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Investigating the Enhancement of Students' Engagement with Learning Activities through the lens of Self-Determination Theory

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ABSTRACT

Self-Determination Theory (SDT) posits that, within formal school settings, students' satisfied needs for a positive teacher-student relationship, perceived competence and autonomy may be utilised to predict their engagement with learning activities. The current research was seeking insights through the research question: What does prior SDT-embedded research reveal to be the strongest sociocultural motivational influences upon students' self-reported engagement with learning in science and other subjects? The findings from an adapted meta-ethnographic review (MER) revealed that, whilst SDT emphasises the importance of autonomy as a basis for students' engagement with learning, the motivation to exercise autonomy within science (and other curricula subjects) is a potential outcome cumulatively influenced by the students' perceived competence and quality of the teacher-student relationship. These findings present the three SDT constructs as hierarchical, in that there is an emergent 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). The findings are significant, in terms of the proposed hierarchy, and enhancing research practitioners understanding of students' motivation to engage with science learning activities. The findings are presented such that it may be further applied and modified by academics and practitioners as part of their classroom-based research agendas.

1. Introduction

Empirical research applying Self-Determination Theory (hereafter referred to as SDT) within classrooms suggests that the simultaneous satisfaction of three basic psychological needs predict students' motivation to engage with learning activities. These 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. The quality of the teacher-student relationship has been alluded to as a "supplement" within the SDT model, with autonomy and competence more often being emphasised as the basis for self-determined engagement (Ryan and Deci, 2009, p. 178).

To date, SDT-embedded research investigating motivational variables that have a positive impact upon students' engagement with learning activities has highlighted a number of key contextual factors. One such factor is students' enjoyment of learning within a learning environment where they are able to perceive their own competence. This may be the motivational driver that influences their desire to exercise their own autonomy. Another factor is teacher-afforded feedback that gives students a sense of their current competence

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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. Indeed, prior research suggests that the role of the teacher is central to the motivation that stems from the enhancement and progression of feelings of autonomy and competence (Reeve, 2002, 2012; Ryan and Deci, 2009).

How the three SDT basic psychological needs potentially mediate between sociocultural contextual factors and engagement does not appear to have been investigated to date. Indeed, it has been difficult to envisage the potential 'flowchart' 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 simultaneous in their influence. This perspective has been placed central to the current research, by investigating the potential 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).

Further to Wood (2017, 2019), a review of 32 research SDT-focused articles revealed teacher behaviours and methods that appear to have a common influence upon students' perceived competence and motivation to be autonomous are optimized when students perceive that they have a positive relationship with the teacher within the classroom. Where students perceived a positive teacher-student relationship, different forms of motivation were enhanced. This included 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). Such a hierarchy amongst motivational variables informing different forms of engagement has been proposed by Reschly and Christenson (2006, 2012), who argue that cognitive and emotional engagement precede and inform the quality and persistence of behavioural engagement. Fredricks et al. (2004) felt that further 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. Within the current paper, motivation is defined as an unseen, inner drive to action (Abrahams, 2011) whilst engagement is defined as observable interactions with other individuals and learning activities within a known context (NRC, 2004).

The motivational perceptions that appear to inform the influence of the teacher-student relationship quality upon competence, and vice-versa, are discussed in this paper. The discussion within this paper has been approached with the objective of gaining 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. This includes some of the variables which prior research has argued to be pivotal to the potential motivational relations between the teacher-student relationship and students' learning engagement in science and other curricula subjects. These variables have been included as they have consistently emerged as having a strong impact upon students' motivation to engage themselves in learning within science, and within classrooms in general.

