DOCTORATE IN EDUCATION

Physical Activity and On-Task Behaviour in Adolescent Classrooms of a Further Education College

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Abstract

Teachers commonly report that high-levels of off-task behaviour hinders learning in their classrooms. Previous research in school children under ~12-years-of-age has demonstrated physical activity (PA) interventions may decrease off-task behaviour. The current thesis planned to extend the literature to UK Further Education College classrooms of 16-19-year-old learners via a mixed-methods design of observations and student interviews.

111 college sport and drama students were observed for on-task behaviour via momentary time-sampling (70 male and 41 female, age 17.1$\pm$0.8years). In a cross-over design, observations occurred in classroom lessons immediately before and after a PA-based lesson in a sports hall/drama studio, or a seated classroom. Mean on-task behaviour was higher only in the lesson after a PA-based lesson ($p<0.001$). Individual-level analysis; however, highlighted that a quarter of students saw no change or a decrease in on-task behaviour after the PA-based lesson.

To further explore these quantitative outcomes, 36 students were questioned on their perceptions of on-task behaviour before and after PA via semi-structured interviews, with responses analysed via thematic analysis (20 male and 16 female, age 17.2$\pm$0.6years). Surprisingly, the most common factors for variations in on-task behaviour students mentioned in the interviews were not directly related to PA. For example: coursework deadlines, time-of-day variations and differences in classroom delivery. Themes students directly linked to the PA-based lessons centred on feelings of fatigue, energisation and recovery. Several students specified fatigue could help their ability to be on-task, while other students implied insufficient recovery and/or cool-down opportunities prior to subsequent lessons hindered on-task behaviour.

These findings have implications for practice, principally providing empirical evidence that PA in UK FE colleges can improve classroom on-task behaviour but likewise is influenced by a range of other variables that PA may not always mitigate. These factors should be considered alongside PA interventions by teachers and academic planners for optimum on-task classrooms.

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Chapter 1 – Introduction

1.1 Synoptic Overview

At the time of embarking on this research, the author was a lecturer specialising in exercise and physical activity (PA) at a Further Education (FE) college in the United Kingdom (UK). In this role, peer-lecturer concerns around students being overly restless and off-task in lessons that followed a physically active lesson in the college's sports hall were frequently a focus of staffroom discussions. Colleagues reported that these physically active lessons increased the difficulty for students to concentrate on learning-related tasks. Such vocational reflections perplexed the author as the literature appeared to counter this conjecture, suggesting instead that PA had largely positive effects on classrooms and student learning (Mahar et al., 2006; Barros et al., 2009; Wiebelhaus & Fryer-Hanson, 2016).

Upon commencement of this doctorate in 2013, many published studies involved large-scale cross-sectional analysis of student daily PA levels as correlated to academic grade outcomes (Sattelmair & Ratey, 2009; Booth et al., 2013). Only a small number of investigations directly looked at the effect of PA on students variables within classroom lessons (Mahar et al., 2006; Morgan & Hansen, 2008; Grieco et al., 2009). This literature was devoid of research relating to learners towards the upper-end of adolescence (15-19 years of age) and of studies carried out in the context of FE colleges in the UK. Typically, studies focused on young children and those with disabilities, particularly attention-deficit hyperactivity disorder (ADHD), in primary and elementary schools (Verret et al., 2012; Den Heijer et al., 2017). Moreover, investigations into the potential mechanisms of PA in improving behaviour were lacking and studies seldom gathered participant perceptions of how PA influenced their classroom behaviours, which would be valuable in gaining more insight into the mechanisms at play. Hence, the current thesis planned to investigate PA's effects on behaviour in college classrooms via a mixed-methods design of observations and student interviews.

1.2 Why Physical Activity is Important

PA is often defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" (Caspersen et al., 1985 p. 126) and includes activities of daily living or planned and structured movements (Webster, 2013). PA is important for health and wellbeing, often being associated with many benefits and a reduction in the risk of a number of physical and mental ailments (Lee et al., 1997; Hillman et al., 2008; Biddle & Asare, 2011). For example, high PA levels have been positively associated with: reduced risk of cardiovascular disease, type II diabetes, hypertension, elevated blood cholesterol, obesity, and some cancers (Powell et al., 1987; Centers for Disease Control and Prevention (CDC), 2011), improved self-esteem, and confidence, and reduced depression, and anxiety (Dimeo et al., 2001; Strong et al., 2005).

There also appears to be a dose-response relationship, with mortality highest in populations that exhibit the lowest daily PA levels (Paffenbarger et al., 1986; Haskell & Nelson, 2008). Indeed, low PA levels are a serious and widespread contemporary concern with reports of PA rapidly declining in western societies (National Health Service (NHS), 2018). This mounting evidence-base into the importance of PA has led to the World Health Organization (WHO) defining low PA as the fourth leading cause of global mortality, consequently, health organisations and governments are investing extensive resources to encourage increased PA in daily life (WHO, 2010).

1.3 Physical Activity and the Classroom

Various factors influence student performance in the classroom and ultimately academic achievement (Duckworth et al., 2012; Rowe et al., 2012; Howie et al., 2015). 'Academic achievement' as a construct has been defined as "relating to school performance or the quantity or quality of a student's work. It includes content-specific knowledge, educational performance markers, student dropout, and engagement" (Howie & Pate, 2012 p.162). Assessment of academic achievement can include, but is not limited to: grade point averages, scores on standardised tests, cognitive functions for example executive function, measures of concentration, attention, and memory, and classroom behaviour (Strong et al., 2005; Watson et al., 2017). Similar to the associated literature, the terms academic achievement, academic outcomes, or academic performance are used interchangeably to refer to variations of this definition in this thesis (Howie & Pate, 2012).

Since at least the 1900s, advocates and sceptics have debated the role of PA in educational institutions, the main argument of the sceptics being that structured PA, sport and physical education (PE) detracts time from prioritised core subjects such as maths and literacy and thus reduces academic achievement potential (Hodges et al., 2015; Dinkel et al., 2017). Research to discover the true nature of the relationship between PA and academic performance has recently gathered pace in both the quantity and quality of studies, conceivably due to the paralleled increases in evidence highlighting the significance of PA to health (Singh et al., 2012; Li et al., 2017; Sullivan et al., 2017). Howie and Pate (2012) termed the search for a strong evidence-base of a positive connection between PA and academic performance as the 'holy grail' for PA in education, as those in decision-making positions may be more likely to place increased standing on PA opportunities across the curriculum.

Many large-scale cross-sectional studies frequently associate increased PA in or outside the school environment with improved grade point averages and standardised test scores (Erwin et al., 2012; Singh et al., 2012; Mora-Gonzalez et al., 2017; Watson et al., 2017). Other studies have also claimed a positive effect when increasing PA in the school day at the cost of classroom time of directly-examined subjects, mainly as almost no evidence of deterioration in academic performance was found (Ahamed et al., 2007; Stead & Nevill, 2010; Dinkel et al., 2017). There are also examples of null outcomes in the literature with no association between PA levels and academic outcomes (e.g., Kalantari & Esmaeilzadeh, 2016). Significantly though, studies rarely report a negative association between PA and academic outcomes. A systematic review of 43 studies found that only 1.5% reported negative results, indicating that PA initiatives are unlikely to hinder academic performance (CDC, 2010).

While standardised tests and grade improvements may be the most 'headline-grabbing' outcomes for academic leaders and teachers to consider increasing PA in schools (BBC, 2013). Many grade outcome studies on academic performance only detail large scale cross-sectional relationships, making it difficult to prove causality and deduce possible mechanisms for academic performance improvements (Stead & Nevill, 2010; Donnelly et al., 2013). Possible components conducive to academic achievement that may offer possible mechanisms to explain findings include PA improving cognitive abilities such as brain activation, selective attention, memory, and executive functioning (Sattelmair & Ratey, 2009; Haapala, 2013; Diamond, 2013; Li et al., 2017). PA can also increase positive mood, and reduce stress, all factors that may assist academic achievement (Taylor, 2000; Campbell et al., 2002). Research in these areas, however, is often conducted in controlled environments and/or with outcomes specific to retrospective measures; thus, direct application to the classroom and academic performance is limited.

Another domain of academic achievement that has gathered research momentum is how PA may influence classroom on-task behaviour, particularly because students seated and inactive for extended periods of time tend to exhibit more undesirable behaviours (Barros et al., 2009; Murray & Ramstetter, 2013). Behaviour can be an important component of maximising academic achievement (Alexander et al., 1993; Malecki & Elliot, 2002), with more desirable classroom behaviours appearing to facilitate improved learning (Diperna et al., 2002; Algozzine et al., 2010) and with poorly behaved students often achieving lower grades than those seen as exhibiting more positive behaviours (McIntosh et al., 2008). Positive student behaviours have also been associated with improved teacher-student relationships, which may increase the overall functioning of the classroom (Hagenauer et al., 2015; Maykel et al., 2018).

Nevertheless, in May 2019 the UK government invested £10 million pounds in initiatives to specifically tackle ‘bad behaviour’ in schools (Department for Education, 2019) and many teachers continue to identify high-levels of inappropriate and off-task student behaviour as one of the most significant challenges for their classrooms (Haydn, 2014; Camahalan & Ipock, 2015; Roberts, 2018). Previous papers have claimed that despite considerable prior research there is an enduring lack of universally effective, easy to implement and scalable interventions to encourage positive behaviour in classrooms (Godwin et al., 2013; Fedewa et al., 2015). PA may be able to address some of these intervention issues; however, the promising positive research in PA improving classroom on-task behaviour is relatively junior, and significant to the author's vocational practice, the implications to FE college classrooms have yet to be investigated.

1.4 Further Education Colleges in the United Kingdom and Physical Activity

Further Education (FE) Colleges in the UK provide over 750,000 16-18-year-old students technical and vocational education, helping to develop their career opportunities and enabling progress to university or higher-level vocational education (Association of Colleges (AOC), 2019). These students spend a significant amount of their time-awake in the college environment on days that require attendance; therefore, colleges represent a captive and opportune place to promote PA to adolescent populations (Webster et al., 2017; Snyder et al., 2017; Ferrer & Laughlin, 2017). For some students, structured PA in schools and colleges may be the only preparation they have for an active lifestyle (Dinkel et al., 2017). This is especially important as adolescence has been identified as a period of high sport drop-out and that PA decline and low levels of PA in youth have been found to predict future low adulthood PA levels (Malina, 2001).

Perversely, educational institutions have been revealed as one of the main environments of inactivity, with reports of over 92% of educational time being sedentary (Burns et al., 2015; Grieco et al., 2016). The sedentary nature of seated classroom lessons where students are expected to sit for long periods of time and be passive has been identified as a significant contributory factor (Finn & McInnis, 2014; Martin & Murtagh, 2015). In order to help address this problem, The Centers for Disease Control and Prevention (2015) and The World Health Organisation (2015) are encouraging educational institutions to provide students with more opportunities during the learning day to be physically active.

FE colleges are a sector in the UK that could gain most from the research that offers a justification of resource spend on PA initiatives with only 24.5% of FE students classified as 'active', achieving 150 or more minutes of moderate activity per week and 25.5% classified as 'inactive' completing under 30-minutes of moderate activity per week (AOC, 2018). Senior leadership teams in FE colleges have more autonomy than UK state-funded schools to make their own decisions about resource allocations and have no requirement for any minimum physical education time, unlike UK state-funded schools (British Council, 2013). Yet, competing concerns such as summative performance targets and constant cuts from UK government funding to FE colleges, have resulted in the reduction or elimination of PA enrichment programmes in many FE colleges (Trost & Mars, 2009; Office for Standards in Education, Children's Services and Skills (Ofsted), 2012; Weale, 2018). Failure to address low PA levels and barriers to PA opportunities in colleges could be a false economy. Particularly as an ever-increasing evidence-base appears to be accumulating for PA facilitating improvements in a range of factors that could help student academic achievement and college performance, beyond simply the associated health benefits (Tremblay, 2000). Prominently, for student behaviour ‘Ofsted’, which is the all-encompassing inspectorate for quality and educational performance of UK colleges, has reported that negative and off-task classroom behaviours are an important consideration that can interrupt learning and should be minimised (Ofsted, 2014a; Ofsted, 2014b; Ofsted, 2015). If PA can help improve on-task classroom behaviour, this may contribute to the increased likelihood of a positive Ofsted outcome, which is one of the most valued college performance outcomes to educational leadership teams, thus another reason this area may be worthy of investigation (Hill et al., 2016; Department of Education (DfE), 2019). This research, therefore, intends to investigate if PA in college curricula effects the level of on-task behaviour in student classrooms. This may have the wider potential to benefit to student academic performance, their health and well-being and external quality judgements of Colleges such as Ofsted ratings.

