	5

32.	I know the goals for my science lessons.	1	2	3	4	5
33.	I am punctual and ready to start my science lessons on time.	1	2	3	4	5
34.	I know what I am trying to accomplish within my science lessons.	1	2	3	4	5
35.	I pay attention during science lessons.	1	2	3	4	5
36.	I try to understand the work within my science lessons.	1	2	3	4	5
37.	I know how much work I have to do.	1	2	3	4	5
38.	I cooperate with other students when doing assignment work.	1	2	3	4	5
39.	I share my books and resources with other students when doing assignments.	1	2	3	4	5
40.	When I work in groups in this class, there is teamwork.	1	2	3	4	5
41.	I work with other students on projects in this class.	1	2	3	4	5
42.	I learn from other students in this class.	1	2	3	4	5
43.	I work with other students in this class.	1	2	3	4	5
44.	I cooperate with other students on class activities.	1	2	3	4	5
45.	Students work with me to achieve class goals.	1	2	3	4	5
46.	The teacher gives as much attention to my questions as to other students' questions.	1	2	3	4	5
47.	I get the same amount of help from the teacher as do other students.	1	2	3	4	5
48.	I have the same amount of say in this class as other students.	1	2	3	4	5
49.	I am treated the same as other students in this class.	1	2	3	4	5
50.	I receive the same encouragement from the teacher as other students do.	1	2	3	4	5
51.	I get the same opportunity to contribute to class discussions as other students.	1	2	3	4	5
52.	My work receives as much praise as other students' work.	1	2	3	4	5
53.	I get the same opportunity to answer questions as other students.	1	2	3	4	5

APPENDIX 3.19

The SQ7 Questionnaire

STUDENTS' ACTIVE ENGAGEMENT IN SCIENCE
STUDENT QUESTIONNAIRE 7 (SQ7)

STUDENT ID: **Date:**

Please reflect on the degree to which each of the following statements currently applies to your perceptions of your Science lessons. Using the scale below, please circle the appropriate number for each item. **PLEASE REMEMBER – your responses are confidential to you and the researcher.**

Strongly Agree 1	Agree 2	Neutral / Not sure 3	Disagree 4	Strongly disagree 5

1	One of my goals is to learn as much as I can within Science lessons.	1	2	3	4	5
2	One of my goals is to learn new scientific content.	1	2	3	4	5
3	One of my goals is to master new scientific skills.	1	2	3	4	5
4	It is important that I understand my work within Science.	1	2	3	4	5
5	It is important for me to learn the scientific content that is taught.	1	2	3	4	5
6	It is important to me that I improve my science skills.	1	2	3	4	5
7	It is important that I understand what is being taught to me within Science lessons.	1	2	3	4	5
8	Understanding scientific ideas is important to me.	1	2	3	4	5
9	What I learn within Science lessons can be used in my daily life.	1	2	3	4	5
10	What I learn within Science lessons is interesting.	1	2	3	4	5
11	What I learn within Science lessons is useful for me to know.	1	2	3	4	5
12	What I learn within Science lessons is helpful to me.	1	2	3	4	5
13	What I learn within Science lessons is relevant to me.	1	2	3	4	5
14	What I learn within Science lessons is of practical value.	1	2	3	4	5
15	What I learn within Science lessons satisfies my curiosity.	1	2	3	4	5
16	What I learn within Science lessons encourages me to think.	1	2	3	4	5
17	I can master the scientific skills that are taught.	1	2	3	4	5
18	I can figure out how to do difficult work within Science lessons.	1	2	3	4	5
19	Even if the science work is hard, I can learn it.	1	2	3	4	5
20	I can complete difficult work within Science lessons if I try.	1	2	3	4	5
21	I will receive good grades within Science.	1	2	3	4	5
22	I can learn the work we do within Science lessons.	1	2	3	4	5
23	I can understand the content taught within Science lessons.	1	2	3	4	5
24	I am good at science.	1	2	3	4	5
25	Even when tasks are uninteresting within Science lessons, I keep working.	1	2	3	4	5
26	I work hard within Science lessons even if I do not like what I am doing.	1	2	3	4	5
27	I continue working even if there are better things to do.	1	2	3	4	5
28	I concentrate within Science lessons so that I won't miss important points.	1	2	3	4	5
29	I finish my work and assignments on time.	1	2	3	4	5
30	I don't give up even when the work within Science lessons is difficult.	1	2	3	4	5
31.	I concentrate within Science lessons.	1	2	3	4	5
32.	I keep working until I finish what I am supposed to do.	1	2	3	4	5

APPENDIX 4.1

Summary of the themes discussed by students during the Focus Group Interviews: perceptions of SDT-related phenomena.

AGE GROUP	RELATEDNESS									AUTONOMY SUPPORT	COMPETENCE				ENGAGEMENT		
	TSIPRQ within lesson	R(TC)	PosTreat	NegTreat	SLikeT	SDislikeT	R(TS)	TExp	TSRExt	PAS	PCom	SelfEff	SelfConf	ComStrat	PosAffec NegAffec	CogEng CogDiseng	AcaEng AcaDiseng
Group 1 **10 – 11**	N (1)			•		•		N - TNRC	N	N – I, L N – Tcont PCI		P		N - I	N	N	N
Group 2	P				•		P		P	P - I	P	P	P	P - L	P	P	P
Group 3 **11 – 12**	V				V	V			V	V – I	N	P	P	P	V	V	V
Group 4	V / Imp				P / Imp		P /Imp		P/ Imp	P / V	P/ Imp	P/ Imp	P	P/ Imp	P/ Imp	P/ Imp	P/ Imp
Group 5 **12 – 13**	N	N		•		•	N	N (A)	N	N – I	N		N	N	N	N	N
Group 6	V		•		V	V	V		V	N – I	P		P	P	V	V	V
Group 7	P								P	A / Imp	P / Imp		P/ Imp	P/ Imp	P	P	P

Key: P = Positive responses / self-reported perceptions (mainly); N = Negative responses / self-reported perceptions (mainly); V = varied responses / self-reported perceptions: a mixture of positive and negative responses: I = Investigations; L = Lessons; TCont = Teacher Controlling; PCI = Preferred Choice within Investigations; NI = Not interesting; TNRC = Teacher Not Recognise / Acknowledge Student Competence; A = Ambiguity / Ambiguous; Imp = Improvement since last year.

Notes; Where a blank space has been left, the theme was either not discussed or insufficient information was available to form a perception as to whether the response was, on the whole, positive, negative or varied.

ABBREVIATIONS: TSIPRQ – Teacher-Student Interpersonal Relationship Quality; R(TC) = Relatedness (Teacher Care); PosTreat (Positive Treatment); NegTreat (Negative Treatment); SLikeT = Students Like Teacher; SDislikeT (Student Dislikes Teacher); R(TS) = Relatedness (Teacher Support); TExp = Teacher Expectations; TSRExt = Teacher-Student Relationship external to science lessons; PAS = Perceived Autonomy Support; PCom = Perceived Competence; SelfEff = Self Efficacy; SelfConf = Self Confidence; ComStrat = Strategies that have helped the students achieve success; PosAffec = Positive Affect; NegAffec = Negative Affect; CogEng = Cognitive Engagement; CogDiseng = Cognitive Disengagement; AcaEng = Academic Engagement; AcaDiseng = Academic Disengagement.

APPENDIX 4.2. Examples of questions asked and areas explored during the Focus Group Interviews

Describe how well you get on with your current Science teacher, outside the Science lesson.

Do you have much contact with him outside of your Science lessons? Do you see him for other lessons, or for other activities?

Do you think that liking your Science teacher outside of the Science lesson makes a difference to how you feel about Science lessons at all?

Do you prefer him when he is being the Science teacher, or when he is being the [Housemaster / Games Teacher / English Teacher]?

Would you say that your perceptions of your teacher affect how you enjoy Science?

Do you look forward to Science lessons?

Is that different from last year, or is it the same as with your previous Science teacher? Which did you prefer, and why?

If you had that choice, would you have your previous Science teacher back, or would you stick with the one you've got now?

Did your perceptions change over time? If they did, what might have caused those changes in your perceptions?

If you're not feeling happy within Science lessons, what have your science teachers done to help?

What would your ideal Science teacher be? What would you want from your ideal Science teacher?

Does your Science teacher listen to you? Do they use your ideas, and do you feel that your Science teacher is listening to you?

Do you feel able to say to your current Science teacher, "Can we have a lesson where we can show you that we have actually learned this?" Would you be able to do that?

Are you given lots of opportunities to discuss your ideas and thinking, or are you expected to have the right answer?

What do you like most about your Science lessons?

Do you get quite a lot of an opportunity to design, and do your own investigations? Does that make a difference to your enjoyment of Science lessons?

What would be your ideal Science lesson?

Is the teacher the most important factor in your enjoyment of Science?

How does your Science teacher help you to feel more confident within Science?

How does your current Science teacher use feedback in terms of how well you're doing?

Does this help you to feel more competent, and that you are doing well within your Science?

Do you get a lot of praise from your Science teacher?

In what ways has your Science teacher helped you to understand what you're learning? How do they help you as individuals?