2. Literature Review

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, 1994; Hughes and Chen, 2011; Hughes et

al., 2008). Positive psychosocial experiences within classrooms have an impact upon students' motivation to engage with learning activities: a result of repeated positive experiences that lead to sustained positive outcomes (Eccles and Gootman, 2002). These include academic achievement (Connell et al., 1994; Connell and Wellborn, 1991, 1994; Skinner et al., 1990), social functioning, well-being (Fredricks, 2011), reduced dropout rates, boredom, and disengagement with learning activities (Fredricks, 2011: Fredricks et al., 2004; NRC, 2004). Students' engagement with learning is regarded as an essential basis of the long-term commitment of students to learning goals and prosocial approaches to academic success (Fredricks et al., 2004; Lawson and Lawson, 2013; Reeve, 2002, 2012). 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).

Teachers have been asserted as the key factor in motivating and engaging students within their specific learning contexts (Hughes et al., 2008; Martin and Dowson, 2009; Reeve, 2002, 2012; Reeve and Tseng, 2011; Royal Society, 2007; Ryan and Deci, 2009). Teachers whose positive attitude and enthusiasm for learning within specific curricula subjects are more likely to motivate students to engage with learning and achievement opportunities within the subject (Fredricks et al., 2004; Jarvis and Pell, 2005; Jennings, 2003; Jimerson et al., 2003). 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) is essential for a sustained academic achievement (Christenson et al., 2012; Fredricks et al., 2004; Marsh and Martin, 2011; Reeve, 2002, 2012). Large international surveys, such as 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 with science and maths, and the subsequent improvements that students make in their academic achievement in that subject (Willms, 2003). It may be 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). These variables have regularly been identified as essential in 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, 2009, 2012). Indeed, student engagement has been argued to be an outcome of motivational processes (Christenson et al., 2012; Appleton et al., 2006), taking the form of a combination of observable behaviours and self-reported affect-driven perceptions (Fredricks et al., 2004; Klem and Connell, 2004; NRC, 2004).

The quality of the teacher-student relationship 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; Hughes et al., 2008; Krapp, 2000; Ladd, 1999). 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).

The evolution and sustaining of academic competencies is one of the most demanding motivational and cognitive challenges that developing children face (Zimmerman, 1995, p. 202). These evolving perceptions of competence are constantly evolving and are acquired or informed as a result of feedback from teachers, personal aspirations, intrinsically motivated goals, self-endorsed values, and a self-determined approach to activities through perceived autonomy-orientated causation (Reeve, 2012). All are informed by and internalised through context-specific experiences and self-reflective 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 perceptions about individual teachers based upon, for example, their experience of prior interactions. Such teacher-specific worldviews are based, therefore, upon experiences that may act as means of interpreting and forming expectations regarding a teacher's intentions, reliability and trustworthiness (Bretherton, 1987). This, in turn, influences students' perception of the strength of their attachment to individual teachers, and is likely to influence future verbal and behavioural responses.

Self-Determination Theory (SDT), as a sociocultural motivational theory, involves the psychological and philosophical interplay of three basic psychological needs (BPNs) - relatedness, autonomy and competence (Ryan and Deci, 2000a: see Figure 1). SDT asserts that optimal self-determined motivation as synonymous with intrinsic motivation, and regards self-determined motivation and perceived competence as being inextricably linked (Ryan and Deci, 2000ab, 2009). A key question is whether one or the other is the more influential of the two within learning activities: perceived competence or self-determined motivation? Such a question was central to the study of perceived competence by Vallerand and Reid (1984), who reported that positive performance feedback from the teacher led to students' self-reported perceptions of enhanced self-competence and intrinsic motivation at the individual level. This suggests that perceived competence has a mediating effect upon intrinsic motivation, resulting in students developing perceptions that learning activities are enjoyable for their own sake (Deci and Ryan, 1980). SDT is a single motivational theory that encompasses factors such as autonomy, competence and the teacher-student relationship have equal influence upon students' engagement with learning. SDT encompasses a continuum from proactive intrinsic motivation via passive extrinsic motivation to inactive amotivation. It has been empirically shown to be both predictive and indicative of an individual's sense of relatedness, perceived competence and behavioural regulation within classrooms as specific sociocultural environment (Reeve, 2002, 2012; Ryan and Deci, 2009). SDT differs from other sociocultural motivation theories in two distinct ways (Ryan and Deci, 2000). First, it emphasises the *quality* of the unseen motivational regulator as opposed to the *quantity* of the motivational regulator when considering the impact of different forms of motivation upon students' engagement with learning activities. Therefore, a distinction is made between the different qualities of motivation, which range along a continuum from the most positive quality (self-determined motivation) to the most negative: a complete lack of motivation (amotivation) (Ryan and Deci, 2009, p.173). Second, it is the only sociocultural motivational theory that places the importance of autonomy (or self-determination) as central, taking the form of an individual's self-regulated, volitional and sustained engagement during an activity. The three constructs of SDT centre upon the extent to which an individual perceives that his / her allied 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 influence self-regulated behaviours indicative of engagement within the classroom (Reeve, 2002, 2012; Ryan and Deci, 2009). Where the three basic needs of SDT are perceived as satisfied and sustained, it has been predicted that this will result in an individual developing a more informed self-concept, including the perception that they may exercise autonomy in the form of self-determination.