Chapter 2 – Review of the Literature

2.1 Literature Review Introduction

Student inattentiveness and disengaging behaviours have been repeatedly identified by teachers and researchers as the factor that accounts for the largest loss of instructional time in the classroom (Karweit & Slavin, 1981; Pellegrini & Davis, 1993; Godwin et al., 2013). Many teachers frequently report struggling to engage students in learning tasks and report that their students find it difficult to maintain focus for extended periods of time (Haydn, 2014; Camahalan & Ipock, 2015). In addition, negative classroom behaviour may not only affect the learners who are exhibiting these behaviours but also negatively impact other learners in the same classroom (Godwin et al., 2013). The scale of the problem of student behaviour and the implications for academic performance are enough to argue for investigations into strategies that may facilitate improved student classroom behaviour (Ma et al., 2014).

One approach to improving classroom behaviour that has been the focus of recent research and teacher interest is the use of physical activity (PA) interventions (Camahalan & Ipock, 2015; Webster et al., 2017; Dinkel et al., 2017). According to this body of research, PA appears to facilitate behaviours such as paying attention, concentrating and focusing on classroom learning activities, all vital aspects of learning behaviour that can directly affect academic outcomes (Caterino & Polak, 1999; Strauss & Young, 2001; Howie et al., 2015; Sullivan et al., 2017). A term that has become prominent in the research literature to collectively describe these desirable classroom behaviours has been 'on-task behaviour' (Mahar et al., 2006; Godwin et al., 2016a; Goh et al., 2018).

2.1.1 Defining On- and Off-Task Classroom Behaviour

Definitions of on- and off-task behaviour in the literature have featured small variations in phraseology between different research papers within the literature. These variations in definitions highlight the complexities of defining on-task behaviour as it can be subjectively problematic to precisely outline its definitive boundaries (Karweit & Slavin, 1982). In addition, there is limited extended discussion on what is, or what constitutes on and off-task behaviour in the literature that engages the topic; often with only restricted discussion featuring a definition. However, common themes emerged between operational definitions with some definitional and terminological consensus. Some authors have placed the importance of operationalising on-task behaviour through visual engagement via students looking directly at the teacher, classroom assistants and/or learning activities or material (Ruff & Rothbart, 2001; Godwin et al., 2013). Eye gaze has been a common measure of visual attention (Just & Carpenter, 1976; Henderson & Ferreira, 2013), but visual engagement is arguably an imperfect measure of definitive on-task behaviour as students could still be on-task without direct eye contact (Ruff & Rothbart, 2001; Godwin et al., 2013). Riley et al.'s (2016) study also adds the important notation that on-task behaviour should not be merely considered as just time spent 'behaving', but instead is time spent directly engaged in academic learning and is situationally dependent on the pedagogical requirements at that moment from the teacher.

In some studies, on-task behaviour is referred to as 'time-on-task' but features corresponding definitions and similarly identifies ratios of classroom time on and off-task for analysis. Thus consistent with the papers of Rowe et al. (2009), Mullender-Wijnsma et al. (2015) and Grieco et al. (2016),'on-task behaviour' and 'time-on-task' are used interchangeably in this thesis to refer to verbal or motor behaviour that is appropriate to the learning situation, while following the rules of the classroom with reference to the academic activity assigned by the teacher. Examples of specific classroom on-task behaviours can include: working quietly at one's desk, engaging in group activities when appropriate, responding to teacher questions, demonstrating activity to others when expected to do so, and engaging in relevant conversation during class discussion (Mahar et al., 2006; Godwin et al., 2013; Maykel et al., 2018).

Important to the definition of on-task behaviour is that when a student is not on-task, he or she is then considered to be off-task; off-task behaviour then refers to behaviours unrelated to the narrative and curriculum where there is no learner interaction with the lesson content when the learner is expected to be engaged (Rowe et al., 2009; Bartholomew & Jowers, 2011). Off-task behaviours may include gazing out of the window, wiggling in or out of his/her seat, or placing his/her head down on the desk, reading inappropriate material or talking to other students about content not related to the lesson (Bartholomew & Jowers, 2011; Maykel et al., 2018).

2.1.2 The Importance of On-Task Behaviour in the Classroom

On-task behaviour has been specifically identified as a key predictor of academic success (Worthen et al., 1994; Donnelly & Lambourne, 2011; Riley et al., 2016). Likewise reducing off-task behaviour is important as it has been recommended that a classroom should display at least 80% on-task behaviour as a benchmark to sustain an academic environment conducive for optimal learning (Greenwood et al., 1979; Mitchem et al., 2001; Burns et al., 2016). Carroll's (1963) time-on-task hypothesis, with time as its central element, suggests that the longer a student spends engaged with learning materials, the more opportunities the student has to learn (Baker et al., 2004; Gašević et al., 2015). Importantly in this hypothesis, student learning is seen as depending on how this time is used, not just the total amount of time allocated (Gašević et al., 2015; Hatala et al., 2015).

A number of studies on classroom learning that followed Carroll's (1963) time-on-task hypothesis have typically supported the theory that increasing the amount of time students actually spend on learning can be a key element of effective learning and educational performance (Worthen et al., 1994; Donnelly & Lambourne, 2011; Hatala et al., 2015; Riley et al., 2016). Similar to many areas of educational research there are also examples of inconsistent and non-significant effects concerning student achievement and time-on-task (Karweit & Slavin, 1982; Worthen et al., 1994; Godwin et al., 2016a). Other studies where significance has been identified, suggest engaged minutes account for only a small proportion of the variance in student achievement (Karweit & Slavin, 1981; Karweit & Slavin, 1982; Hatala et al., 2015; Godwin et al., 2016a).

Even when acknowledging that time-on-task effects can be inconsistent, in practice, teachers have often designed learning programmes to explicitly increase on-task behaviour and subsequently reduce off-task behaviour, through various approaches such as student self-monitoring strategies and teacher-timed attention and feedback to individual students (Amato-Zech et al., 2006; Howie et al., 2015). Developing strategies that support student engagement in learning is still considered one of the foremost ways of improving student learning and research continues to be published with this focus (Gašević et al., 2015; Hatala et al., 2015). Therefore, in creating optimal learning conditions, on-task and non-disruptive classroom are likely to be beneficial (Black & Fernando, 2014).

2.1.3 Literature Review Boundaries and Structure

The purpose of this review was to examine previous literature that investigated the relationship between PA and on-task behaviour in classrooms. During initial exploration of the literature in 2013, it became apparent that studies considering on-task behaviour and PA primarily appeared to fit into one of two broad categories: experimental designs surrounding a PA intervention and producing data of a quantitative nature, or designs of qualitative student and/or teacher perceptions around PA affecting classroom learning with some reflection appearing inductively on changes in classroom behaviour. Studies involving qualitative questioning based purely on behaviour and PA were rare, later a small number of studies were a ‘hybrid’ of both categories where quantitative data were presented alongside teacher and/or student qualitative opinions began to emerge (Wiebelhaus & Fryer-Hanson, 2016; Massey et al., 2017; Bublitz & Rhodes, 2017; Stoepker et al., 2018). Numerous studies were found that investigated elements tangibly linked to PA and on-task behaviour such as recess, cognitive functioning, concentration, focus and other academic achievement markers in schools.

Consequently, to help concentrate this review on studies that were directly relevant to the current thesis, operational boundaries were drawn. Only peer-reviewed studies that directly mentioned and addressed on- and/or off-task behaviour or studies that sought student and/or teacher opinions about PA effects on classroom performance were reviewed to control for quality, quantity and thesis foci. Quantitative studies were also required to have either recorded PA objectively or feature an instructor/teacher-led PA session to increase the confidence of augmented PA. For example, studies such as Jarrett et al. (1998), Norlander et al.,(2005) and Barros et al. (2009) investigated the recess breaks of free play among young children and found improved behaviour in classrooms when compared to no recess situations. Although in these studies, the recess may have provided an opportunity for additional PA, it cannot be assumed that more PA had taken place as PA was not assessed or observed. In addition, playground-based recess periods tend not to exist in FE colleges and physically active free-play is thought to decline with age (Smith & Pellegrini, 1993).

A large volume of research literature has investigated the benefits of PA for the behaviour of specific groups of students with diagnosed or designated learning and intellectual difficulties, such as ADHD and autism (Miramontez & Schwartz, 2016; Den Heijer et al., 2017). These studies were excluded from the literature review due to the specific dysfunctional nuances and divergent complexity in assessing behavioural changes in students who already have impaired attention and behaviour capacities (Dekkers et al., 2017; Den Heijer et al., 2017).

An important consideration for the literature review and the ensuing methodological design of the study were ethically passed early 2014, whereas the following literature review was informed by literature current to the start of 2019. Thus, the review in places may appear broader to the direction of the study’s succeeding methods and aims, due to the inductive nature of the qualitative interview process of this thesis's ensuring methods. However, it offers an overview of the state of the knowledge in this area at the time of writing and is intended to educate the reader for a more informed position in the subsequent analysis of the thesis's outcomes.

2.2 Quantitative Investigations of Classroom On-Task Behaviour and Physical Activity

When reviewing the literature, the relationship between on-task behaviour and PA appeared overwhelmingly positive, with over 20 quantitative studies found reporting a significant facilitatory effect of PA as increasing classroom on-task behaviour. Null outcomes of no significant effect from PA interventions also featured in the on-task literature, but these are much smaller in number (Metzler & Williams, 2004; Logan et al., 2015; Wilson et al., 2016). Most significantly, no study featuring quantitative outcome data could be found that showed PA decreasing mean-level classroom on-task behaviour and recent systematic reviews also report similar conclusions (Li et al., 2017; Sullivan et al., 2017).

One of the earliest mentioned studies in the literature that specifically investigated the relationship between on-task behaviour and PA is an unpublished manuscript from Metzler and Williams (2004) cited in Kibbe and colleagues' (2011) review paper. Metzler and Williams (2004) did not set out to investigate on-task behaviour, but when deploying a classroom intervention to increase classroom PA, anecdotal feedback from teachers suggested improved classroom behaviour from students after PA. This prompted further exploration with systematic classroom observations from the authors; however, even though Metzler and Williams (2004) revealed a 21.4% reduction in off-task behaviour after the classroom PA, this was reported to be statistically insignificant. The original manuscript was not available on any of the databases searched, thus the possible reasoning behind this non-significant result is not clear.

Mahar et al.'s (2006) study followed-up these findings with a paper that purported a significant 8.3% increase in on-task behaviour after classroom-based PA compared to control conditions. This paper was one of the primary inspirations for the inception of this thesis in 2012-13 and appeared to have instigated a rapid increase in the volume of studies since. Three to four more on-task behaviour and PA experimental designs were published between 2009-2013 and then a considerable explosion of over 16 studies appeared between 2014-2018, with a large number adopting or adapting Mahar et al.'s (2006) observation method. Further supporting, at the time of writing, on-task behaviour and PA research investigations were a current and noteworthy area that needed further inquiry.