What could your teacher do to make the relationship between you and him stronger within the Science lessons?

Is it important to like your Science teacher, and your Science teacher to like you, to make a difference to your enjoyment and your progress within the lessons?

Is there anything else that you want to say about your enjoyment or improvement of Science, anything like that, that I haven't asked you about, or that you haven't had the opportunity to discuss?

In what ways may / does your Science teacher feel less confident during Science lessons?

Why don't you get a lot of praise from your Science teacher?

Does your current Science teacher's feedback help you to feel more competent during science lessons?

APPENDIX 4.3 FGI TCA KEY THEMES DISCUSSED

GROUP 1

10-11 years old – change of science teacher in September

RELATEDNESS

1. Good relationship because of response to teacher's controlling behaviour – "I am always doing what he says …."
2. Negative affect towards relationship with science teacher
3. Teacher Behaviour towards student interpreted as negative and annoying – "I wish that he was more enthusiastic, like he was more into stuff, like what we said, and he had a happy tone, and he was interested in it."
4. Consistency of teacher behaviour has been observed within other lessons
5. All respondents stated that they do not look forward to science lessons
6. Dependent upon content of the lessons. Fun as opposed to writing.
7. Lack of insight by teacher as to what students find enjoyable and interesting
8. Gets really annoyed and shouts at the students
9. QUESTION – the role of the teacher as the most important factor influencing and informing the students' enjoyment of science; Student confirms this
10. Previous science teacher has a way of making even the most uninteresting of areas covered within science. Again, active learning is involved where students recount that they are able to do things within the lesson.
11. Prior science teacher is not regarded as ideal either
12. The interviewees suggest that their previous science teacher enjoyed working with them and looked forward to seeing them for the next lesson. Conversely, they felt that their current science teacher was only focused upon the current lesson.

AUTONOMY / AUTONOMY SUPPORT

1. No element of choice or opportunity to state how they would like to approach the subject matter
2. No level of autonomy within investigations that the group have done
3. Teacher's controlling behaviour and direction that activities should take
4. Previous year, had undertaken investigations that the teacher had designed but were also able to perform their own investigations – "He'd never used it before, but because he…, he was curious that it looked good, he wanted to, and we were too, and he said, "Well, let's try this"
5. Preferred having the choice of whether to undertake their own take on an investigation or to be directed by the teacher
6. Teacher does not approach the presentation of lessons in way that a student would wish to or does approach activities. A singular approach based upon adult cognition.
7. No effort to make learning enjoyable (fun)
8. Teacher ignores the responses of students when they articulate that they are already able to do something that teacher is presenting within the lesson.
9. Ignores the students' views and presents lessons in his own way
10. Teacher's controlling behaviour preventing any perceived sense of autonomy by the students
11. Teacher's continuation of controlling behaviour within children's exploration of their own learning – 4 examples given: how tasks should be approached and completed; teacher directs how activities should be undertaken; makes changes without discussion with students; questioning but does not always respond to answers given.

12. Alters what the students have said so that it fits with the teacher's planning and / or own ideas of how things should be approached within the lessons
13. Disengagement / Amotivation to participate as their verbal contributions and ideas are not utilised
14. Insufficient time to investigate scientific concepts and ideas before having to move on to the writing stage of a lesson. The content of the prior lesson is repeated within the next lesson, rather than having the opportunity to explore learning through, for example, a game about / using circuits

COMPETENCE

1. Lack of interest as continuing to repeat the same topic within lessons
2. All of the respondents felt that they were in a position to move on in their learning
3. Preference to be taught by the teacher that they were with during the last academic year
4. Enjoyment through practical activities
5. Previous science teacher could perceive when the children were confident and competent within the scientific areas they were studying, and then move them on to the next stage of their learning – "when he gives us an activity, [name of teacher] and then he says like, "You can do it" but he always puts us in partners, and it really helps me, anyway, to be in partners.", "because one partner…, your other partner might know something that you don't know, and they help you, and also, he will let us like chat amongst ourselves if we are quiet in our activities together." and "because we can like chat, and people can have a little fun time by inventing our own ways, instead of what we're doing, because we know what he wants us to do already,"
6. Interviewees perceive that the teacher does not recognise their competence / achievement levels, even though the students feel that they have already achieved something
7. Response to students' suggestions and ideas, such as through the incorporation of these into lessons and investigations – referred to as 'ideas and inventions'
8. Refers to the science teacher who listens to and incorporates the students' ideas within activities and lessons as 'active'.
9. However, the teacher who listens to the students but does not incorporate their ideas into the lesson as 'lazy'
10. Perception of the importance of the influence of fun upon how the student learns – "we were doing our circuit, and…, and we started talking, he would tell us all to be quiet, and we would all have to be quiet for the whole thing, whilst putting on a plug."
11. Opportunities for students to demonstrate that they have learnt something
12. Students did not feel able to say or do this as they predicted that the response of their teacher would be one of annoyance

ENGAGEMENT

1. Frustration - ? Amotivation / disengagement?
2. Engagement through enjoyment' something that is fun but not silly fun'
3. Student's suggestion as to what may be done within a lesson on circuits to make it more enjoyable
4. A desire to remain active and fully involved in an activity rather than having to wait and take turns – expressed twice
5. Active in terms of the integration of active learning and movement onto different concepts each week
6. Motivating and enjoyable factors at the end of the lesson
7. Changes in tempo and activity content of the lesson
8. All lessons are conducted in the science room; the interviewees have not used ICT / the Internet to acquire knowledge independently, to investigate concepts or to present their ideas

MISCELLANEOUS

1. Discussion of age of the teacher as a factor – the link with the number of years that someone has been teaching and their inference that this means that the teacher will be more strict with their students

GROUP 2

10 - 11 years old – no change of science teacher in September

RELATEDNESS

1. Teacher sometimes humorous – tells jokes
2. Teacher able to determine how the students are feeling in terms of their emotions
3. Teacher support – "He'll find someone that could help you, so that…, he might not help with the problem, but he can easily find someone that could."
4. Perceived that a good relationship with teacher outside science could influence relationship within lesson – "it does, because it's like if you…, if you have a good relationship with him outside of the classroom, then you will probably get along better with him inside the classroom."
5. The relationship with the teacher can have a positive influence upon students' confidence levels within science lessons
6. Teacher treats all students equally; no signs of favouritism – "He likes us all equally as much as everyone else, he doesn't favour anyone in the class."

AUTONOMY SUPPORT

1. All students agreed that they get the chance to design own investigations
   "We get like involved and active."
2. Autonomy – teacher promotes autonomy support through freedom within design of investigations – "The good thing about our [science teacher] is…, we, when we are in an experiment, he says "Get your bits, and see what you can find out" and we can just go…, we can be free with these circuits and find out more about the circuits."
   "He will like let us go and find out for ourselves."

COMPETENCE

1. SelfCom – how teacher helps students' feelings of competence related to understanding content – "He explains it in really good detail, and so, if you don't get something the first time, he will try and explain it better the second time, or he will come over there and help."
2. Plenty of opportunities to build upon prior learning from previous academic years whilst gaining new knowledge – "we have always done circuits, but he'll make sure that we learn more each year, for example, this year, we learned about circuits, but that's the same with all of the subjects, with the body, who makes sure that we learn a lot more than we did [last year], about the body, and with force, which we will do a lot more about force than we did [last year], and we learned completely new stuff, and he will do it in a new style and new ways."
3. Increasing competence / understanding through practical investigation – "And so we do the talking, and then we will get to try out some of those things, and learn…, learn by doing them, the investigation, how..."
4. Correction of mistakes; teacher would approach the student and help them to correct the mistakes that had been made. This would either happen during the lesson or towards the end of the lesson.

5. Students also had opportunities to let the teacher know if they were finding concepts hard to understand or they needed help from the teacher to increase their understand – "…you can just explain to him what you feel you don't understand."

   "I would kind of stick my hand up slightly, he would uhhhm, come over to me, once everyone is settled in with their work, and then he would come and help me, just in case you didn't want to do it in front of the class."

<u>ENGAGEMENT / Positive Affective and Cognitive Engagement</u>

1. All of the students looked forward to their Science lessons
2. Use of videos / audio-visual aids – "like I like watching his videos, that's his Science videos that he shows us, and he's fun, how he just draws all of the pictures, and helps us."

   "I like how like we can…, if he says, "How would you…, how would you make an experiment? Let's do an experiment" You can actually like do an experiment yourself"

   "and then say "Right, let's see if you can find out what this problem would be" and he will turn…, he will turn the lesson into a lot of fun."

3. Lessons located in venues in addition to the Science room / room used for Science lessons
4. The students stated that their lessons could be improved even more by having an increased amount of time to undertake investigations / experiments – "So that we can like have more time in a lesson, so we can like do more of that fun stuff, and like have quite a bit of time of doing them, all the working and writing out, and having some time with the finding out, trying it out for yourself."

   "We always get to interact with items, or we like we get to make stuff, and do more experiments."