3. Method

Meta-ethnographic reviews (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). A MER draws upon the qualitative means used to analyse and interpret evidence, as qualitative interpretations more often focus upon understanding than knowledge (Noblit and Hare, 1988, p. 24; Savin-Baden and Major, 2013).

Using the research question, "What does prior SDT-embedded research reveal to be the strongest sociocultural motivational influences upon students' self-reported engagement with learning?", an MER was used to synthesise and translate 32 research studies in order to find common SDT-based motivational patterns of influence upon academic engagement in learning activities. This was done in order to gain a more informed insight into 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 question. SDT was utilised as a theoretical lens as it 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), particular as it has been effectively used as a basis for developing evidence-based practice within schools (Ryan and Deci, 2009).

The MER had three objectives: to identify and understand key motivational variables that enhance students' engagement within learning activities; to outline some of the key common behaviours and characteristics of teachers that students regard as being most influential upon their engagement, and; to understand the potential associations between teachers' relational behaviours, students' perceived competence, and their perception of autonomy supported learning, together with the relative influential hierarchies of such variables based upon students' self-reported motivation to engage with learning. 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). In turn, this appears to enable 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).

Extensive searches of ten bibliographic and citation databases revealed 32 peer-reviewed articles and unpublished doctoral research that could be accessed, was based upon students' self-reported perceptions, and were written in English (see Table 1). The three essential elements that had to be present for a study to be included were: the use of SDT as the theoretical framework for explaining / interpreting the factors that enhance children's motivation for and engagement with learning in the classroom; the inclusion of children aged between 8 and 13 amongst the participants[1], and; 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).

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, some of the doctoral theses could not be fully accessed, 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, with further screening resulted in a total of 32 studies being included in the MER (see Table 2).

Table 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

Table 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 [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.

4. Discussion of results of the analysis of the 32 included studies

The following section should be read in conjunction with Table 3. The prior research outcomes that emerged across the majority of the 32 studies were used as the basis of second- and third-order interpretations. First-order constructs, in the form of direct responses acquired from participants which can only be compared at the descriptive level at which they are made available to the researcher) were analysed to form second-order interpretations: the researcher's initial interpretations of the findings (Noblit and Hare; 1988). 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).

Table 3.
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 (2008)	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 (2005)	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	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 American students.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

Table 4
Findings from the adapted MER: concepts (first-order constructs), second- and third-order interpretations

First-order interpretations	Second-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
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
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
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
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
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
Perceived competence informs students' autonomous motivation	The more competent an individual perceives themselves 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
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
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.