2.2.1 Quantitative Measures of On- and Off-Task Behaviour in the Classroom

A consideration when comparing on-task behaviour research is the different operationalisations of time-on-task as a construct; this is reflected in the variety of methods deployed to measure on-task behaviour in the wider literature (Karweit & Slavin, 1982; Hatala et al., 2015). For example, previous research has assessed on-task performance through eye-tracking, sometimes with advanced technology such as computer-monitored spectacles (Davis & Tomporowski, 2011; Gašević et al., 2015). Others have adopted cruder notions of on-task behaviour, such as recording the number of lectures or school days attended (Admiraal et al., 1999; Hatala et al., 2015). A more typical approach to measuring on-task behaviour was to use observational methods such as monitoring participants at specified time intervals and coding that behaviour using a predefined coding scheme (Allday & Pakurar, 2007; Gašević et al., 2015). Studies that have directly investigated classroom on-task behaviour and PA are particularly dominated by direct systematic momentary time-sampling observation with classroom behaviour usually reported as a ratio percentage of timed-intervals a student appears to be exhibiting on-task behaviour, compared to off-task behaviour.

Some studies have further divided on-task behaviour into additional subcategories, such as 'actively engaged', which refers to reading, writing or performing a teacher-set task or 'passively engaged', which includes behaviour such as seated listening (Mahar et al., 2006; Ma et al., 2014; Riley et al., 2015). Off-task behaviour in these studies has also been subcategorised, for example: off-task motor i.e., fidgeting, drawing, restlessness, off-task verbal i.e., talking to classmate, speaking when not called upon or off-task passive i.e., gazing off, not making eye contact to the speaker, head down on the table (Ma et al., 2014). However, between these subdivisions, limited statistical significance has been detected and authors of these studies often resort to only reporting the gross on-task and/or off-task behaviour scores, possibly signifying that the observation subcategories are not a sufficiently sensitive instrument of categorisation within classroom observations.

Commonly, the momentary time-sampling method used in a large number of studies has evolved from the observation instrument used in Mahar et al. (2006). This method typically involved a researcher attending classrooms and observing a student's on-task behaviour, then rotating systematically to another student in the class. In earlier studies, the observer would observe the student for 10-seconds and then after each 10-second interval, the observer had 5-seconds to record the behaviour by circling an appropriate code (on task, motor off-task, noise off-task, or passive/other off-task) on an observation recording sheet (Mahar et al., 2006). Trends in more recent studies have removed additional sub-codes due to lack of significance previously reported and to reduce observer complexity. Later studies have also reduced momentary time-sampling to 5-seconds observation on each student in an attempt to increase data reliability through a lower probability for more than one behaviour to occur within a shorter interval and to allow for more observation intervals in a given amount of time (Grieco et al., 2016; Burns et al., 2016; Goh et al., 2016).

Rarely did studies expressly address the issue of the occurrence of both on-task and off-task behaviours occurring in the same time interval. An exception by Maykel et al.'s (2018) study stated that when observing on-task and off-task behaviours simultaneously in the same observation interval, students were marked as on-task. Another noteworthy adaptation of Mahar et al.'s (2006) observation method, occurred in Howie et al.'s (2014) research, where videotapes were used to record the classroom and on-task behaviour determined by the direction of the student's gaze, either at the instructor or on learning materials. Videotapes were also used in Wiebelhaus and Fryer-Hanson's (2016) study but in this case, their role was to help confirm and validate primary observations. The use of video is important as this may have in itself 'formed' the data and change the dynamic of the 'observer effect', whereby participants possibly aware that their behaviours were being recorded for future observation, and performed to the camera (Sparrman, 2005).

Not all studies adopt or reference Mahar et al.'s (2006) method as the foundation of their observation method. For example, Ma et al. (2014) used the Behavioural Observation of Students in Schools Tool specifically with off-task behaviour being recorded using a timed partial interval method (Shapiro, 1996). This involved a 30-second observation of a given student before moving onto the next student, the duration of any off-task behaviour was also recorded as occurring for (i) a short period of time (i.e., 1-4 seconds), (ii) some of the time (i.e., 5-25 seconds), or (iii) the entire duration of the observation interval. However, interestingly, regardless of the momentary time-sampling observation method, a positive significant interaction with PA was commonly observed.

Three studies were found that did not use researcher-led observation or specifically observation of students' behaviour in the classroom as an on-task measure. Herman et al.'s (2013) study observed teacher behaviour, recording the number of disciplinary comments made by the teacher to the class. These authors noted that teacher disciplinary comments reduced significantly with the PA intervention compared to control sedentary lessons, leading the authors to conclude that incorporating PA into the classroom is likely to improve classroom on-task behaviour. Camahalan and Ipock's (2015) measurement of on-task behaviour came direct from teachers who recorded the frequency of on- and off-task behaviours themselves. Specific details of the data collection by teachers was vague and it may be questionable to how a teacher could instruct a class and in a systematically valid fashion observe classroom behaviour simultaneously. Nevertheless, in Maykel et al. (2018) and Riley-Tillman et al. (2008) moderate positive correlations were reported when comparing teacher perceptions of on-task behaviour percentages to researcher observations.

A common weakness of classroom observation may have caused difficulties in blinding participants to the consciousness of being observed, whether via researchers, cameras or teachers. Classroom observations may, therefore, resulted in some participant reactivity, where students modify their behaviour as a consequence of being observed. Some studies such as Mahar et al.'s (2006), Ma et al.'s (2014) and Wilson et al.'s (2016) attempted to minimise reactivity by not revealing the specific students being observed, positioning observers out of the direct sight of participants and prior placing of observers in classrooms for a familiarisation period. In Massey et al.'s (2017) study students and staff were deliberately blinded to the purpose of the study and the content of the data collection; this raises contentious ethical considerations, however (Gillham, 2008).

It may have also been difficult to double-blind observers, particularly as the PA had just taken place from several visible physiological and verbal clues, such as sweating and heavy breathing. Limited or no attempts to blind observers in much of the associated literature also raises the possibility of observer bias. In a partial attempt to address such concerns of bias and subjectivity, studies often deployed secondary observers. Using more than one observer allows methods to be evaluated for reliability and validity (Viera & Garrett, 2005; Rodwell, 2015). All quantitative studies that reported inter-observer reliability were found to be within the acceptable limits quoted by Mahar (2011) as a Cohen's kappa>0.75 and over 80% inter-observer reliability as required by Goh, (2017) and van der Mars (1989). Many studies report much higher inter-observer agreements: for example, Mahar et al.'s (2006) study reported an average agreement of 94%, while Goh et al.'s (2016), reported 96%, suggesting the observation methods were highly reliable, providing creditably for the objectivity of the data produced (Stylianou et al., 2016a). Observers were also often ‘trained’ in observation and some studies highlighted that discussion and reflection were encouraged between observers where discrepancies arose (Ma et al., 2014; Grieco et al., 2016). Indeed, Sullivan et al.’s (2017) study identified both training and reflection as features of good observation practice that may help the trustworthiness of data (Maeda & Randall, 2003). However, not all studies mentioned that observers were ‘trained’ and even in those that did, the nature or criteria of this training was largely absent (Riley et al., 2016; Goh, 2017).

2.2.2 Design and Timing of Quantitative Measures to Record On-Task Behaviour

The study design, placement and timing of when on-task behaviour observations occurred is a key variable that differs between studies. Commonly, studies deployed repeated measure designs, recording on-task values before and after PA on the same day (Mahar et al., 2006; Herman et al., 2013; Ma et al., 2014). Others compared multiple repeated measures on differing school days (Logan et al., 2015; Riley et al., 2016; Burns et al., 2016). In Stylianou et al.’s (2016a) and Mahar et al.’s (2011) papers baseline observations were not possible on the day due to the implementation of before school PA interventions, therefore, comparisons were made instead to control observation days. Some studies examined change in on-task behaviour in longitudinal designs; for example, in Burns et al. (2016) each classroom was observed at baseline and at 6- and 12-weeks after the commencement of the PA intervention, with on-task behaviour significantly increasing 14% from baseline at 6-weeks and 20% at 12-weeks. From the limited evidence available, it is not plausible to deduce there may be an accumulation effect over-a-period of time and same day studies have reported similar degrees of change. However, no study had focused on comparing acute effects systematically to chronic, possibly because such designs would be challenging to implement.

Only few studies explicitly mention observing students at the same time of day between comparison conditions to control for circadian effects, that have also been previously suggested to influence on-task behaviour (Crowley et al., 2007). Further vagueness between studies also existed to when observations began and finished in relation to PA. For example, Grieco et al. (2009) stated that observations took place within an hour of PA, although exactly how long after PA for each student is unclear. This may be important in ascertaining the time-course effects for on-task behaviour. For instance, qualitative teacher opinions in Section 2.5 suggest a transitioning problem between classroom learning and PA; thus observations immediately after PA may indicate a more off-task classroom that becomes more on-task as the lesson progresses. Only one study was found that investigated the time-course interactions, where on-task behaviour averages were calculated for three 15-minute blocks over a 45-minute observation period after PA, but no significant difference was seen between these blocks (Maykel et al. 2018). It has been suggested that future research should involve more extended observation periods to determine time-course changes (Wilson et al., 2016; Maykel et al., 2018).

2.2.3 Sample Characteristics of Quantitative Studies

Sample sizes across studies exhibited considerable variability. Some included large scale samples such as 448 participants in Szabo-Reed et al.

(2017) and 1460 participants in Burns et al. (2016). Large samples may be beneficial to increase validity in trends applying to a wider selection of classrooms with differing characteristics. Other studies involved very small samples, for example, three students in Wiebelhaus & Fryer-Hanson (2016) and ten in Camahalan and Ipock (2015), chiefly, as these two study's approaches were different from much of the rest of the research literature. Camahalan and Ipock (2015) conducted teacher-initiated action research, whereas Wiebelhaus & Fryer Hanson (2016) used a case study design. Both papers reported ratio data that indicated PA decreased student off-task behaviours, however due to the limitations of sample sizes, this was concluded via rudimentary visual analysis of graphs and anecdotal notes rather than statistical inference. Other authors that have used larger samples ($\geq$21), have also reported insufficient sample sizes may have influenced their ability to detect statistical significance (Mullender-Wijnsma et al., 2015; Logan et al., 2015; Bublitz & Rhodes, 2017). To avoid such problems, Riley et al. (2016) deployed sample size power calculations pre-study which may also be considered good ethical practice in research (Bacchetti et al., 2005). Similar strategies are likely to have also been used by other authors to determine how many participants would be suitable, but often this is not explicitly mentioned in methodologies.

Most research in PA and classroom behaviour had come from the United States (Mahar et al., 2006; Grieco et al., 2016; Wiebelhaus & Fryer-Hanson, 2016; Goh, 2017), but other notable locations included the Netherlands (Mullender-Wijnsma et al., 2015) and studies from Australia (Wilson et al., 2016; Riley et al., 2016). High-quality studies from UK-based populations were largely absent. Also, many studies appeared to feature single site or single education district, operating under a common administrative structure (Kibbe et al., 2011; Wiebelhaus & Fryer-Hanson, 2016). These geographical and sociocultural variations may present higher concentrations of certain influential factors such as socioeconomic status, which has been suggested as an influencing variable in student on-task behaviour (Wiebelhaus & Fryer-Hanson, 2016; Sullivan et al., 2017). Not all studies offer detailed information about samples investigated, so it is currently challenging to deduce the influence of these factors.