<u>MISCELLANEOUS</u>

1. Science Fair – "I would kind of like to do it again, uhhhm, because the thing is that we only get to do it once, at school, in [name of] Form, and we have done it, and I find it quite exciting when we are doing it, but I find…, feel that I really want to do it again, because we don't have a chance."
2. Investigation of other students' Science Fair projects – finding out more about the areas that had interested others – "it would be nice to like kind of look into some more interesting projects further, with you know…, and find out, sort of like a project that we have never heard of before."

GROUP 3

11 - 12 years old – change of science teacher in September

<u>RELATEDNESS</u>

1. A number of the students felt that they had a better relationship with their science teacher outside of science lessons; that is, within other areas of School life – "….a lot better with my Science teacher, than I think I do inside the lessons. I think mainly because he is my [title], and I…, I can talk to him about things outside, as well, like if…, if I had a problem with something, I could say something to him if I wanted to .."

2. Perception that the science teacher behaves differently within the Science lesson than he does elsewhere in the school – “he…, he can be a lot…, a bit more impatient, and…, yeah, he can get a bit sharp if we don’t…” and “He’s not as nice…, nice, and as…, he is quite…, as [name] said, he is very impatient, and he doesn’t like sort of things that you don’t…, you sort of don’t know what you’re supposed to be doing, and he gets really angry at that, even though it’s not… not too bad.”

3. Sudden changes in the teacher’s reactions to students as reported as individual students within the FGI – “I don’t really know, because I know he doesn’t get along with my brother, but he…, he’s sometimes really nice to me, but then he sometimes gets really angry at me, for not much at all, so, …..I’m a bit confused really, and so I don’t really know.”

   “I find he is better outside the Science Lab, because he is…, he is a bit more of a joke, he’s always having a laugh, but he will take it seriously sometimes inside the Science Lab, as everyone has said, he’s really impatient, and so you have to go really fast, and you can’t go at your own speed.”

4. Relationship with previous science teacher – “last year, he could sometimes be very, very nice to me, and he could sometimes be very very… I really really hated him, and it was like so hard to tell if he liked me or not, sometimes I thought that he didn’t really like me that much at all, and sometimes I thought that he sort of liked me.”

5. Ambiguity as to whether the students’ perceptions of the quality of their relationship with their science teacher influenced their enjoyment of science

   “he is very sort of…, if when we’re not enjoying it, he’ll sort of like…, he’ll pick it up, and he’ll just make us work like…”, “Even harder”, “Make us work even harder, but work…, I…, I’m happy that if I learn something, but I’m not happy to the point that I’m being…, it has to be a balance between work and play, and sometimes he will set us too much, that it’s all work, and sometimes he won’t set us enough, and so it’s all play, I…, I think that we need to find a balance.”

6. Students’ suggestions for making the Teacher-Student Relationship stronger – “I think, be a lot more positive and encourage us, because sometimes if…, if I think, “Yes, I did a really good piece of work there” I think that he would be happy that I did some really good answers, and he…, well, I’ll just get a feedback, “Good work [name of student], quite scruffy” or, it wouldn’t be very well.., “[name of student], can you please work on your presentation? though it was really good work” it…, it’s more…” followed by “Slightly more negative.”

7. Need for more focused feedback upon the work that has been undertaken rather than a singular focus upon the quality of the presentation of the work – “I don’t think he gives out enough feedback on what we’ve done” and “I know that he marked my work wrong, but he didn’t explain it why, so, I didn’t really know what to do.”

   “He needs to give us more feedback, as everyone else has said, because he only gives you a little…, a little, 3 words uhhhm, if we’ve done…, and then if you’ve got it wrong, you don’t know what you’ve done.”

   “Mr [name] would explain it out for us, and he goes, “Has everybody got that?” and then everybody would go, “Yes Sir, we have got it, thank you Sir” or, “Sorry Sir, we didn’t understand that” Mr [name] would go, “OK, you know what you have to do…”

8. Perception as to whether the students feel that liking their Science teacher makes a difference to their enjoyment and progress within science –

“if he doesn’t like you, when he…, he won’t particularly ask you that many questions, he will think, “Oh, you won’t know it, because you’re not that good” so, he will go and ask someone who will know, so they will get the right answer.”

“I had my hand up first, and he asked like seven people before me, and then he eventually got to me, and it was like “Oh [*Sighs*], what is it now [name]?” and I sort of answered the question, and it was like, “Mmm” and I wasn’t…, I wasn’t that encouraged about it.”

“Yeah, that’s like when it happens to me sometimes, I put my hand up knowing the answer, and then he asks other people, but then they say the answer, and then he comes to me, and I will say, “Oh, I’ve forgotten it” and he’s just like, “Well, that’s just tough”

“I’ll go, “It’s this Sir” he then…, he’ll then tell me off for shouting out, because he would go around the class, and I would be further…, further away, and he would pick everybody else, and then…, and then he will look down to…, he’d look around, and I would say…, I have still got my hand up, and then I will say the answer, and then he will tell me off for shouting out.”

9. Further perceptions re the teacher’s liking of a student having an influence upon whether they teacher selects the student to answer the question and / or how they react to them –

“If he doesn’t like you, he won’t ask you questions, and say, if you wanted to go with someone, say I would want to go with [names of two students], uhhhm, he…, he would know that, and he would say “No, I want you to go with these other people” and he gives you a hard time about it, and you don’t learn as much.”

“….it sort of helps to have a good relationship, so then you learn more, uhhhm, you can just have a better time at school in general.”

“…, if you don’t have a great relationship with him, before anything else, it will make your life quite a lot tougher, and if I was trying to do something, or somebody else, I ask a question, like, “Can I do this?” he would go, “I have told you before, it’s like this, no more questions, no more this” and he will just make like a… Even though I don’t think that he is doing it on purpose, but it makes it feel like he is being sort of specifically hard on you….”

““Get on with it” instead of saying “No, that’s not right, because…” he just goes…, like tells you off for it, and like [in another named part of the School] he will give you a hard time if you’ve got…, if you’ve like done something wrong in his Science lessons.”

“If you…, if you don’t…, you’re expected to get…, you’re not expected to get every question, you…, you…, you’re expected to get most things right, he’s very…, he’s not very understanding of the way that we…, we think, maybe…, it’s because he lives in…, when he was a child, it was different, but it…, it…, it’s the same, like [in named part of School] if we’re…, if…, if we’re expected to get something out of that, and then, if we don’t do it, yeah, we’re in big trouble.”

10. Current science teacher; perception that the teacher had favourites amongst the students – “He has…, he has favourite people, and he just doesn’t like certain people.”

“…he doesn’t give you a chance to try and be one of his favourites, and he is always just giving you a hard time, and he…, he doesn’t…, he just…, he just doesn’t like you, whereas some people, he just favours a lot.”

"…if he starts to not like you, he won't like you for the rest of the time, unless you do something really really good, but that, it is quite unlikely if uhhhm, if you're with him, because you can't do something that you want to do that's good, because you are always having to do it his way, but then if you do it his way, you might do it badly, but if you do it your way, you'll do it goodly, and so it's kind of hard."

11. Perceptions of favouritism, and the lack of incentive to try and make an effort if the student perceives that s/he is not a 'favourite' of the science teacher – "…, it won't put me any higher or lower, even if I am trying, giving it my absolute all, but if like it's on the…, if it's something that I'm confident with, and I do well in that, I would go up a bit at something, but I'm not so confident, well, instead of going " [name of student], that was good, you tried there" uhhhm, he would…, he would just kind of be silent, and he wouldn't appreciate how much the effort that you have put into it."

    "…..or maybe in the Science lesson, if…, if it's not done…, if it's not done as he says, his way, or how he wants it, he will…, he will get annoyed with you, it's gone, nothing will happen, and then that will sometimes make your relationship stronger with him, sometimes make it weaker with him, but it is also a two-way thing, if we respect him, he should respect us…"

<u>COMPETENCE</u>

1. Teacher expects the students to have understood the instructions the first time they are given – "once he's said it once, you…, you're not allowed to say it again, and if you don't really know what you're doing, you're sort of stuck…"

2. Despite the lack of a positive teacher-student relationship, the students did feel that they learnt more; for example – "Because he is more sharp and uptight on us, but we're not necessarily…, it's…, we still learn a lot more, and I'm happy with what I've learnt, and I've learnt…, I think I've learnt quite a lot, but I'm not enjoying it as much as I was, but ……he'll say something like "Do this, there's the instructions, do it" everybody would do it, but if we went, "Are we meant…, did you say we should have this?" he would go, [*Mimics Teacher*] "I told you before" That…, that's it really, he…, he only has to say it once, that's all, he only says it once he does."

3. Difference with previous Science teacher – "I certainly am learning a lot more than I was, I'm…, I'm learning a lot more than last year, I had…, I had a bad relationship with my last Science teacher, but I didn't…, I didn't learn as much ….I still learned quite a lot from my last Science teacher, and I found it more enjoyable, and yeah, last year, I was just like "Yes, it's Science now" but this year, I'm sort of like "Oh God, it's Science" because you have got to focus, because as [name of another student] said, you can only say things…, he only says things once, and…, and you have to get that into your head, and not forget it."

4. Less of an emphasis upon investigations with the change of teacher in September but the students felt that they were learning more in terms of scientific concepts. They preferred the previous teacher but felt that they were learning more from their new teacher.