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

The combined findings indicate that the strength of the interpersonal relationship with the teacher is 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 but such perceptions were all directly influenced by the teacher-student relationship quality (TSRQ: term coined by Hughes et al., 2008). The strongest association informing the TSRQ 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' perceived autonomy and their self-determined motivation. Autonomy emerged 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, evidence within the current research supported the ideas of a potential cumulative relationship between students' perceived competence and the perceived teacher-student relationship quality. 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 desire for their teacher to be autonomy-supportive. However, students who had self-perceived control over opportunities to demonstrate their competencies through a teacher's autonomy-supportive learning behaviours and positive feedback were 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. For example, Pat El Tellima and Van Koppen (2012) report that the teachers' performance feedback had an impact upon students' perceived TSRQ. Feedback had an optimal effect upon students' positive perceptions when a teacher had a positive teaching style that enhanced students' perceived competence. TSRQ 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 TSRQ. The influence of perceived competence upon engagement was further reinforced by Soric (2009), who noted that that motivated successful students, who feel autonomous and self-determined rather than controlled by others, attributed their success to more internal and controllable causes" (p. 403). Zhang et al. (2012) reported similar results in that teachers' behaviours predict students' motivation and achievement. Their study revealed the importance of the influence that teachers' competence supportive and reinforcement of students' motivational constructs, and subsequent engagement and achievement. Their conclusions reveal 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 and achievement outcomes. The 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, activities that students regard as important, interesting, and have 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 students' expectancy-related and self-efficacious beliefs. Some of the studies focused upon the enhancement of perceived competence within classrooms through the lens of SDT (for example, Conroy et al., 2005). Student's perceived competence was found to predictive of sustained engagement, higher levels of self-reported intrinsic motivation and self-esteem, and the satisfaction of all three SDT basic psychological needs. Common across age ranges 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 enhanced self-determined motivation and intrinsic motivation. Clearly, the variability in these perceptions was measured at the within-subject level but it was also possible to make inferences as to the key mediating and influential variables at the between-subjects level. 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). As with other studies focusing upon the influence

of relatedness upon students' engagement with learning, a central influence upon the enhancement or thwarting of self-determined motivation, and the resultant quality / strength of the desire to engage with learning in a specific context, depends upon the motivating presence of upon teacher-afforded variables such as care, support and feedback.

Students' classroom-based perceptions of teacher support influenced student's perceived competence, with both being predictive of students' motivation to engage in learning. For example, Hardre et al. (2006) state that if teachers are to enhance and promote students' motivation for learning, teachers need to focus upon learning goals, the active promotion of students' perceived self-competence, and the development of students' self-determined motivation within a teacher-supportive learning environment (p. 204). The central importance of the teacher-student relationship was affirmed, whether in the provision of a supportive learning environment by the individual teacher or positive interpersonal relationships (p. 202). Indeed, the majority of the reviewed studies reveal that relatedness and competence are 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.

The mediating association and effects between relatedness and engagement are potentially reciprocal via perceived competence and autonomy leading to stronger and more positive perceptions of competence, motivation and well-being temporally. Therefore, while autonomy needs and self-determined motivation are predictive of engagement and achievement, the pre-requisite appears to be a strong interpersonal relationship between student and teacher which is strengthened by the teacher's afforded behaviours that lead to the enhancement of students' positive perceived self-competence. Prompted by the findings of all of the studies discussed within this research, the puzzle continued 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 relatedness and competence are vital pre-requisites for students to have a motivational need for autonomy and to be volitional within learning contexts be regarded as predictive of engagement with learning. This emergent variance in the hierarchical influences of each of the three SDT needs upon the other two and students' motivated engagement with learning led to the consideration of the extent to which autonomy is a motivation-regulated outcome within SDT. As a teacher, it makes experiential sense to place the TSRQ 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 will have an impact upon adolescents' self-concept and perceived capabilities (Ryan et al., 1994). In addition, students often reported that they were more positively disposed to the quality of the teacher-student relationship when they were given opportunities to demonstrate and develop their subject-specific competence through the autonomous design and conducting of their own investigations. If autonomy is an outcome within the proposed SDT flowchart, the decision to be autonomous will be made in response to affective and cognitive perceptions of the extent to which students perceive that the classroom / school climate meets their needs for both relatedness and competence (Appleton et al., 2008; Hipkins, 2012; Park et al., 2012; Zhou et al., 2012). Therefore, it is proposed that autonomous motivation is an outcome mediated by students' perceived relatedness and competence, which are either enhanced or thwarted by their teacher. That is, while the basic need for autonomy is acknowledged as an essential element of self-determined engagement with learning, its presence as optimal autonomous motivation is only predicted by positive perceptions of the teacher-student relationships *and* self-competence.