A sample descriptive, almost universally detailed by papers, was participant ages and educational level. Studies predominantly featured children under-10 years old, and many were carried out in elementary/primary school settings. There were very few studies that involve adolescents above 14 years old (Goh et al., 2016; Wilson et al., 2016; Ferrer & Laughlin, 2017) and therefore little evidence regarding whether PA may also affect on-task behaviours in adolescent classrooms. Interestingly, Wilson et al. (2016) directly attributed the use of 'older' 10-12 year-old students compared to previous positive outcomes in younger samples as possible rationale for witnessing no difference in off-task behaviour. There are examples of age being a contributing factor in wider academic research and also with PA affecting academic markers in primary but not secondary school students (Mora-Gonzalez et al., 2017). Further, a number of cognitive functions arguably related to on-task behaviour such as concentration (Caterino & Polak, 1999), sustained attention (Betts et al., 2006), working memory and inhibition control (Diamond, 2013) are thought to develop through to adulthood. For example, basic attention increases with age until around 11-12 years, when it is thought to become more stable (Dias et al., 2013; Sullivan et al., 2017). Basic and sustained attention has also been mentioned to develop rapidly through childhood until around 11-12 years, before beginning to plateau into adolescence (Betts et al., 2006; Cohen et al., 2011; Sullivan et al., 2017). It could be therefore that younger students have shorter attention spans compared with older students and thus are more likely to benefit from PA in terms of increasing their on-task behaviour (Erwin et al., 2012; Wilson et al., 2016). From a review of the literature, it is apparent that more studies are needed in a broader range of educational institutions such as UK FE Colleges and students towards the 'older-end' of adolescences, to assess if PA can also benefit other educational environments (Wiebelhaus & Fryer-Hanson, 2016; Wilson et al., 2016).

Other reported characteristic details of sample populations varied considerably between studies. For example, some authors failed to even mention the gender distributions of participants (Camahalan & Ipock, 2015; Goh et al., 2018) despite gender being proposed as a possible influencing variable to behaviour and cognitive measures (Jones & Myhill, 2004; Howie et al., 2014). This is a potential shortcoming as more complete information about sample characteristics involved in studies could help improve understanding and guide general dissemination of effective classroom physical strategies with greater confidence across a variety of students and educational institutions (Stead & Nevill, 2010; Kibbe et al., 2011; Sullivan et al., 2017).

A small number of studies have directly analysed sample category variables that may mediate student behaviour, such as: body mass index (BMI), intelligence quotient (IQ), gender, race, school engagement and social-economic status via parental education/occupations and free school meal status (Raver, 2012; McCormick et al., 2014; Howie et al., 2015). When such analyses have been deployed, outcomes have been shown to be limited and inconsistent, partially due to study designs (Grieco et al., 2009; 2016). For example, a small number of studies have indicated that students who are most off-task appear to improve the most in on-task behaviour (Mahar et al., 2006; Ma et al., 2014), while Howie et al.'s (2014) results did not support these findings. This discrepancy may be partly due to classification banding cut-offs fluctuating between studies. In Mahar et al. (2006), for example, students were considered to be in the 'least on-task' category if they were on-task less than 50% of the time. Whereas in Howie et al.'s (2014) study 60% was used, as only six participants averaged less than 50% on-task behaviour, so this boundary was adjusted to allow effective statistical comparisons. Similar contrasting outcomes have been reported with the interaction of BMI. Howie et al. (2014) found a demonstrable effect of BMI when categorising students into low compared to high BMI groups yet, in their analysis Grieco et al. (2016) found that on-task changes were unrelated to BMI. More consistent and abundant information about responses to PA and on-task behaviour from different sub-sample groupings could help guide the general dissemination of effective classroom PA strategies with greater confidence across a variety classrooms and individual characteristics (Grieco et al., 2009; Kibbe et al., 2011; Carlson et al., 2015; Dinkel et al., 2017).

2.2.4 Physical Activity Interventions Deployed in Studies

When reviewing the literature, interventions of PA varied markedly between studies. This is perhaps to be anticipated as Caspersen et al.'s (1985) all-encompassing and wide-reaching definition of PA can refer equally to participation in sports (Bradley et al., 2013), physical education classes (Ardoy et al., 2014) and daily physical tasks such as commuting to and from school (Mora-Gonzalez et al., 2017). Furthermore, PA can be delivered in multiple ways and the variety of differing PA interventions between studies can be further explained using the FITT principles concept (American College of Sports Medicine (ACSM), 2014), namely Frequency (how many times a day/week), Intensity (how hard / level of effort), Time (duration) and Type of PA (mode).

2.2.4.1 Physical Activity Type

The type of PA refers to the form PA takes or the mode in which it is delivered and varied considerably between studies (ACSM, 2014). A large number of studies used gross motor skill activities with minimal equipment, for example, push-ups, sit-ups, stretching, running, dancing and jumping, usually all on the spot in a classroom (Camahalan & Ipock, 2015; Logan et al., 2015; Burns et al., 2016; Maykel et al., 2018) or outdoor walking/running activities (Stylianou et al., 2016a; Stoepker et al., 2018). By far the most common mode or form of PA many studies investigated was the implementation of structured PA packaged into short 10-15-minute durations, often infusing academic content with movements in what Martin and Murtagh (2017b) described as Movement Integration (MI) Programmes. These were typically delivered either alongside or during academic content, without the need for specialist equipment or space, to assist with feasible implementation in classroom environments.

The most frequently deployed MI programme in the on-task behaviour literature either directly or indirectly adopted as the foundation for PA interventions was TAKE 10! (Metzler & Williams, 2004; Goh, 2017). Some authors had stated replicating closely TAKE10! protocols but instead call these 'energizers', presumably due to commercial conflicts (Mahar et al., 2006; Grieco et al., 2009; Wilson et al., 2016; Burns et al., 2016). TAKE 10! was designed as a way to increase PA in lessons (Tsai et al., 2009) while linking academic learning objectives and content in various subject areas, including language arts, math, social studies and science (Tsai et al., 2009). Examples of activities from the TAKE 10! can be found from http://www.take10.net and an example shown in Figure 2.1 briefly illustrates a sample TAKE 10! Session.

Sample TAKE 10! Session Activity
A Healthy Week* Using the tune from a popular holiday song, sing and perform the following activities: Start with the first day; pause to do the activity after singing the verse. Then go to the second day, singing the verse and pausing to do the action, then repeating the first day's verse and action. For each succeeding day, sing the verse and complete the new action, then count back to the first day with each round. On the first day of good health, this is what we do: First - One breath that fills your lungs up. Second - Two forward lunges. Third - Three overhead claps. Fourth - Four forward kicks. Fifth - Five backward arm circles. Sixth - Six vertical jumps. Seventh - Seven deep squats.
*Adapted from the TAKE 10! curriculum

Figure 2.1. Example Take 10! Session (Tsai et al., 2009).

Most other MI programmes adopted similar structures; for example, in the A+PAAC MI programme, maths students might hop or skip across the classroom and counted their own ‘laps’ as well as added laps of groups of students (Donnelly et al., 2013; Szabo-Reed et al., 2017). Although most MI programmes used in the literature were similar, differing characteristics in delivery were also evident. For example, MI Programmes commonly aimed to be 10-minutes in length with the exception of the Comprehensive School Physical Activity Program (CSPA) (Burns et al., 2016) and EASY Minds (Riley et al., 2016) which lasted ~60-minutes in an attempt to meet World Health Organisation recommendations that children participate in at least 60-minutes of moderate-to-vigorous PA (MVPA) each day (WHO, 2010). As such, these lessons had a broader scope of activities as outlined in Figure 2.2.

Academic concepts	Description of activity
Recall multiplication facts	• Students performed a modified version of the popular dance "Macarena" whilst recalling mathematics facts. This involved crossing the right hand to left shoulder, left hand to right shoulder, right hand to left hip and left hand to right hip whilst recalling number facts •Students performed slap count whilst recalling mathematics facts. This involved students facing a partner and taking turns to place their right hand on the palm of their partner's right hand and then their left hand in their partner's left hand whilst recalling number facts •Drill ladders-students used a variety of footwork patterns and recalled multiplication facts whilst stepping in each rung
Multiple choice algorithms	• Students were given an algorithm on the whiteboard with four possible answers • Students responded to the answer by performing a set movement • E.g., Answer A = tricep dips, B = squats, C = march on spot
Create line graphs	• Students completed a 10 min aerobic routine and recorded heart rates every minute (heart rate monitor worn by several children). This information was then used to create a line graph
Estimate distance	• Students estimated distances around the school. E.g., Classroom to office. They counted steps, recorded using a pedometer and checked using a trundle wheel • Students threw, kicked and struck objects of different sizes. They then estimated and measured distances using tape measures
Use a digital stopwatch	• Students used a stopwatch and timed themselves over various short distances, 10, 20 m. They used this information to predict how long it would take to race 100 m. This was used for a variety of locomotor movements
Work out mode, mean and median	• Students completed a tabloid of activities including, skipping, throw and catch, ball bouncing, shuttle runs over 30-s periods. The results of groups were compiled and students worked out means, modes and median values
Solve mathematical equations	• Koosh balls were thrown on to a horizontal target mat of concentric circles with a score value. The total score was then multiplied by the number rolled on a 20 sided dice.

Figure 2.2. Example activities used in the EASY Minds Programme (Riley et al., 2015)

Integration of academic content has been suggested as a way to increase children's engagement and PA without losing time intended for academic learning, thereby increasing the likelihood of teacher 'buy-in' to using these programmes (Mullender-Wijnsma et al., 2015). A number of these MI programmes appeared to have commercial elements, with websites featuring saleable products marketed at schools to deliver PA programmes. This may be part of the reason these interventions frequently appeared in much of the literature and had received commercial research funding to enable resources for investigation. This may subsequently call into question the impartiality, influence and commercial motivations of some papers but is a common problem and occurrence across funded research (Djulbegovic et al., 2000; Lexchin, 2012).

The personnel who deliver the PA interventions was another variable that differed between studies. Most commonly, PA was delivered by the classroom teacher (Mahar et al., 2006; Burns et al., 2016; Maykel et al., 2018), yet in a small number of studies, PA interventions were researcher-led (Howie et al., 2014; Riley et al., 2015, 2016; Grieco et al., 2016) or used video-based PA instruction to engage large numbers of students (Mahar et al., 2011). Using researcher-led PA could impact the interventions sustainability and likelihood of implementation in schools and colleges due to supplementary costs of external instructors. Howie et al. (2014) partially justified such an approach to ensure consistency of delivery between participant groups and because resources needed to train teachers in the delivery of a PA programme are also costly. Studies that used teachers commonly signposted the fact that teachers were ‘trained’; however, inconsistency in the details and extent of teacher training was apparent. For example, in Szabo-Reed et al. (2017) teachers were trained to deliver A+PAAC over 12-hours of in-service sessions, whereas Mahar et al. (2006) and Goh, (2017) conducted a single 45-60-minute training session. Other studies such as Stoepker et al. (2018) did not mention any specific training of delivery staff. These factors may all affect the consistency and comparability of studies as quality control mechanisms may be reduced in PA delivery.

In contrast, Szabo-Reed et al. (2017) proposed the A+PAAC MI programme as simply representing a concept whereby PA is integrated with classroom academic instruction and actively encouraging the individual creativity of the teacher to infuse PA into lessons. This may arguably be more applicable to practice as different learner and classroom needs may need novel and personalised approaches to delivery for increased acceptability. Other studies also appeared to encourage similar flexibility yet lacked significant detail to identify accurately the structure of PA delivered. For example, in Herman et al. (2013, p.43) the authors state “The PA classes in which students participated for the Post-PA trials were 30-minutes in duration and involved various physical activities of a moderate-intensity”. This is significant, as PA dose has been identified as an important issue in fully understanding the mechanics and optimal prescription of PA for increasing on-task behaviour with minimum impact on academic instruction time (Howie et al., 2014). From the data available it is not apparent that one mode of PA may was preferential to another. Studies have not been designed with this as a research objective; instead, more progress has been made in consideration around the intensity and duration of PA. More information on mode may be useful to help teachers to identify what type of activity is most beneficial, but a large number of studies may be needed to answer this. Perhaps mode is not the most defining factor compared to PA intensity and duration (see 2.2.4.2 and 2.2.4.3) and studies with diverse and random modes may also be useful in the pursuit to identify modes importance and more reflective of reality of PA in schools and colleges.