5. Similarity of view as with the 11 year old students within one of the other FGIs – as regards teacher behaviours – "when you're doing something, he only lets you do it his way, he doesn't let you try to do it a different way, he doesn't let you try and use other things to do it, he…, you have to do it his way, and with his things that he gives you."

6. Teacher's questioning approach / style does not increase the students' sense of competence – "when you ask him a question, he is like, "Well, what do you think?" and like, "I'm not sure" and he said, "What do you think?" and he just…, and he sort of…, and I said, "I don't know", and he said, "Well

have a think about it" and I'm still not sure, so, I'm a bit…, I don't really know what to do, and he is not sort of helping. That is in and out of lessons."

7. Methods that the teachers use to increase their students' sense of competence

   "…in our books he's quite convincing, that we're doing…, doing well,"

   "He just sort of ignores what we've said, "Well answered" but he always has a criticism for just about everything."

AUTONOMY SUPPORT

1. Comparison with last year in terms of differences in degree of autonomy afforded by different teachers – "but it wasn't held together that well, we were allowed to TRY and see if it worked with something else, but this year, we have to do it with what he says, and we're not allowed to…"

2. Same view as younger students re the amount of time needed to undertake and complete work proficiently – "he doesn't give us time to do it, he…, he thinks that we can go at the speed that he can go at, but we can't, because we're not…, because he can."

   ""That is not a question, you ask me out of Science, not in Science, we are learning about this, we are not learning about that question"

3. Investigations and approaches to mastering and understanding concepts within Science are determined by the teacher and communicated to the students – "….if someone is always not right, you have to do it his way, like, instead of saying, "Oh, can we try this, would that work?" it's like, "No, this is the way to do it" So…he doesn't want to let you try, try anything else new to you, and even related to…, to…, to the topic that you are doing, he sort of like, "We are doing this experiment, and this is what we're doing, and you're not doing any other experiment, you're doing my experiment, and that's it, and you will write it down how I want you to do it" He's sort of like…, you don't choose what sort of experiment you might like to try out, he's sort of like, "You do this experiment, and that's the only one you're doing, and you break it up like this"

4. Preference for greater autonomy as with the previous science teacher – "he wanted us to adventure out and see what it was like for ourselves, because in life, that's what you have to do, you have to try some new stuff, do different stuff …."

5. Comparison between two science teachers; current and previous teacher – "he used to let you, so if you are making a car, to do with friction, you don't have to do it the way that he tells you, you can try anything, anything you like that might work, but with Mr [name], he doesn't let you do that, and I thought I learned more when I just tried out different ways."

   "….thinks that teaching is, you tell the children something, and they remember it, but, not everyone remembers it, so, every time you get something wrong, he'll give you a hard time for it, and he wants you to get it right EVERY single time."

ENGAGEMENT

"well I'd like to do an experiment and then write up a report, so that you know what you've done, and you completely understand it as well."

How do you think that you would test for, let's say, hydrogen?" and then everybody would come up with different answers, and then you go, "OK".

“He’d tell you the best…, the teacher would tell you the best answer, and then you would go and do it, you’d have fun with the experiment, and then you write it up, and then you’d be proud of what you’ve done, that you haven’t…, that you haven’t done it his way, you’ve done it your own way, with your own ideas.

“….once we’ve looked it up, if we find anything that we don’t know, and we really want to try…, try something, then if we could try something, then that would be much better than sort of like, “No, you’ve done your experiment, write it up in your own time” it would be better if you could do it in the Science Lab, and write the experiment up.”

“I think the way to do it is to learn a little bit about it, and then like [name] said, do ask which way you wanted to do the experiment, which way you think will be the best, and then come up with the best one, and then do your experiment the way which you thought of, and then you come up with the best one out of those, and then you write up your report about your one.”

“….do some experiments, but if there is a couple of ideas which are quite good, do both though, to like see which one was either better to do, or not to do, because like… and then write it up, and then clarify them.”

GROUP 4

11 -12 years old – change of science teacher in September

<u>RELATEDNESS</u>

Perceptions different from the other group of the same age; very different relationship with the current and previous science teachers – converse in perceptions and affect

1. Good relationship with science teacher outside science lessons / around school – “we do have a lot of time with him, because he is [title within school], and so we have a pretty good relationship, personally”, “I sometimes don’t get on with him during a lesson, but I get on with him in the House” and “He’s completely different outside the lessons towards us, and he never…, he never really talks about things that we have done inside the lesson, outside or [elsewhere in the school]”

2. Prefer the teacher outside the lesson and around the school, rather than within science lessons
3. All in agreement with this view

4. Perceive a better relationship with the current science teacher – “I prefer his teaching style much more, I mean, he…, he actually listens to our questions, rather than saying, “We’ve got to get on now” I…, I find him easier to learn off than last...”
5. Perception of the previous science teacher’s attitudes toward them as a group – “He kind of hated us.”

6. Current science teacher helps them more with their science; Previous teacher – “he didn’t…, he would just say “Get on and do it” and “Mr [current science teacher] likes you to have your own ideas more than [previous science teacher], [previous science teacher] sort of brushed away your ideas, and always said that his theories was the right one**,** but Mr [current science teacher] allowed our…, our ideas to come into a discussion in lessons,”

7. Perceptions of the affective responses / attitudes of the previous science teacher – “…he had mood swings sort of, sometimes you would walk into a lesson, and you can tell what he is like, or he just says…, if I sit here, and then he sits there next to me, he says, “Move, you’re not sitting next to each

other, why would I ever let you?" and then like the previous lesson, you have just sat next to him. With [the current science teacher], he…, he doesn't change his mood, he is always just like that, he is pretty cheery most of the time, a positive attitude."

8. With the previous science teacher –"….I didn't enjoy Science as much as I did this year ……and uhhhm, last year, as [name of student] he has mood swings and he can be angry some days, and he would always like tease us like, "Oh, if you mess around on this lesson, you are not going to be doing any experiments next week or on Saturday"

   [*All Talk at Once*]

   [Same student]
   And we never even got to do them, so…

   [Second student]
   He sometimes just like took the mickey out of us sometimes.

9. Negative behaviour of the previous science teacher towards an individual student – the students' affective response to this; "….he was a bit mean to [name of student] last year, with the [behaviour of the named student with the] charts, which he…, in Science lessons, [name of student] would [description of behaviour], …..and he [the science teacher] would get angry and write stuff on the board like, "Don't touch anything [name of student] and stuff. He took the mick out of him, because…, it might not even be his fault, he just does it, like [description of the other student's behaviour], and then he [the previous science teacher] just goes, "If you touch that one more time, I'm going to send you out, I'll hang you up by your feet so you can't [behaviour] ever again" stupid stuff like that. ….[name of student] takes it the right way most of the time, but I could see that going the wrong way, if it got too much."

10. Comparison between the attitudes of the previous and current science teachers – "At the beginning of the year, he [the previous science teacher] sort of , decided that you weren't …, he didn't like…, he didn't like having you in his classes, and even if you were good, he had that fixed, picture of you, so, he didn't really give you chances, and so he was trying not to change his picture of you, and so that would be…, it would make him quite angry with you most of the time, if you weren't doing anything wrong, but he…, he had made up his mind at the beginning of the year. …..but now, where we have got [the current science teacher], it feels like you have got another chance, so…, so a second chance…"

11. Difference in the expectation-driven responses of the previous science teacher – "He would take the people who were more like better at Science, and like keep going on with them, but he wouldn't help the others who struggled with it."

    "…some were struggling, and he blames you for getting bad marks, and saying, "You should have…, you should have revised" and you would just say that you don't know what to do, and then, what we did last year, we barely…, barely understood anything, and when we told him we hadn't, he just said, "Well you can read this textbook again until you do understand" And then we had one lesson about 2 days before the exams, where we had revision, and by then it was too late, because we had picked up barely anything, it was too much to learn, about 10 topics in a half an hour lesson."

12. Students confirmed that their science teacher is central to their enjoyment of and engagement with Science – "If you don't like the teacher, you don't like the subject" and "….if your teacher is always on your back, you know, absolutely grilling you for not handing in like a tiny bit of prep or something like that, then you're just going to think, "What's the point of going to Science? I'm just going to get shouted at" but, If there is a teacher who is being quite kind to you, saying, "Yeah, you didn't hand in

your prep but it's OK" and "He will actually see reason, it's better, because like you're not…, you're thinking, "Actually, yeah, I mean I'm going to learn something here, there's a point of doing it, and so I'm not going to get shouted at pointlessly."

COMPETENCE and AUTONOMY

1. Current science teacher; autonomy and competence enhancement – "[he] …..leaves it to do…, he leaves us to do it ourselves, which I think is better, because it allows us to think more, about what we like"

2. "He gives us a lot more time to finish tasks that he has set, and uhhhm, he… he treats everyone equally, which is really good, and he just…, well, everyone seems to be…, everyone seems to be getting on at the same level this year…."