Interestingly, TSRQ has been referred to as a 'supplement' within the SDT model, with autonomy and competence more often being emphasised as the basis for self-determined

engagement (Ryan and Deci, 2009, p. 178). However, the current findings suggest that relatedness, as TSRQ, is the essential catalyst informing the quality of students' engagement through the enhancement of perceived competence. 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, evidence within the current research supported the ideas of a potential cumulative relationship between students' perceived competence and the perceived teacher-student relationship quality. 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 desire for their teacher to be autonomy-supportive. However, students who had self-perceived control over opportunities to demonstrate their competencies through a teacher's autonomy-supportive learning behaviours and positive feedback were 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 and during the learning activities themselves.

5. Conclusions and Implications for Science, Mathematics and Technology Education

The discussed cumulative findings suggest 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. Of all the variables that appear to stimulate students' engagement behaviours, the students most commonly 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). It appears that students are more receptive to teachers' behaviours and methods that highlight and enhance their perceived competence within, for example, STEM subjects. Such perceptions as to a teacher's use of competence-enhancing behaviours and methods successfully have an impact upon perceived competence, and, in turn, upon the motivation to engage positively with learning activities. The motivation to be autonomous consistently emerged as an outcome of the combination of teachers' relational-enhancing behaviours and the extent to which teachers' competence-based feedback enhances students' perceived self-competence. A key point is that, across the reviewed studies, autonomy perceptions emerged as founded upon students' perceived TSRQ and competence, both of which were enhanced by their teachers' behaviours. This was 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 subject-based activities, 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.

As the research was retrospective in design, 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. The use of single motivational theory ensured that the research questions, design, methods and the analysis of

the evidence were approached from one theoretical perspective. Gorard (2013) notes 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). Therefore, SDT was selected as it is a wide-ranging motivational theory that has evolved from and shares similarities with other motivational theories. In addition, and most importantly, prior research has demonstrated its applicability within a variety of educational settings regardless of the students' prior achievements, ability, gender, culture or socioeconomic status. Therefore, the use of SDT has been shown to "…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. However, the use of SDT 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. This is particularly so when objectivity is defined as the elimination of bias (Eisner, 1993).

An outcome of this research is the emergent interaction between the students' perceived relationship with their teacher, 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, often integral to subjects.

The results have practical implications for teachers across a range of formal and informal learning environments, as well as school leaders and others developing research-informed 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, particularly within practical subjects. The embedding of SDT enabled an evidence-based understanding of some of the key variables that inform such motivation and engagement, regardless of the age, gender, ability and culture of the students. Finally, it may be that autonomous and self-determined forms of motivation are synonymous, with 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 within learning.

In summary, the current research identified some of the key contextual variables that have a positive impact upon students' self-determined engagement with learning activities. These variables are suggestive of a potential reciprocal relationship between the quality of the teacher-student relationship, the outcomes of students' perceived self-competence, and the extent to which students were motivated to be autonomous. The current research makes an important contribution to knowledge of how teachers may enhance students' motivated engagement with subjects and activities. Further research should consider how teachers' understanding of students' engagement with learning may be enhanced and embedded through a range of learning approaches. Therefore, the current findings will need to be applied and developed in order to evaluate how its use in classrooms may impact upon the enhancement of teachers' evidence-based practice and further teacher inquiry (Hall, 2009; Thomas and Pring, 2004). Finally, the actual impact of developmental differences upon students' motivated engagement with subjects, and the impact of such engagement upon the quality of teacher-student relationships and students' perceived competence, provides a further impetus for school-based research.

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