2.2.4.2 Physical Activity Intensity

Intensity refers to the rate at which PA is performed or the magnitude of the effort required to perform an activity (WHO, 2014b). Intensity has been indicated as important in studies that have investigated academic and cognitive performance (Coe et al., 2006; Bowling et al., 2017; Li et al., 2017); yet, in the on-task literature, intensity is a variable yet to be fully examined.

To deduce intensity, PA needs to be recorded; measures used in previous on-task literature include: pedometers(Mahar et al., 2006; Stylianou et al., 2016a; Burns et al., 2016; Stoepker et al., 2018), accelerometers (Mahar et al., 2011; Grieco et al., 2016; Wilson et al., 2016; Riley et al., 2016), heart-rate monitors (Mullender-Wijnsma et al., 2015), and observations (Howie et al., 2014; Szabo-Reed et al., 2017). Many review papers have suggested these methods are prone to imprecision and bias. For example, the construct validity of pedometer steps has been questioned given that these devices only accurately capture lower-limb ambulatory movement (Burns et al., 2016). However, beyond the use of the gold standard isotopic doubly-labelled water method, which costs over £1000 per participant, pedometers and accelerometers are still thought to be some of the most cost-effective options available to research teams (Booth et al., 2013; Snyder et al., 2017).

Intensity is difficult to calculate at an individual level, as the intensity of PA depends largely on an individual’s previous exercise experience and their level of fitness (WHO, 2014b). Ideally, therefore, fitness needs to be assessed to ensure participants are operating at the desired percentage of their maximum intensity. Only two studies could be found that assessed participant fitness, gathering maximum heart rate data to derive individual intensity zones

(Mullender-Wijnsma et al., 2015a; Mullender-Wijnsma et al., 2015b). Furthermore, variations in PA recording methods made comparisons between studies problematic to assess with consistency the true nature of intensity and on-task classroom behaviour. In response to this problem, set activity cut-points had been devised to create universal thresholds for PA intensity classification, with Moderate-to-Vigorous PA (MVPA) repeatedly mentioned as a threshold cut-point for optimum benefits in the academic and cognitive performance literature (Coe et al., 2006; Bowling et al., 2017; Li et al., 2017). MVPA is usually defined as any PA over three metabolic equivalents, an estimate that indicates that an individual's energy metabolism has increased three-fold from resting baseline values (Ainsworth et al., 2015). In simpler terms, MVPA is PA that requires moderate physical effort such as brisk walking, dancing, housework and sports (WHO, 2014b). MVPA has also been suggested as a possible desirable threshold by several studies in the on-task behaviour literature (Mullender-Wijnsma et al., 2015; Stylianou et al., 2016a; Wilson et al., 2016) and some report intensity specifically by categorising the percentage of time in MVPA (Riley et al., 2015); however, the literature was not at an advanced enough stage to indicate MVPA as a conclusive threshold for on-task behaviour.

One of the most interesting studies on PA intensity and on-task behaviour was by Grieco et al. (2016) who used accelerometers to measure PA and a 'spelling relay' as the PA intervention. Students were grouped into four intensity conditions: (1) seated and sedentary, non-competitive lesson control; (2) seated and sedentary working in competition against other groups; (3) low-moderate intensity PA (LMPA) competition where students walked to and from the classroom board and to sit down between turns; (4) moderate-vigorous PA

(MVPA) competition where students were instructed to run to and from the board and execute jumping actions (e.g. star jumps) as they awaited their next turn. Grieco et al.'s (2016) results indicated that on-task behaviour decreased following the control lesson and showed no change following the sedentary competitive condition. This was interesting, as adding competition without PA appeared to have prevented a reduction in on-task behaviour that followed the control and perhaps needs consideration in future research designs. A significant increase was seen in both PA conditions LMPA and MVPA. The effect size of the MVPA game was nearly three times the effect of the LMPA game; however, baseline time-on-task in the MVPA condition was significantly lower than all other conditions, which is likely to have impacted the magnitude of change. The absence of a cross-over design weakens this study's potential to indicate intensity as a key variable, as it was not possible to rule out the influence of the individual characteristics of each class on outcomes.

Few further studies directly investigate PA intensity and on-task performance and often those rare studies that do, feature indifferent outcomes and like Grieco et al. (2016) had considerable methodological limitations. For example, Ma et al. (2014) reported a positive association between intensity and off-task behaviour, however it must be noted his recording methods used crude intensity methods' where observers estimated a score from 0-3, with 0 representing no PA participation and 3 representing enthusiastic participation. The authors, however, failed to mention the descriptive criteria for a 1 or a 2 score in the paper. Mullender-Wijnsma et al. (2015) used arguably more accurate measures of intensity via heart-rate telemetry but no significant relationship between the intensity of the PA by the percentage of MVPA and time-on-task was identified.

Many studies in the on-task literature failed to report quantifiable PA intensity and the intensity of PA in some study designs was not prescribed and deliberately laissez-faire. For example in Szabo-Reed et al. (2017) and Wilson et al. (2016) teachers were freely able to select the content, mode and learning objectives of the PA-based lessons and in Stylianou et al.'s (2016a) study students were instructed to either walk or run for the duration of the programme, selecting for themselves their PA intensities. Another consideration some authors have highlighted is that high-intensity PA may not be suitable or enjoyable for a significant proportion of students (Wilson et al., 2016; Ferrer & Laughlin, 2017). High-intensity PA requires significant physiological effort, therefore may not be desirable for students with low fitness, motivation or know health alignments (ACSM, 2014) and may lead to additional issues with such as excessive sweating, requiring a change of clothing for hygiene purposes. High-intensity PA is also more likely to require greater physical space to be implemented safely due to the increased speed of movements. More research is needed on PA intensities that strike a balance between positive on-task outcomes and acceptability with participants and classroom functioning. Acceptability could be even more pertinent for adolescence, as this stage of development is where habitual PA-levels decline sharply and sport participation drop-out is particularly high; thus PA more broadly may be plagued with unacceptability in this population (Shennar-Golan & Walter, 2018).

2.2.4.3 Physical Activity Duration

Unlike mode and intensity, duration of PA was typically detailed in studies and could be significant as many physiological responses require a minimum time to initialise, such as delayed increases in breathing and heart rates (Howie et al., 2015; McMorris, 2016). Most commonly, PA interventions lasted between 10-15-minutes (Mahar et al., 2006; Ma et al., 2014; Maykel et al., 2018). It was not clear from the literature why this was the case but possibly this was deemed sufficient time to induce a physiological response. Shorter durations may also be helpful as teachers reported time as a principal barrier to implementing PA into their curriculum (Tsai et al. 2009). Thus, for feasibility and sustainability, briefer sessions may be more likely to be implemented within busy classroom schedules. Less frequently, some PA interventions lasted longer, such as the HOPSports MI programme which lasted approximately 30-minutes (Mahar et al., 2011; Hopsports, 2017), and Herman et al. (2013) deployed a 30-minute moderate-intensity PA session which appeared to resemble a PE lesson. The longest interventions noted was EASY Minds (Riley et al., 2016) and CSPAP (Burns et al., 2016) MI programmes that featured 60-minutes of PA.

It was unclear if longer durations result in a more marked improvement in on-task behaviour. Howie et al. (2014) specifically investigated differing durations of PA interventions of 5, 10, 20-minutes compared to 10-minutes of sedentary classroom activity. Time-on-task was only significantly higher in students after 10 and 20-minutes PA compared to a sedentary control. A trend towards a higher increase in on-task behaviour in the 20-minutes was noted by the authors but was not significant. Stylianou et al. (2016a) examined a before-school walking/running programme lasting either 15 or 20-minutes in two different schools and reported no significant difference between either intervention duration. Due to the limited number of studies that have compared durations, the minimum or optimum duration to influence on-task behaviour was unclear. Nevertheless, Sullivan et al. (2017) and Burns et al. (2016) suggest that longer PA interventions may be more likely to increase the 'odds' of PA being effective in improving classroom on-task behaviour.

2.2.4.4 Physical Activity Frequency

One of the most notable differences in design between studies was whether the study investigated an acute bout of PA, or was longitudinal in design, featuring bouts of PA over several days, weeks or years (Riley et al., 2016; Szabo-Reed et al., 2017). This may be influential as repeat PA sessions over an extended period of time may have additional effects in areas like fitness improvements and reductions in BMI, which independently may also affect student behaviours (Tkacz et al., 2008). Nevertheless, due to the lack of comparative designs, it was unclear whether longitudinal repeat bouts of PA have additional benefits or a diminishing returns effect to on-task performance.

Studies of acute or longitudinal interventions typically featured a PA frequency of one bout per day (Goh et al., 2016); however, this was an area that was not always clearly detailed between studies. Sometimes studies involved repeat bouts over the educational day; for example, Burns et al. (2016) and Szabo-Reed et al. (2017) where teachers were encouraged to implement at least two bouts of PA per day and Stylianou et al. (2016a), where teachers averaged 3.38 separate MI programme exposures per day. Some other longitudinal studies reported exposures per week. For example, in Mullender-Wijnsma et al. (2015), the MI programme was performed three times a week over 22 weeks and three lessons per week for six weeks in (Riley et al., 2016). Only one study has tried to systematically investigate if more than one bout per day carries more benefit, Goh et al.'s (2016) study reported that classes that received more than 1.5 times per day PA sessions saw a 9.8% increase in on-task behaviour, which was significantly higher than classes that received less than 1.5 times/day, with a 5.1% increase. From the sparse available evidence, however, it was not possible to deduce any solid conclusions other than, as with duration, more exposure to PA is likely to increase the odds of an effect (Burns et al., 2016; Sullivan et al., 2017).

Significantly, when reviewing the frequency, intensity, duration and mode of PA used in education settings very few studies focused on 'naturally occurring' PA in schools' curricula such as PE lessons. Often PA-based and PA engaging lessons such as PE, in one guise or another, are mandatory in many national schooling curriculums (Department of Education, 2019; Foster & Roberts, 2019; Victoria State Government, 2019). Linked to this only a handful of studies have looked at durations that may be close to these naturally occurring lessons; for example, 30-minutes (Mahar et al., 2011; Hopsports, 2017) and 60-minutes MI programmes (Riley et al., 2016; Burns et al., 2016). As already mentioned, short durations may be popular due to commercial motivations of MI programmes or in the pursuit for PA to be easy to implement. Still, this appears to be a key omission in the literature, as lessons that already feature high PA would perhaps be an obvious and convenient starting point and provide defence against their removal (Rudgard, 2018; Association for Physical Education (afPE), 2018). This could help further enlighten our understanding around how forms of PA effect on-task behaviours.

2.2.5 Controls and Baselines Commonly Deployed

Having reviewed PA interventions, it was also important to consider the control conditions used for comparison baseline data. The mode of the inactive controls varies between studies; often the controls are detailed only as inactive/sedentary lessons with limited further detail (Mahar et al., 2006; Grieco et al., 2009; Herman et al., 2013). Other studies offer more intricate control situations in an attempt to isolate the effects of PA from the effect of having a break from lesson material. For example, Wilson et al. (2016) compared 10-minute PA to a 10-minutes of reading quietly and in Ma et al. (2014) compared 10-minute PA to a 10-minute inactive lecture on non-lesson related topics such as healthy eating and the history of sport.