3. Flexibility of response by current science teacher – "He understands more if you have got activities going on in the week after extra curriculum activities, and so he will give you 10 or 15 minutes in the beginning of the lesson, and just says, "Listen along" so you don't…, and so he picks up on things, rather than just say "Well, it's your fault, you can catch up in your own time" and so he lets…, gives you some of his time" and "….he's a lot more understanding, and so say if you do have.., you couldn't do your work because say you have got an activity or something, he will say, "Actually, yeah, that is not your fault" and so he will give you time in the lesson to catch up. So, say if somebody has got like about 12 activities to do, like constantly missing prep because they are [involved in extra-curricular activities]" and "….he gives us time to catch up, he doesn't just like say, "Well actually, your Science prep is more important than your activities, do it in your own time."

4. Autonomy - Not undertaken any open-ended investigations where the students decide upon the question, the data they are going to collect or how to present their findings.

5. In the previous year, the teacher had given them the question as the basis for their investigation – "He told us the question to ask" and "…half and half, [the previous science teacher] did half, and we did another half of that experiment, so, he started it off, and then we finish off how we would carry that out."

ENGAGEMENT / FORMAT OF THE LESSONS IN CURRENT AND PREVIOUS YEAR

1. The previous science teacher "didn't really explain himself, he just told us the theory, and told us to get on with the work, he didn't really explain how to do it or anything."

2. The previous science teacher was "…..more of a textbook teacher, because, he would just…, , most of the time, he would say, "OK, read Page 4 on your textbook" and you would…, you would sort of go, "Oh, I don't want to read the page on the textbook" because it is a bit.., you know, boring really, reading the textbook, but [the current science teacher], he will just like stand up, you can ask him questions, but if you ask [the previous science teacher] a question, he will just go, "Well, is it in the textbook?""

3. Difference in the format of lessons – "with [the previous science teacher] , we just did either a whole lesson of practical or a whole lesson of writing textbooks. With [the current science teacher], it's…, it's like 20 minutes writing textbooks, and then 20 minutes practical, and then sometimes we will change the other way around, and then we will have most of our prep, and do a small report, rather than writing a whole report out."

4. Response to question re whether any of the investigations they had done within the current academic year had interested them – “Mmm, sort of.”

5. Felt that previous teacher had spent too long emphasising the safety aspects of an investigation, leaving little time, comparatively, to undertake the investigations – with the previous science teacher, “….he actually did like hour long safety lectures”, “And you are sitting there thinking, “Hey, we have got 10 minutes to do the experiment now” and you…, I mean, you have not got a lot of time, because you have got to rush it” and With [the current science teacher], he says, “Alright…” If it is dangerous, he will say…, we haven’t used a Bunsen Burner, but if we were, he would go, “Be careful, because this can burn you, and that would be it, it’s good, because you actually have more time to do our experiment.”

6. Writing and recording – “[The current science teacher] makes us do a lot more writing than [the previous science teacher], but that is better, because when it comes to exams, you have something to revise from, and you can revise and that when… When…, when we did our [name of year group] exam…, yeah, basically, [the previous science teacher] just made us do it from the textbook, because we had very little work in our Jotters that we could actually revise on.”

7. Attitude to students helping each other when one of the students is experiencing difficulties with understanding the work that has been given – “….if somebody is like a bit behind, you can help, he doesn’t mind, you don’t have to ask, you can just go over, and then they like…, they get what your view is if they don’t really…, don’t know. And if [the previous science teacher] was here, he would say, “I think they can help themselves”, and he is a lot more negative to that sort of helping each other idea, [the current science teacher] is completely free about that, and so he doesn’t mind at all.”

8. Approach within science lesson for making them more engaging and enjoyable – “…..summarise what we are going to do, but not totally, so that we have got a bit…, something to look forward to, then after 10 or 15 minutes, then we get on and do it, so you have got quite a while to like test stuff, experiment with things, and see what happens.”

   “……you are not spending ages on one subject, like you’re not spending like five lessons on the stomach, you’re only spending one lesson on the stomach, which is good, …..because you have done it in much less time, and if you’re just doing that every single time, in detail, it can get quite boring, because I mean, you’re thinking, “Oh, what’s our lesson today?” and you’re thinking, “Oh yeah, I might look forward to Science today” but then, it’s the same thing that you have done the other four lessons, so, it’s nothing new, and it is nothing that you really want to be there for.”

   To “….make the lessons more enjoyable, we could do more investigations, like tests and experiments.”

9. Some use of ICT to research information and present findings in the previous year – “We’ve done like…, we use a microscope on the computer and things, and we’ve…, we did like, we researched [name of topic] ….., and did a few topics like that….” and “We don’t really get to, but I think we kind of should, because in Science, doing Physics and stuff, that’s making new technology, and so if you’re studying a subject which creates new technology, and you’re not using that technology, it kind of defeats the purpose of making it, so, it’s a bit pointless.”

   “…..sometimes the pace of his lessons are a bit irritating, because sometimes, because one week he can be going really slowly, go to each point, which can be quite tedious, because we want to move on to the next step like, when there is Chemistry next, ….then sometimes he would go really fast through a topic, which I think that was maybe because he enjoyed the topics which he did slowly more.”

"…..you didn't know what pace you were going, so you…, one lesson you would go really fast, and one lesson you would go really slow, and sometimes, people just couldn't catch up"

[Second student]
Like if they were topics that we preferred, he went really quickly, and the ones we didn't like as much, he went slowly.
[Third student]
He is…, [the current science teacher] is more of a teacher, whereas [the previous science teacher] is more of a scientist, and so, he's…, he's…, his attitude in teaching is very different to [the current science teacher]."

Perceptions of the ideal science teacher

1. The previous science teacher "….was really dull, and would just say, uhhhm, "This is how you do it, this is how you do it, not like that, your idea isn't right" and then he would be really dull in a way, and also, to be quite…, the fun side of teaching, so that we can do experiments, rather than just writing things from textbooks."

   "I would like our Science teacher to be a bit odd, and to just go for it, see what happens, rather than like a lot of practical, just "Do this, do this" So, yeah, a bit odd."

   "I think that a Science teacher should have a perfect balance of experiments and written work, but they should also allow their pupils to have their own ideas and theories"

   "……just a bit batty, but also like, being batty, but at the end, so you do your practical first, and then at the end, he explains it, not like doing it…, explaining it before, because then you know what's going to happen, he just makes the experiments seem just slightly a bit more exciting."

   "I would quite like someone who would do an even amount of work, but he was a bit mad, he would just let us do it, but still do like safety precautions, but after that, he would just let us get on with it."

Perceptions of the ideal science lesson

One student's response – "[in the first year] he was a lot more sort of get up and go, but in the [name of next age group], I mean, he was more, "OK, let's do about.., for every lesson of experiments that we do, we'll do about four lessons of theory" He could be just a bit…, you know, because you spend an entire week of doing theory, and then a little half an hour period of doing experiments, and so you're thinking, you know, it's not really the most fun session, because you want to be doing lots of experiments, I mean, that is personally what I think Science is about, you know, experimenting to find new stuff, so, I mean, if they teach us that theory is that, you have got to do, you know, a lot of theory…, and you do have to do theory, but you have got to do thousands of tonnes of theory, before you can do a small experiment, it just…, it gets a bit tedious …. [the previous science teacher] ….used to guide us, I would say too much through our work, like most of the time we wanted to just get on with it, and sort of do it ourselves, but then he would explain loads and loads, and then we had one minute at the end to do our written work, because he had been explaining it for so long, and you just zone out after loads and loads of explaining, so…, and you just want to get on with it after a bit."

Another student's response – "After he said…, like explained everything about the experiment, if we're doing one, it would…, it wouldn't be as fun as it would be, because he has told us everything about it."

GROUP 5

12- 13 years old – change of science teacher in September

RELATEDNESS

1. Relationship with science teacher outside of the science lesson – not regarded as positive: "…not very good", "Mr [Name] always uses sarcasm", "it's not very easy to talk to him" and "Because you don't know when he is being sarcastic or not."

2. Favouritism – student regarded this as being a long-held perception – "…he shows more interest in other pupils, doesn't he?"

   "After [event], he had a grudge against me for some reason, and it's just like it has always gone on since then."

3. Influence upon relationship with the teacher within the Science lesson:

   [First student]
   Well, you don't really want to talk to him.

   [Second student]
   Yeah, you get scared if he's talking to you.

   [Third student]
   He will shout at you.

   [Second student]
   Definitely.

   [First student]
   And so definitely, you don't want to talk to him.

   [Second student]
   And outside of the Science classes, he is quite sarcastic.

4. Ambiguity re responses expected by teacher; students do not easily perceive what constitutes an appropriate response that will be acceptable to the teacher – "He does say stuff which you don't quite know how to answer" and "Makes it quite awkward."

5. Clarification – ambiguity of what the teacher is saying / asking for in terms of a response – "…Well, it just goes quite quiet once he says something and "It's the wording of stuff."
   [First student]
   And then once he says it, it just goes quiet.

   [Second student]
   Yeah, it's the whole like room, just goes dead.

   [Third student]
   Yeah.

   [Second student]
   And no one talks.

   [Third student]
   Just silence.