Some studies failed to provide a sedentary control condition making it difficult to indicate causality with confidence and reducing the internal validity of outcomes (Camahalan & Ipock, 2015; Burns et al., 2016). In cross-over study designs, individual students acted as their own control and baseline reference (Herman et al., 2013; Mullender-Wijnsma et al., 2015; Wilson et al., 2016). This may be beneficial as other intra-individual influencers to behaviour such as social-economic status, BMI and physical fitness may be more tightly controlled in a cross-over design (Grieco et al., 2009; Howie et al., 2014; Maykel et al., 2018). Also, several studies (see for example Grieco et al., 2009; Mahar et al., 2011; Riley et al., 2016) featured some form of randomisation when allocating participants to control or intervention groups, order of interventions and/or choice of students to be observed in each lesson. Thus, perhaps helping to minimise selection bias thereby contributing to data credibility in those studies.

2.2.6 Summary of the Quantitative Research Literature

Overall, the quantitative data surrounding PA and on-task behaviour indicated a strong, yet incomplete case for the implementation of PA in the learning day of young children. While most quantitative studies used analogous methods of observation to measure on-task behaviour; directly comparing outcomes between studies remains problematic due to variations in study designs and prescribed PA. Almost all interventions in the quantitative literature that objectively record PA demonstrate augmented PA, compared to sedentary control conditions; however, the monitoring of PA beyond the intervention such as playground breaks, after school sport and PE and drama lessons, was largely absent (Logan et al., 2015; Sullivan et al., 2017).

The few studies that record whole school day PA consistently indicated that students did not compensate for increased intervention PA by a subsequent decreasing of PA throughout the rest of the learning day (Mahar et al., 2006; 2011; Wilson et al., 2016; Riley et al., 2016). Beyond the school day, studies largely failed to record student PA levels before or after school. Many students could potentially be involved in extracurricular PA that contributed to the frequency, intensity and duration of their daily PA volume. This is particularly important as additional PA and participation in sports outside of the school day could also affect on-task outcomes (Sullivan et al., 2017).

Even between studies, the duration, volume and frequency of PA is highly variable and was an area the literature commonly expressed needed further investigation (Howie et al., 2015; Wilson et al., 2016; Stylianou et al., 2016a). Understanding these differences may be useful for making tailored PA recommendations for optimum classroom on-task performance (Howie et al., 2014). For practical feasibility and sustainability, briefer sessions perhaps are likely to be implemented and integrated within busy classroom schedules (Howie et al., 2015), but this does lead to another question left largely unanswered in the literature: is more PA better? Currently, the dose-response data is limited and therefore must be interpreted with caution until replicated (Grieco et al., 2016). In addition, studies commonly seem to report outcomes with short-duration and purpose-built PA interventions. No data existed surrounding the impact of naturally occurring and structured PA lessons like sport, PE and drama-based programmes that occur in FE colleges. The question as to whether these 'already occurring' lessons in FE colleges can also contribute to a positive on-task effect remained unanswered in FE colleges and broader education sectors.

2.3 Qualitative Investigations of Classroom On-Task Behaviour and Physical Activity

Several studies investigated the perceptions of teachers and students surrounding the general potential benefits of PA to their classrooms by a range of qualitative methods. Frequently within these datasets, behaviour inductively emerged as a common theme, yet such qualitative outcomes are usually brief, as study questioning was often not explicitly focused on classroom behaviours. The differing nature of the qualitative data produced by these methods compared to the quantitative research can make the drawing of causal inferences difficult; however, scholars have argued for the need to include multiple perspectives, including that of participants, in order to gain a more comprehensive understanding of a research area (Creswell & Tashakkori, 2007; Bryman, 2016).

2.3.1 Qualitative Recording of Perceptions

Methods for the qualitative capture of data varied noticeably, with interviews (Tsai et al., 2009; Benes et al., 2016), questionnaires (Morgan & Hansen, 2008; Howie et al., 2015) surveys (Carlson et al., 2015; Tannehill et al., 2015), self-reflective notes (Stylianou et al., 2016a) and age-appropriate methods such as drawing and writing activities for very young children (Martin & Murtagh, 2015; Snyder et al., 2017; Martin & Murtagh, 2017b) all featuring. Appraisal of strengths and weaknesses of these methods was beyond the scope of this literature review, but can be found in methodological literature (see: Cohen et al., 2011; Silverman, 2013; Jones & Gratton, 2015; Denzin & Lincoln, 2017). Such variations in outcome measurements, however, distorted the clear appraisal of comparable studies and limited the ability to establish consistent relationships between variables (Rasberry et al., 2011; Sullivan et al., 2017).

Teacher and student perceptions of PA and classroom behaviour can be valuable for interpretations of any effects, but bias cannot be ruled out (Denzin & Lincoln, 2017; Sullivan et al., 2017). Existence of various teacher biases have been previously reported, including literature on racial and ethnic bias using behaviour rating scales (Mason et al., 2014) and anti-fatness bias toward obese students (Lynagh et al., 2015). However, differing methods appeared to report stable themes and therefore, may increase confidence in the reality being reported (Dey, 2005; Creswell, 2013).

2.4 Student Perceptions of Physical Activity's Effects on the Classroom

Only a small number of studies have investigated student perceptions of PA and the classroom. Those that do commonly used survey, focus group responses or write and draw activities with various analysis methods such as thematic and content analyses. Only one study to the author's knowledge specifically scrutinised student on-task classroom behaviour and PA perceptions as the foci of investigation, but this study contained only three participants (Wiebelhaus & Fryer-Hanson, 2016). Most studies focused on general insights from student perceptions of PA over an intervention period or specific PA MI programme (see for example, Kibbe et al., 2011; Szabo-Reed et al., 2017; Martin & Murtagh, 2017b). From a review of the literature, two main student factors related to on-task behaviour were commonly reported, namely enjoyment and enhanced learning abilities.

Almost all of the studies that considered student perceptions highlighted increased enjoyment in learning with PA. In some studies, student enjoyment was also linked to increased student academic motivation (Vazou et al., 2012; Martin & Murtagh, 2017b). Grieco et al. (2016) was a unique study that attempted to identify if improved on-task behaviour stems from the PA or if it is the result of enjoyment factors of a break from traditional instruction. Their findings suggest that there may be some benefit to behaviour from the enjoyment of differing activities in lessons, regardless of the presence of PA as a sedentary competitive lesson intervention outperformed a no-intervention control.

Reports of enhanced learning abilities such as increased attentiveness, concentration and focus was another reoccurring theme of student perceptions of PA and the classroom (Tsai et al., 2009; Finn & McInnis, 2014; Howie et al., 2014; Ferrer & Laughlin, 2017; Martin & Murtagh, 2017b). For example, in Wiebelhaus & Fryer-Hanson, (2016) one of the few studies that combines observations of on-task behaviour and student perceptions in the same paper, looked at whether 5-6-year-old students' perceptions of their ability to focus would change with the implementation of classroom-based PA. The participants thought that PA every day helped them pay more attention during lessons. Triangulation of field notes and observed frequency charts confirmed that one-third of the students' perceptions of themselves were consistent with other data (Wiebelhaus & Fryer-Hanson, 2016).

Students also identified improvements in social and emotional control that may help learning. In Martin & Murtagh (2017b), students expressed improved social interactions during the lessons and in Massey et al. (2017), students reported experiencing reductions in bullying and anti-social behaviour at recess in response to the implementation of a MI programme. Another associated ability frequently reported by students was feelings of increased energy and being energised by PA. For example, in Howie et al. (2014), 19% of students reported that PA allowed them to perform better on the tests afterwards, think more clearly, or be more awake. Some authors linked these abilities to possible improvements in on-task behaviour such as Finn & McInnis, (2014, p. 246) who state "we did not measure on-task behaviours, but the students felt that PA helped them to feel less tired and more alert". More studies are needed beyond surveys and write and draw activities to gain more access to participant perceptions, feelings and thoughts. Studies that investigate qualitative student responses using deeper-level methods such as interviews and with questioning focused specifically on on-task behaviour may have the potential to enrich our understanding in this area.

2.5 Teacher Perceptions of How Physical Activity Can Affect the Classroom

Teacher opinions are considered as they may offer additional insight into the effects of PA and classroom on-task behaviour (Maeda & Randall, 2003; Sullivan et al., 2017). Teacher perspectives also provided important 'face validity', which may be an influential factor to other educators who are considering implementing PA in their classrooms (Litwin, 1995; Maykel et al., 2018). A large number of studies commonly report teachers either experiencing or believing that PA can be positive to pupil learning and outcomes. Frequently, teachers specifically indicate noticeable changes in students' classroom behaviour. Maeda & Randall, (2003) reported the sole teacher interviewed perceived more positive classroom behaviour and ability to cover more lesson content with some time left for students to do their homework on days that featured a 5-minute PA break of walking and running, compared to control days. Similarly, in Camahalan & Ipock, (2015) the teacher reported sensing a change in the dynamics of the classroom after PA with more calm students and less student fidgeting.

Similar positive perceptions also occur in multi-participant designs (Tsai et al., 2009; Howie et al., 2014; Hodges et al., 2015). For example, five "teachers appraised the (PA) programme highly with regard to student learning and facilitators of learning such as time-on-task" (Martin & Murtagh, 2017b p. 225). In Mueller et al.'s (2017) study teachers spoke of observed benefits related to PA and students' self-regulation of their emotions in the classroom, such as the ability to share, avoid/solve conflicts and an overall increase in empathy toward other students in the classroom. In contrast, Carlson et al.'s (2017) paper indicated that classroom behaviour improvement was the lowest-rated benefit when analysing survey responses of 337 classroom teachers. Yet, teachers who perceived PA could improve classroom behaviour, were also more likely to implement classroom PA, suggesting the high importance of using PA as a behaviour-management strategy (Carlson et al., 2017).

Teachers in several studies considered that PA could increase student focus and concentration, both qualities conducive to on-task behaviour (Tsai et al., 2009; Martin & Murtagh, 2015; Webster et al., 2017). A large portion of teachers in Benes et al. (2016) and Gibson et al. (2008) described that they used PA primarily to refocus students and break-up the monotony of a classroom. Other studies reported that teachers considered PA helped with student motivation and inclination to focus (McMullen et al., 2014; Carlson et al., 2015; Stylianou et al., 2016b; Martin & Murtagh, 2017b). Notably, some studies also reported that teachers understood students enjoyed PA interventions, so would use these as a form of reward or punishment for good behaviours (Gately et al., 2013; McMullen et al., 2014). In this regard, however, Herman et al. (2013) cautioned teachers against excluding students from PA as a form of behavioural punishment, as this may further exacerbate disruptive behaviours.

A number of studies reported that classroom management problems were, in fact, a deterrent to PA implementation, specifically with 'settling-down' students after the PA and returning to on-task behaviour in the sedentary lesson that followed PA (Gately et al., 2013; Dinkel et al., 2017; Martin & Murtagh, 2017b).

For example, Stylianou et al. (2016b, p.401) reported problems with transitioning back to an on-task classroom, citing teacher comments such as: “setting the pupils down is time-consuming sometimes’ and there is ‘no issues starting but there’s issues stopping’”. Interestingly, similar concerns reported by the author’s colleagues inspired the current thesis’s inception. This is one of the few instances in the literature where negative views regarding the relationship between PA and classroom behaviours are identified. Nevertheless, it is encouraging that teachers within these studies also frequently report more generally favourable pupil outcomes with PA than problems, but transitioning may be an important area of consideration in practice.

2.6 Summary of Qualitative Research Findings

Substantially more studies had investigated teacher versus student perceptions. Both appeared to largely support the quantitative data for possible benefits of PA and on-task behaviour. However, these investigations were commonly generic in focus on the effect of PA on the classroom. Questioning around specifically the effect of PA and on-task behaviour appears absent. The current literature is devoid beyond outlining noticeable changes in behaviour and as such, may be limited in value for understanding the possible mechanisms, signalling a need for further research into student perceptions could be beneficial.

2.7 Evaluating the Evidence

Overall, the current small volume of literature concerning classroom on-task behaviour almost exclusively implied that PA has positive effects, with notably fewer studies reporting null outcomes, and some teacher reported concern when transitioning back to sedentary learning. Within the null outcomes, no apparent trend or commonality was evident to explain the lack of significance. Further, authors in these studies typically indicated that a positive trend was evident but lacking statistical significance. Most notably, there has yet to be a study that has reported PA leading to a mean decrease in on-task behaviour (Wilson et al. 2016). Thus, PA initiatives appear worthy of investment for a more on-task classroom. This may however, be a product of favourable research methodology and a trend towards positive outcome-reporting bias, where non-significant or negative associations in selected outcome variables are not fully reported or addressed (Wood et al., 2008; Howland, 2011). In addition, this could also be a result of positive publication bias where researchers and academic journals have refrained from publishing null or negative results (Dwan et al., 2013). Yet negative or null outcomes could help our understanding, particularly what is ineffectual PA prescription to improve on-task behaviour (Emerson et al., 2010). Understandably, this is not an isolated problem to this area of research but could be a factor in the state of the published literature almost exclusively indicating positive effects.

The literature review in this thesis has demonstrated a current and growing body of research interest, indicating that this as a topical area worthy of investigation; however, a consistent theme from a number of review papers featuring PA and classroom behaviour highlighted the limited number of studies that may be deemed ‘high-quality’ (Stead & Nevill, 2010; Sullivan et al., 2017). Many studies have disputed methodological rigour, lacked preferable pre-post research design, quasi-experimental research, or randomised-controlled trial research designs, contributing to weak and in some cases unclear procedures with generally small sample sizes (Biddle et al., 2011; Li et al., 2017; Sullivan et al., 2017). Further discrepancies between study designs such as variations in definitions of on- and off-task behaviour, observation interval times ranging from 5-15 seconds and some studies analysing off-task behaviour instead of on-task behaviour, all contribute to making cross-examining the evidence challenging. Another significant and influencing factor that made cross-comparison of effects difficult is the wide range of modes and forms of PA investigated in the associated literature, which consequently require different cardiac, biochemical and metabolic responses and recruit different muscle units, which may have also impacted outcomes (Maughan & Gleeson, 2010; Rasberry et al., 2011; Li et al., 2017). Furthermore, exercise protocols and particularly intensities were generally under-reported or vague (Sullivan et al., 2017). Unsurprisingly then, the optimal type, frequency and dose of PA to improve academic outcomes was unknown and this was often stated as a key consideration for future research. Perhaps an interesting area not widely acknowledged was that many of the PA interventions in the literature required extra resourcing, either with time, training and/or equipment. Only one study could be found that had investigated PA similar to a PE lesson. This is perhaps surprising as PE is naturally occurring in some school days. More research into PE lesson effects on behaviour could be useful in defence against its removal or decline in education (Herman et al., 2013; Rudgard, 2018; afPE, 2018). Similarly, naturally occurring PA has rarely been addressed in on-task behaviour beyond school recess breaks where free play was encouraged. Moreover, the volume of PA was not quantified and compared against control conditions.

From the reviewing the literature, it was evident most studies outcomes centre on mean-level changes (Mahar et al., 2006; Grieco et al., 2009; Webster et al., 2015; Wilson et al., 2016). There was little individual-level consideration beyond small sample case studies, anecdotal deliberations and groupings of students into categories such as ‘least-on task’ and BMI stratifications (Mahar et al., 2006; Howie et al., 2014; Wiebelhaus & Fryer-Hanson, 2016; Grieco et al., 2016; Maykel et al., 2018). Systematically applied individual-level data could be insightful beyond mean level changes. Allowing a more informed position on how many students’ behaviour was influenced by PA and any specific characteristics that appear to have impacted these effects.

Specifically, there are very few studies that have examined the effect of PA on classroom behaviour in adolescents in the 16-19 age range. Studies typically feature children aged 3-12, and none to the author’s knowledge in a UK Further Education College. This may be an important factor as PA may have a larger effect on younger participants due to factors arguably related to on-task behaviour capacities, such as working memory, inhibition control and sustained attention, which are thought to develop during childhood and may be underdeveloped in younger children (Betts et al., 2006; Erwin et al., 2012; Diamond, 2013). So, effects seen in younger children may not be guaranteed transfer to older adolescents. Research around PA and on-task behaviour in adolescent learners may or may not provide greater impetus for FE college-based PA promotion, which are both significant areas of concern in declining PA levels (Shennar-Golan & Walter, 2018; AOC, 2018). In addition, the majority of the current literature was non-UK based with some exceptions and was also limited in the European context (Stead & Nevill, 2010; Bublitz & Rhodes, 2017). Culturally, this may or may not have been a factor, as there can be higher concentrations of certain influential factors in particular geographic areas (Wiebelhaus & Fryer-Hanson, 2016; Li et al., 2017; Sullivan et al., 2017).

Few studies used both quantitative data and qualitative data concurrently, with studies rarely triangulating such data (Wiebelhaus & Fryer-Hanson, 2016). The small number of qualitative studies investigating PA effects on the classroom tended to canvass teacher opinions with only a small number considering student perceptions. Investigating perceptions offers further potential to enrich our understanding of possible reasons 'why' behaviours may change after PA sessions from the participants' internalised feelings, thoughts and attributed rationales. This is important, as currently the mechanisms underlying the relationship of PA improving classroom on-task behaviour and learning are not well documented or understood, principally perhaps, because student classroom behaviour is considerably multifaceted (Webster, 2013; Ma et al., 2014), and the currently available evidence limited and insufficient (Singh et al., 2012; Watson et al., 2017). This may, in part, be because research in this area was relatively new with only a relatively small number of studies found directly investigating classroom on-task behaviour and PA since 2006. No research directly triangulating observations of classroom on-task performance with student perceptions could be found in the literature; such concurrent strategies could offer new and useful insight into this area of research (Teddlie & Tashakkori, 2009; Creswell, 2013; Denzin & Lincoln, 2017).

In summary, there was insufficient evidence to conclude that additional PA increases behavioural performance based on the small number and variety of studies currently published, nor was there evidence that PA is detrimental, although some studies have reported null outcomes. Discrepancies between studies may be explained by methodological limitations and is likely a function of variances in study designs, recording methods, dose and type of PA, sample characteristics and the timing or duration of investigations. As this literature review indicates, many questions surrounding the mechanistic nature and causality between PA and on-task behaviour remained. The need for further and more rigorous research was warranted to aid comprehensive best-practice knowledge to maximise any potential effects in the use of PA as an effective interventional strategy for improving learning differing student populations.

2.8 Statement of Purpose

Following evidence gathered through the literature review process, the purpose of this study was to investigate whether PA affects adolescent classroom on-task behaviour in a UK Further Education College. Student perceptions were also investigated to obtain further insight into any observed on-task behaviour trends.

Three research questions (RQ) guided the study:

RQ1. Do levels of on-task behaviour vary after a physically active lesson compared to an inactive lesson, and if so in what ways?

RQ2. What are student perceptions of their on-task classroom behaviour before and after a physically active lesson?

RQ3. Do student's reported perceptions offer possible explanations for their observed on-task behaviour?

Chapter 3 - Methodology

3.1 Definition of Terms

Definitional morass is common in the research design and methods literature offers differing conceptions (Flyvbjerg, 2006); thus, defining and positioning methodological terms in specific studies can aid clarity (Cohen et al., 2011; Edmonds & Kennedy, 2012). The term 'methodology' refers to the overall approaches and perspectives of the research as a whole entity (Collis & Hussey, 2009) whereas, 'methods' are distinctly different and refer to the specific tools and procedures with which data is collected, analysed and interpreted (Creswell, 2013). This section will aim to outline and address the rationale for the selection of both methodology and methods used in this study.

3.2 Research Approach

A predetermined mixed methods (MM) methodology was implemented with a convergent parallel approach (Creswell & Tashakkori, 2007; Edmonds & Kennedy, 2012; Anguera et al., 2012; see Figure 3.1) to gain varied perspectives into addressing the three central research questions of the study.

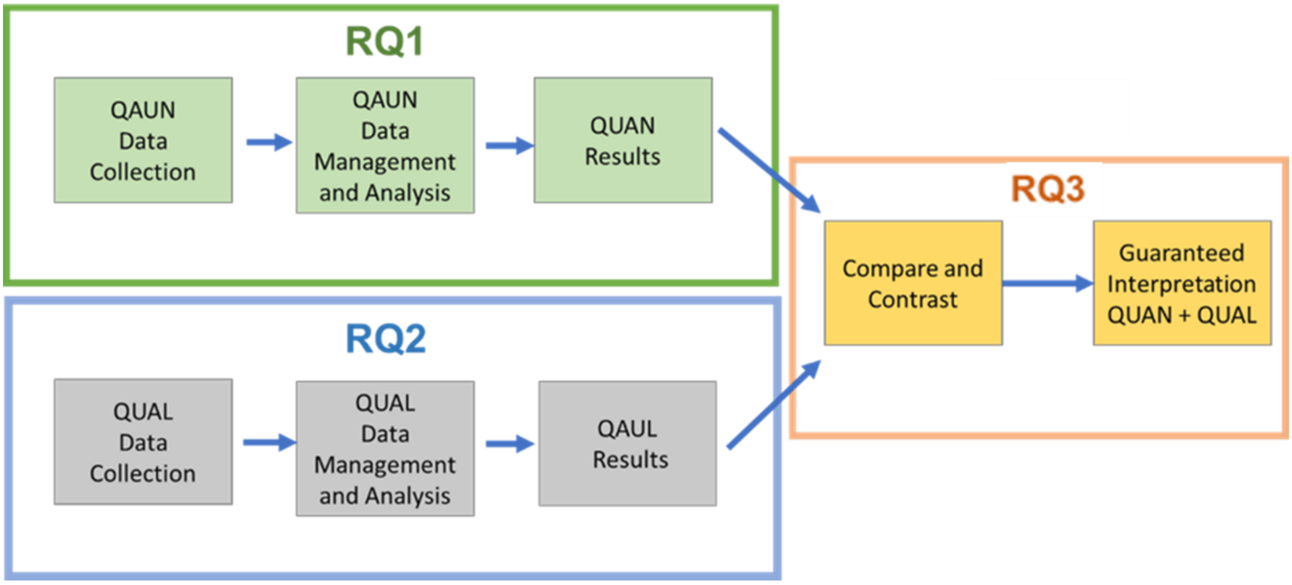

Figure 3.1. Pictorial representation of the convergent mixed methods design of this study, modified with implementation of this thesis's three research questions (RQ) from Creswell and Plano-Clark (2011 p.63) and Anguera et al. (2012 p.20).

Tashakkori and Creswell (2007) outline MM as research where the investigator collects, analyses and draws inference using both qualitative and quantitative approaches or methods in a single study. Qualitative and quantitative research have been traditionally reported as opposites in terms of philosophical perspectives about the nature of reality, epistemology, values, the rhetoric of research and methodology (Creswell, 2013) and correspondingly, work with different underlying assumptions (Castellan, 2010). Usually, quantitative approaches involve formal, objective and systematic processes in which numerical data are utilised to obtain information about the world (Gerrish et al., 2010). Quantitative research identifies with the positivist or post-positivist paradigm, which Gall and colleagues (1996, p.18) describe as the belief "that physical and social reality is independent of those who observe it". Quantitative researchers are concerned with an objective reality that is "out there to be discovered" (Krathwohl, 2009 p.620) and the researcher is independent of that being researched (Castellan, 2010). Generally, the goal is to obtain objective data by conducting empirical observations, implementing statistical analysis to identify potential relationships between independent and dependent variables, minimising nearly all potential sources of bias and verifying theories (Collins, 2015). However, attempts to measure human behaviour with objective, quantitative methodologies have been fraught with overconfidence and a tendency to interpret numbers as more reliable representations of reality than words, partially as numbers are seen to have more absolute meanings (Dey, 2005).