6. Preferred their previous science teacher –

   [Second student]
   [The previous science teacher] makes Science more fun than Mr [Name], he makes it more serious.

   [Third student]
   I don't think that [the previous science teacher] made us think as much though.

   [Second student]
   Yeah, yeah.

7. Reason why previous science teacher was better – treating students fairly; "If for instance he told off someone for something, for laughing in lessons or … something, then that would just be the end of it, and he would just be nice to everyone else" and "But with Mr [current science teacher], if he gets annoyed at somebody, then he is like consistently angry."

8. With the above, a comparison is made between the previous and current science teachers – agreement between two students; no objections or differing opinion from other students

9. Previous science teacher – "He taught us the same stuff but made it more like interesting to listen to."

10. What the students perceive that the current science teacher could do to improve his professional relationship with them;

    [Student 2]
    Smile.

    [*All Chuckle*]

    [Student 2]
    Smiles, he never smiles, he always frowns when he's talking.

    [Student 1]
    Make the work more exciting, make it more…, you know.

    [Student 3]
    Easy to listen to.

    [Student 4]
    Yeah.

    [Student 5]
    Rather than falling to sleep in the lesson.

    [*Anonymous Chuckle*]

    [Student 1]
    Sometimes he just rabbles on.

    [Student 3]
    He keeps it on the same level, he just goes on and on.

COMPETENCE

Methods that teacher uses to improve the students' confidence within science lessons; the learning and understanding of scientific concepts – "He asks you questions, but it doesn't really help me, yeah" and "Yeah, when he says them, and he looks at you and waits for you to answer them, and he's quite sarcastic," and "But he's just like…, he'll wait until you get it, and you cannot tell if he's taking it seriously or not, because then if you end up doing it, then he will tell you off, but if you don't do it then he is a bit sarcastic then."

2. Always one answer to the question (closed questions) rather than the opportunity to offer alternative responses and ideas (open questions):

   ALL
   One, one…, one answer.

3. Previous science teacher's questioning style – "If you said an answer that was quite right, and then he would say "That's close, and that's good" so that you were going down the right route, and then people would answer more and more."

ENGAGEMENT WITH / FOR SCIENCE LESSONS

4. Extent to which this has an effect upon the students' enjoyment of science – three agreed that this had an effect; As a result of the teacher's behaviour and the ambiguity of the interactions – including sarcasm –

   [Second student]
   Quite a lot.

   [Third student]
   Quite a lot.

   [First student]
   Quite a lot

   [Second student]
   I prefer not to go to Science, as in like [*02:33*] into the Science lesson.

   [Third student]
   Yeah.

   [Second student]
   Yeah, yeah, that "Oh no, it's Mr [Name]

5. Concentration within current science lessons – "You have to listen more…, more, because he uses more complicated words", "…..I don't think that he explains it very well" and "Yeah, he doesn't explain that as well."

6. Doing less investigations than during the previous year – agreement between the students

7. Students define 'fun' within science lessons –

   [Student 2]
   Interaction.

   [Student 1]
   Yeah.

   [Student 3]
   And not the same stuff.

[Student 1]
Yeah, because not doing the same things over and over again ….And like using everything in the Science Lab, to try and make it enjoyable as a Science lesson.

[Student 2]: Not reading text books a lot.

DISENGAGEMENT

Format of the last lesson – inference that the activity of reading the text book was amotivating / disengaging -

[Student 1]
Yeah, because the last lesson, we just sat down and read the text book basically.

[Student 4]
He…, he…, he reads quite a lot from books, I think he should say some more out loud to us, than actually just copying what it says in the book.

IDEAL SCIENCE TEACHER

[Student 1]
Fun in the lessons. So, more fun stuff.

[Student 2]
You know, good at explaining and things like that.

[Student 3]
More talkative.

[Student 2]
Yeah, more, yeah, and be really good at explaining things.

IDEAL SCIENCE LESSON

Example of an engaging investigation – all students stated that they are in agreement with the following response from three students:

[Student 4]
Yeah, because we never ever get to do our own investigations, they are all set up by the teacher. We never get to do anything that…, yeah.
[Student 5]
It's the teacher's question that goes into the investigation.

[Student 4]
There is a set way of doing it that you have to do it by that [*06:52*], you can't [*06:53*], like change it or anything.

ALL
Yeah.

[Student 6]
We don't ever get to do our own questions, it is always just set questions.

MISCELLANEOUS

"I like the experiments", "We'll think of our investigations, and stuff I know" and "Like we're given the topic, and then need to find out how to do it quickly, and what conditions, then you make up the whole experiment."

"We figured out our own way of doing it ….I like doing that."

"…it means that it doesn't, when you're writing down …..your method, conclusion and everything, it's different from everyone else's, and so they're not just doing the same thing."

GROUP 6

12 - 13 years old – change of science teacher in September

<u>RELATEDNESS</u>

1. Relationship with science teacher outside of science lessons -

"most of the time alright, but I don't really see him much, so…, but when I see him it's good."

2. Responses of female student –

"I think I have…, I had a better…, like outside Science lessons, relationship with [previous science teacher], just because I just came across him more, I never really see [current science teacher] outside of Science lessons, apart from walking around the school."

"I don't really see him a lot, because he does more like boys' activities, and I don't really see him a lot, but when I do, it's OK."

"I see him quite a lot, and I think he is okay and I like the way he…, he talks about things, and how he talks with the boys, and yeah, it's good."

3. Does the relationship outside of science lessons influence perceptions and approach within the science lesson – only one response: "I know that he is quite nice, so, it kind of encouraged me that if I get something wrong, that he won't be really angry, like he knows, because he is really nice."

4. Part that teacher plays within students looking forward to attending science lessons - Mixture of positive and negative – three quotes:

"I look forward to the Science lessons, and the teacher asks me questions, and asks the class questions, and I try and answer them, and if I get something right, then he'll…, he'll say that's good, but I like it how if you get something wrong, he will try and tell you what you got…, what…, how to improve."

"I don't really contribute a lot, because I once said something wrong, and he wasn't really angry, he was kind of joking about it, but…, [*Chuckles nervously*], he got a bit angry."

"…..he doesn't really play much of a role in Science lessons, because I just look forward to Science anyway."

5. Question – does it make a difference which teacher you have for Science; response was that it makes a difference in terms of 'how good' the teacher is:

"…. I think [current science teacher] is much better at explaining things than [previous science teacher], because, [previous science teacher] kept just going on about things, and he didn't really explain them very well, so, I think [current science teacher] is a bit better, like at explaining them, and helping you understand."

"…[current science teacher] has got a bit more of a commitment to making us realise what is actually happening, while [previous science teacher] will just go and teaches it, and then [current science teacher], he will try and really get it into our heads that this is what happens."

6. Emphasis upon asking boys the questions – difference of opinion; not always the boys that are asked – the second perception was that the same people are asked to answer questions each time:

"…it's just that at the moment, when [current science teacher] asks questions, in particular, he normally asks the boys, and if he asks one of us, and then, we got it right, that would probably, but if we got it wrong, and he explained it, but, I just think that he normally asks boys the questions, I don't know why."

7. Alternative responses – "No, I wouldn't say that, at all. I would say, a lot of times, uhhhm, the same people answer the questions, and [the current science teacher] asks…, asks the same people quite a lot."

"……and getting the right answer, but I wouldn't say that they were mainly the boys, I would say they were boys and girls."

"…..it's if you get something wrong in a question, Mr [current science teacher] is more likely to ask you like trick questions, because if you have got a trick question wrong, which he was just doing to test you, then he would keep asking you questions, until you get them right, and then the people who don't answer questions a lot, or make many mistakes, then they don't get asked many questions."

8. Liking the science teacher and the strength of the relationship was regarded as an important factor by all of the students – different responses:

"It depends what your relationship with the Science teacher is. So, if…, if you don't get along with him, but don't mind him, then it's good, but then if you don't like him, and he doesn't get along with you, and you don't get along with him, then it probably would make it…, effect on how…, how you treat Science, in your lessons."

"For me, I think that if you really, really, like the subject, then I don't think that it would really matter, because you enjoy doing the subject anyway, but if you kind of like the subject, or don't like it, I think that it's in the teacher that makes it fun or interesting for you, and in Science, I think that's really important."

"….. if you've got a good teacher, that does help, because it means that you'll enjoy it more, and then you'll probably learn more, because you're enjoying it, and stuff like that…"

"…..our Science teacher at the moment, , teaches very good as well, and I think that with the Science teacher…, and the last Science teacher, like how you get on, and how good you are at sport, or other activities that the Science teacher does, definitely matters in the way he works with you in class."

AUTONOMY

1. Open-ended investigations: not entirely open-ended as there was an emphasis upon getting the outcome of the investigation 'right' with a lot of guidance from the teacher: "the teacher would tell us what the …, what the investigation was going to be about, and then we had to think of , like an aim, and all of the different roles in …, how we should…, how we should, do the investigation to get it right."

"…..he sort of told us what to do and how to do it, but then, while we were doing it, if we'd said, "Sir, what would happen if we did this?" so long as it wasn't too extreme, he would probably have let us do it, but not many people ever really said that."

2. Any reason why people did not ask about alternatives within investigation – "….people either didn't think of one, or just maybe thought it in their head, what could happen, but no one really ever asks."

COMPETENCE

1. How teacher develops the students' sense of competence:

"If you didn't understand something, he would like go through it again, and keep like asking you questions until you understood it, so, it was in your head."

"…..if we did a piece of work, and then he marked it, and he wrote a comment on it, but then he, instead of just giving you the piece of work back, he told you what that comment was, and how that was really good, or how you could work on it, not just giving you the paper and for you to read the comment, he explained it to you."

"…we would have to try and learn that, and do sheets, but sometimes, if some people didn't get it, then we would go back over them, which was…, which was good."

"…[current science teacher], he sort of goes over it together, so you can put down your little bits for revision if you get it wrong, then you can make your sheets quite…, messy with ideas, and things to revise from."

ENGAGING SCIENCE TEACHER

Idea of the ideal Science teacher – "I like one that does sort of good, fun experiments, but then afterwards, we would sort of think about what we did, and then we learn from that, rather than just talking about…, if we did this experiment, what would happen if you should do something like that?"

"…..if we did this experiment, this would happen, or this wouldn't happen, we didn't really do so many."

OVERALL QUESTION:

Impromptu question - which is the most important of these three…? the relationship with the teacher; your ability to do investigations by yourself; or, the feedback you get about the progress that you're making; which of those would you say is the most important, or are they equally important?

Different responses -

"The feedback, because then you know what to do and what not to do, and it might help you if you get it wrong."

"I think the teacher, your relationship with the teacher, because, if you've got a good relationship with them, then you might be more open in class, to give your opinion and ideas, whereas if you don't…, haven't really…, don't really have a relationship with them, then you might not want to kind of talk…."

"I think, to be able to do investigations on your own, because, you could be in an exam, in a really important exam, and you're so used to working with other people, and then you are actually…, you are on your own, and you don't know what to do and stuff."

GROUP 7

12 - 13 years old – change of science teacher in September

RELATEDNESS

1. Relationship with science teacher outside classroom

"…in [name of activity outside science lessons], I get on quite well with him…"

Student 2: "He just tells you what you can improve."

Student 3: "He doesn't get angry, usually, he sort of helps you a lot in [name of activity outside science lessons]."

2. Influence of students' capabilities in activities outside the classroom, such as performance within different sports, was seen by some students as influencing the teacher's relationship with them around school and within the science lesson:

" …..attitude towards us, when we're working or in sports, like he used to teach us in [name of sport], and [name of year group], he quite liked some of us."

Student 1: "……we played [name of sport] with him and that sort of got him to like us a bit more.

Student 2: "Especially if you were sort of a good key [name of sport] player, like for instance [name of student in the same year group]."

3. Perception as to whether relationship with science teacher is based upon interactions outside of the lesson – varying responses:

Student 1: "Well, some of it."

Student 2: "Sometimes."

Student 3: "Not all of it."

Student 4: "Most of it, because…"

Student 5: "If you do sort of good and strong work, then he will sort of approve of that, and he loves his sports, so, like if you're good at the sports that he likes then…"

Student 3: "He likes you better."

Student 5: "Yeah."

Student 4: "No, he doesn't like you better, he knows you better ….."

Separate responses: "…he would be slightly distant from you."

"….if you were not good at sport, or you do…, you mess around when we are playing sport, he [the previous science teacher] brings it into the Science lesson, when Mr…, our current Science teacher would forget about it.

4. Female students – do not see the science teacher outside lessons on a regular basis

5. Better relationship with current science teacher than with previous science teacher

6. Use of sarcasm by the current science teacher

Student 1: "Sometimes he is quite sarcastic."

ALL: [*Chuckle*]

Student 2: "Yeah, he can be really sarcastic, but…"

Student 3: "Which does confuse you a lot,"

7. Some students revealed that the way they are treated by the science teacher is influenced by the teacher's prior or simultaneous relationship with other members of the student's family, such as siblings:

“our old Science teacher…,because my [name of family relationship], he didn’t have a very strong relationship with him, he doesn’t really have one with me.”

8. Liking as an affective response by current and previous teacher? Varied responses in favour of both teachers compared to the other:

“…[previous science teacher] kind of made it quite obvious that he doesn’t like me.”

9. Students’ perceptions that the teacher liked individual students on the basis of the latters’ performances within school sports activities:

Student 3: “He liked the [name of sport] people.”

Student 2: “If you were in the [name of a second sport], he just loves you.”

10. Factors that influence the students’ liking of their science teacher:

“he is easier to understand.”

“He is just more patient…”

“I like our current Science teacher better, because he understands…, I understand him more, sort of.”

“He explains stuff really well.”

“And he is sort of fun to be around….”

“He makes stuff that you are doing fun.”

11. Perception of previous science teacher:

“[name of previous science teacher] would have understood us more, because he’s [title / responsibility within the school setting], but he doesn’t quite…, I don’t know why, but I think the reason why he doesn’t like us is ….. because sometimes we maybe get in trouble for…”

12. Previous science teacher based perceptions and relationship dynamics upon interactions with students around the school as much as in science lessons / included whether the previous science teacher liked older siblings / Differing responses with performance in sports being a key factor:

For example –

Student 1: “sometimes you have to rely on your older brothers or sisters, because [name of previous science teacher], he didn’t really like [name of sibling and relationship to responding student], and he doesn’t really like me, so…”

Student 2: “….. then it’s the opposite for me.”

Student 1: “Yeah”

Student 2: “Because it’s…, I think it’s because my [two siblings cited] have also been good at…”

Student 1: “[two sports named]”

Student 2: “They’ve both been good at sport, and then they got a good relationship with [name of teacher], and so then he thought, “Well OK, [name of responding student 2] is coming to this school, he is obviously…, he might be quite good at sports, because of what is passed on by his [siblings].”

Student 3: “Whereas with me, it’s different because he doesn’t like…, doesn’t like my [name of family member relationship], as I said, [name], but he liked my other one, [name of family member relationship] [another name] but for some reason, because mine…, mine and [identifying information] I think he knows we’re [name of family members’ relationship], though, but for some reason, he just has a hatred for me, well, doesn’t really like me.”

<u>AUTONOMY SUPPORT</u>

INVESTIGATIONS:

Student 3: “… you enjoy some parts in Science, like when we’re doing…”

Student 1: “Investigations.”

Student 5: “When you’re doing investigations, where that’s fun, because you do it with a partner, and that’s fun, and then when you’re…, when you go to your lesson, it’s sort of…, if you’ve a bad relationship with your teacher, you think, “Oh yeah, we’ve got Science next, but it’s [name of previous science teacher] which isn’t going to be very fun, and [name of previous science teacher], the thing I really hate about him teaching us, is he talks so much, he just…, every lesson, you just sit down and wait for something to happen, he talks, and he explains it too thoroughly, and then...

<u>COMPETENCE</u>

1. Current science teacher explains scientific concepts in a way that is easier to understand

“Mr [current science teacher] explains things really well, and he is easier to understand, ….and Mr [current science teacher] is just really…, he keeps it quite simple and understandable.”

2. How teacher helps student to feel confident that the latter is making progress within science:

Student 2: “…..it’s the way he makes you understand it, and then he can tell when you know, if…, so he is really good at ….., knowing if you are finding it hard, and then he explains.”

Student 1: “Yeah.”

Student 5: “If you find it hard, he explains it really well, what you are doing wrong, and if you get it right, he says what you are doing well…..”

Student 1: “Yeah.”

Student 4: “And before you move on to the next subject, he asks, he makes sure that everyone has understood it.”

Student 5: “And then you can go back to points if you want to.”

Student 4: “If you don’t understand.”

Student 5: “…..our past Science teacher, I don’t really know, he wasn’t…, no one really understood him very well.”

Student 1: “Apart from some of the people, but not really everybody.”

MAKING LESSONS MEMORABLE:

1. EXAMPLE

Student 5: “If it’s a fun investigation then you’ll remember it.”

Student 1: “Yeah.”

Student 3: “But if it’s one of those boring ones where you have to…”

Student 5: “And also you learn because you have time for…, you wrote up sort of hypothesis ……And especially when you do your conclusion, it makes you think about what…, what happened and why it happened.”

Student 1: “Yeah.”

Student 5: “And that’s when you learn.”

(Open-ended investigations without a set conclusion that the teacher is guiding the students towards.)

2. Use of technology / interactive whiteboard as part of helping students to feel more competent with the understanding of scientific concepts:

“…that one of the main reasons that Mr. [name] is slightly easier, is because Mr [name] uses this projector, so, it’s a whole lot easier for us.”

Student 2: “Because he has got these slide shows prepared.”

Student 3: “Yes, it’s interactive.”

Student 2: “So, it’s just like in…, in sort of Geography, we have…, it’s a whole lot easier to learn, because of the slide shows, it’s just the way that they teach, that way is so much easier.”

Student 5: “Whereas [the previous science teacher] just talks, and no one talks throughout the lessons.”

Student 1: “It goes in and out the other side.”

Student 2: “Well, in one ear and out the other, because, all he is saying, you’re forgetting the main points which he mentions, because he goes into too much depth about them, you forget the main reasons for that point.”

Student 3: “Yeah, I agree with that, I think that he goes into too much depth, and then, forget it all.”

Student 2: “It is good to get some depth and…”

Student 3: “Yes, it’s good to get some depth.”

Student 2: “But sometimes, he just goes into it too much.”

Student 3: “Too much, and then you just…, you just forget it.”

OTHER SECTIONS

1. Making the relationship stronger between teacher and student; the students' perspective regarding teacher's relational behaviours:

"…..just don't take everything that happened in the past into your Science lessons.. if you've been really bad, sometimes he is a bit distant from you, so, say like you did something which wasn't right, …….this is for the boys, and he would sort of reflect that sometimes in the Science lesson."

"[the current science teacher] in Science lessons, he would move on from that …."

And "If it's Science, Science is Science for him, and sport is sport, not sport and Science as the same thing."

And "[It should not] Affect your science, or what happens in Science won't affect sport."

2. If the relationship was stronger, question to the students as to whether this would have a positive impact upon their enjoyment of science:

Student 3: "Yes."

Student 2: "Definitely."

Student 5: "Because then it makes…, it makes it more enjoyable if you're not being shouted at."

Student 1: "Yeah."

Student 5: "Because if they are annoyed, and you get a question wrong, because they don't particularly like you if they did…, if they didn't they would sort of bring out all the anger on you."

3. Motivational features of the science lesson – already mentioned use of slides / interactive whiteboard:

Student 5: "Experiments, where he is doing experiments, say we're using something, say a Bunsen Burner, ….there are lots of them, and so you can get into groups of 2 or 3 and do them, in your own…, not in your own way, but, you get to…"

Student 1: "You get to be a part of it."

Student 5: "You get to not just watch, you get to do the stuff …..And so you do the experiment yourself, and it helps you understands it a lot more."

4. Investigations enhance understanding / memorable investigations / experiments – potassium, fizzy drinks, 'gunpowder'

Student 3: " ….. it was something that would…"

Student 5: "Stick in your head."

Student 3: "Stick in your head, make an impression…"

5. Curiosity-driven learning and further exploration beyond the classroom:

Student 3: "…we've been advised to, but when it's not very interesting, so no, it's really if you're curious enough to know the answer."

6. Ideal science teacher:

Student 3: "Funny."

Student 5: "Not sarcastic."

Student 3: "Funny, but learns…, but learns, but…"

Student 5: "Don't joke around."

Student 4: "Sort of in a way that makes it enjoyable, but it is also effective."

Student 1: "Yeah."

Student 4: "So, Mr…, Mr [name] is really effective, and it's quite enjoyable, but I would say…"

Student 4: "He's a bit sarcastic."

Student 4: "I would prefer if we had a teacher who was really enjoyable, and it was…, sometimes it was effective, but if we had our current Science teacher's [effectiveness]……"

Student 2: "Of a Science teacher's personality."

Student 3: "[with our previous science teacher] he just…, he experiments all of the time, any question that we asked, he would just…, "Go and do an experiment"

Student 1: "Yeah, it was really fun, he would just say, "Go and do an experiment"

Student 5: "…..so just someone who does…, does lots of experiments, uhhhm, and fun things, but it makes…, it helps you to learn it too."

APPENDIX 5.1

ONLINE SURVEY

Classroom Factors that influence Motivated Engagement with Learning

Classroom Factors that influence Motivated Engagement with Learning

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Page 1: Page 1

Please think of a teacher that has motivated / inspired you to enthusiastically engage with learning during his/her lessons. Base you answers to the following questions upon the personality, behaviours and methods of that chosen teacher, and how these made you feel in terms of your competence and wish to learn for yourself within the teacher's subject.

Thank you for taking the time to complete this survey. (It should take no more than 5 to 10 minutes).

1 Please select your gender - male or female

- Male
- Female

2 Which classroom-based factors were most important to your motivated engagement with learning within lessons led by your chosen teacher? Please rank the following in order of importance (with 1 being the most important and 5 being the least important) *Required*

Please don't select more than 1 answer(s) per row.

Please select exactly 5 answer(s).

Please don't select more than 1 answer(s) in any single column.

Having trouble with the format of this question? View in tableless mode

	1	2	3	4	5
Positive relationship with the teacher	☐	☐	☐	☐	☐
Positive feedback about your achievement / performance	☐	☐	☐	☐	☐
Feeling positive about your ability to make further progress	☐	☐	☐	☐	☐
The need to decide what you learnt	☐	☐	☐	☐	☐
The need to decide how you learnt different concepts	☐	☐	☐	☐	☐

3Please rank the following in order of importance (with 1 being the most important and 6 as the least important) *Required*

Please don't select more than 1 answer(s) per row.

Please select exactly 6 answer(s).

Please don't select more than 1 answer(s) in any single column.

Having trouble with the format of this question? View in tableless mode

	The teacher provided me with choices and options.	I felt understood by my teacher.	My teacher conveyed confidence in my ability to do well in the lesson / subject.	My teacher made sure I really understood what I needed to do to improve.	My teacher encouraged me to ask questions.	My teacher listened to how I would like to do things during learning activities.
1	☐	☐	☐	☐	☐	☐
2	☐	☐	☐	☐	☐	☐
3	☐	☐	☐	☐	☐	☐
4	☐	☐	☐	☐	☐	☐
5	☐	☐	☐	☐	☐	☐
6	☐	☐	☐	☐	☐	☐

4Please answer the following questions according to the strength with which you agree or disagree in relation to **your own learning** and perceptions when you were being taught by the engaging / inspiring / motivating teacher. *Required*

Please don't select more than 1 answer(s) per row.

Please select exactly 5 answer(s).

Please don't select more than 5 answer(s) in any single column.

Having trouble with the format of this question? View in tableless mode

	Strongly agree	Agree	Disagree	Strongly disagree
The teacher helped me to feel more confident in my ability to learn the lesson materials.	☐	☐	☐	☐
I was capable of learning the lesson materials because of the teacher's behaviours.	☐	☐	☐	☐
I was able to achieve my goals in this course through encouragement by the teacher.	☐	☐	☐	☐
I felt able to meet the challenge of performing well in this course because of the teacher.	☐	☐	☐	☐
I was capable of learning the lesson materials because of the teacher's methods.	☐	☐	☐	☐

5Which features of the teacher's behaviours and methods were most important to you as an engaged learner in his/her lessons? (Please rank the following in order of importance, with 1 being the most important and 4 the least important.) *Required*

Please don't select more than 1 answer(s) per row.

Please select exactly 4 answer(s).

Please don't select more than 1 answer(s) in any single column.

Having trouble with the format of this question? View in tableless mode

	1	2	3	4
I had a positive relationship with the teacher.	☐	☐	☐	☐
The teacher helped me to have confidence in my own ability within their subject / lessons.	☐	☐	☐	☐
The teacher allowed me to direct what I learnt and how I learnt it.	☐	☐	☐	☐
The teacher gave me feedback that made me want to find out / learn by myself.	☐	☐	☐	☐

6 Please state whether you agree or disagree with the following statements. *Required*

Please don't select more than 1 answer(s) per row.

Please select exactly 10 answer(s).

Please don't select more than 10 answer(s) in any single column.

Having trouble with the format of this question? View in tableless mode

	Strongly Agree	Agree	Disagree	Strongly Disagree
My positive relationship with the teacher was due to the teacher being friendly and approachable.	☐	☐	☐	☐
My positive relationship with the teacher was due to the teacher having a sense of humour.	☐	☐	☐	☐
My positive relationship with the teacher was due to the teacher giving feedback that helped me to feel confident in my own ability.	☐	☐	☐	☐
My positive relationship with the teacher was due to the teacher giving feedback that helped me to feel self-competent.	☐	☐	☐	☐
My positive relationship with the teacher was due to the teacher letting me	☐	☐	☐	☐

decide how I should learn.				
My positive relationship with the teacher was due to the teacher letting me decide what I should learn.	☐	☐	☐	☐
The more competent the teacher helped me to feel, the more I wanted to decide how I should learn.	☐	☐	☐	☐
The more competent the teacher helped me to feel, the more I wanted to decide what I should learn.	☐	☐	☐	☐
When I felt competent, it was mainly because of the teacher's influence.	☐	☐	☐	☐
The more competent I felt, the more I wished to self-direct how and what I learnt.	☐	☐	☐	☐

7

Please rank the following in order of influence, in terms of how one led to the other as the basis for your motivation / engagement with learning. (For example, if the teacher-student relationship led to you feeling competent and this, in turn, led to feeling more able / willing to direct your own learning, rank the statements below as 1,2,3.) *Required*

Please don't select more than 1 answer(s) per row.

Please select exactly 3 answer(s).

Please don't select more than 1 answer(s) in any single column.

Having trouble with the format of this question? View in tableless mode

	1	2	3
The quality of the Teacher-Student Relationship	☐	☐	☐
Feeling competent within a lesson / subject: able to achieve within that lesson / subject.	☐	☐	☐
I felt more able / willing to direct my own learning within the subject.	☐	☐	☐

- Finish