Qualitative research is referred to by Erickson, (1986) as the interpretive paradigm and he suggests that the term ‘qualitative’ essentially carries the distinction of being non-quantitative or not numerically focused. Denzin and Lincoln (2000 p.3) claim that “qualitative researchers study things in their natural settings, attempting to make sense of, or to interpret, phenomena in terms of the meanings people bring to them”. Qualitative research is often associated with constructivism in that social reality is thought to be constructed individually, and differently by different individuals (Gall et al., 1996; Castellan, 2010). Within the constructivist paradigm, individuals under investigation are viewed as perceiving and interpreting their world and researchers are viewed as consciously interacting with those being researched (Castellan, 2010; Creswell, 2013). Although qualitative data can indeed contain numbers, this is often transferred or associated to textual data for analysis and requires further considered interpretation and analysis (Silverman, 2011).

Conflict between advocates of quantitative or qualitative research to champion one paradigm as superior has in the past resulted in what some observers have referred to as a 'paradigm war'; however, such simplistic divisions are unhelpful for future research directions (Axinn & Pearce, 2006; Bryman, 2006). Axinn & Pearce (2006) instead argue that the focus should be on the method deployed and processes of data analysis around adding meaning to the questions at hand and consideration of how these 'opposites' can complement each other. This different way of thinking has given rise to another paradigm: the pragmatic paradigm, sometimes called 'pragmatism', which rejects opposition between paradigms, and promotes the mixing of methods (Feilzer, 2009).

Pragmatism has become a way of rationalising the use of quantitative and qualitative research while simultaneously recognising the debate about their supposed epistemological incompatibility between post-positive truth versus the construction of reality (Bryman, 2006; Feilzer, 2009). Pragmatism focuses instead on 'what works' in finding the truth, with specific regard to the research questions under investigation (Tashakkori & Teddlie, 2010). The significance given to research questions is one of the main characteristics of the pragmatic approach: "the primacy of the research question means that research that brings together quantitative and qualitative research is not only feasible, but more importantly desirable or even required for answering certain kinds of research question or combinations of research questions" (Bryman, 2006, p.118). From this perspective, the many different dimensions of research cannot be simply summarised using qualitative or quantitative dichotomy (Axinn & Pearce, 2006; Johnson et al., 2007); furthermore, some methods can produce both quantitative and qualitative data, depending on the specific utilisation by a researcher (Creswell & Plano-Clark, 2011; Bernard & Ryan, 2010). One consequence of MM research is that qualitative outcomes are often not subject to the rigorous data reduction or analysis typically witnessed in purely qualitative designs (Edmonds & Kennedy, 2012). On the other hand, an often cited positive of MM is that it may allow the strengths and weaknesses of opposing paradigms to be counter-balanced, limiting risks to validity that may feature when using only one paradigm (Johnson & Onwuegbuzie, 2004; Creswell & Tashakkori, 2007), thereby allowing confirmation or rejection of hypotheses with increased confidence (Johnson & Onwuegbuzie, 2004). With the current advancement of methodological thinking and pragmatism, it is now more common to view MM research practice on a continuum (Johnson et al., 2007, see Figure 3.2). The current thesis aimed to position itself at the centre of the continuum where both qualitative and quantitative data and approaches are given 'equal status' in contributing insights as one considers most, if not all, data with equal weighting in the final analysis.

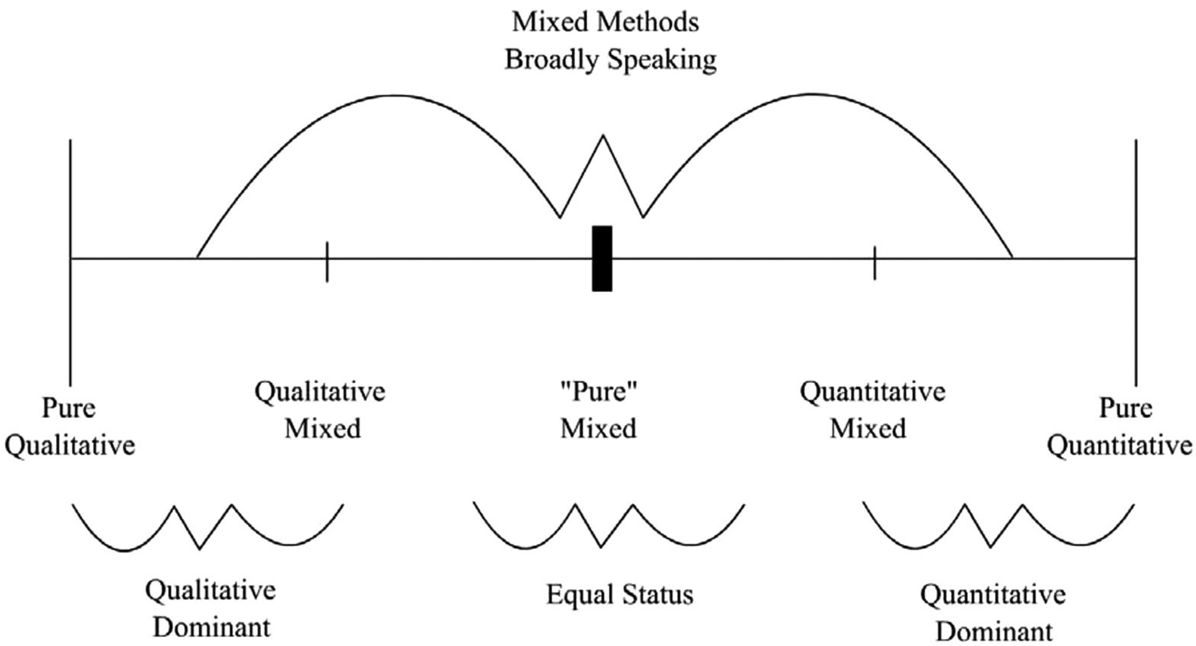

Figure 3.2. Graphic of the three major research paradigms continuum, including subtypes of mixed methods research (Johnson et al., 2007).

A recent review article specific to PA and academic behaviour identified future research should perhaps focus on MM approaches to seek further understanding and gain more insightful assessments, as such designs were devoid in the literature (Sullivan et al., 2017). Reasons for the use of MM needs to be fully considered in the formation of a research design, as usefulness or workability can be challenging and vague unless explicitly addressed by the researcher (Johnson & Onwuegbuzie, 2004; Creswell, 2013). The two principal methods used in this MM design were observation and interview. This combination was thought to offer additional validity and help limit the potential bias that can arise from the use of just one method (Greene et al., 1989; Johnson et al., 2007; Sullivan et al., 2017). Specifically, this study sought to investigate whether the quantitative observation outcomes in studies of young children would be consistent with adolescent learners of an FE College, and through qualitative interview, to gain internal insight into the thoughts and feelings of the same adolescent learners.

The MM design in this study, therefore, utilised differing methods that complemented one another, maximising relative strengths and minimising relative weaknesses. Observations would supply an observed reality of externally exhibitable behaviours. Although observations are to some extent subjective as they rely on an assessment by an observer, the use of strict observation criteria can minimise subjectivity, so may be said to be nearer a quantitative and positivist epistemological stance (Onwuegbuzie & Johnson, 2006). The qualitative interview allows insight into the internal perceptions of perceived reality of those observed, thereby leaning towards a more qualitative constructionist approach (Collins, 2015; Denzin & Lincoln, 2017). Thus, this MM combination was intended to generate a more complex meaningful analysis, currently lacking in the research area of PA and on-task behaviour.

Each differing method deployed in this study can be considered to acquire a different ‘line of sight’, directed towards the same point (Berg, 2004). In this way, the study sought to obtain a more substantive picture of reality between PA and on-task behaviour, through a richer, more comprehensive means of verification between methods (Creswell & Plano-Clark, 2011). The use of multiple viewpoints or lines of sight is often termed ‘triangulation’ (Berg, 2004; Teddlie & Tashakkori, 2009). The collection of different kinds of data bearing on the same phenomenon is argued to allow for potentially greater accuracy and robust confidence in judgements compared to a monomethod study (Johnson & Onwuegbuzie, 2004; Newby, 2014; Mertens, 2015, see Figure 3.3).

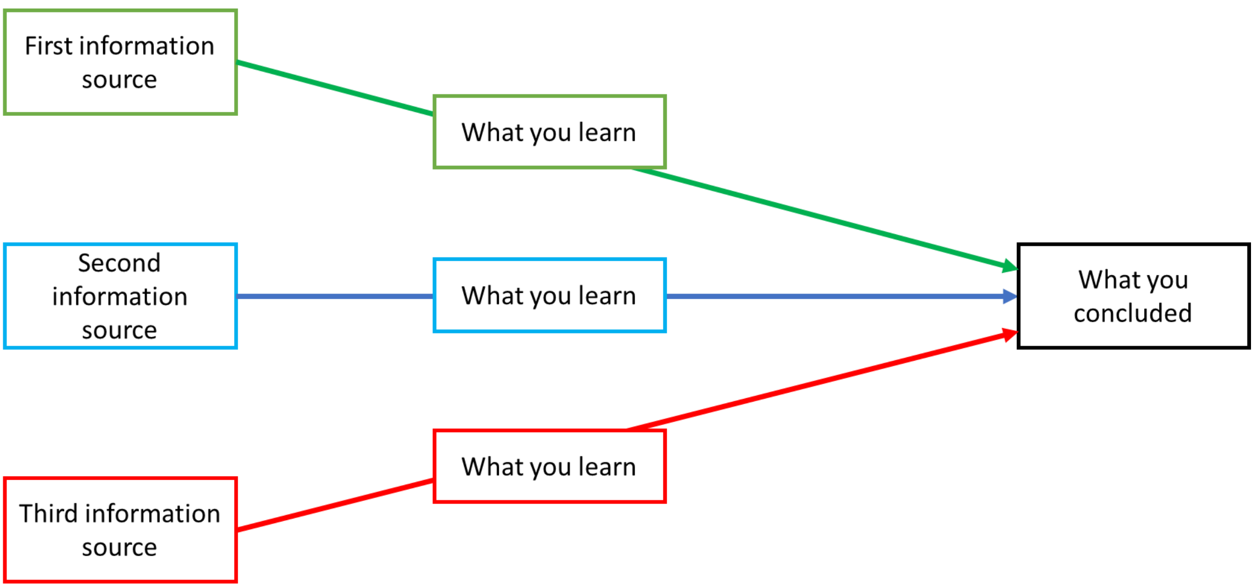

Figure 3.3. Illustrative diagram of the principle of triangulation (Newby, 2014).

Triangulation is likely to be most effective when planned in advance, with an appreciation of the various potential biases to data (Greene et al., 1989; Mertens, 2015). This study implemented two types of triangulation identified by Greene, et al. (1989): firstly 'Data Triangulation', the use of multiple data sources was used to help offset the possibility of unrepresentative data and secondly, 'Methodological Triangulation' was achieved through using a variety of data collection methods. The differing data sources and data collection methods featured in this thesis were observed behaviours and the perceptions from student interviews.

The convergent parallel design adopted by this study and illustrated previously in Figure 3.1 has been regarded as the classic approach to triangulation (Anguera et al., 2012; Creswell, 2013). In this design qualitative and quantitative data are collected at the same time in the same visit to 'the field', allowing timely integration of the research questions together (Creswell, 2013). Other ways of mixing can include a sequential or exploratory design where data is collected in one paradigm and then a follow-up analysis of the opposite paradigm is used (Creswell & Plano-Clark, 2011). This can offer greater ability to consider questions based on initial outcomes but was not deemed to add significant value or to be a timely possibility in the restricted data collection window of the colleges' remaining academic terms.

It is important to note that the benefits offered by MM and triangulation do not guarantee a study to be innately more or less valid. MM can suffer from a clash in theoretical paradigms, making the synthesised mixing of analysis from differing data streams difficult to fuse coherently and effectively (Castellan, 2010; Cohen et al., 2011). Shulman (1986) cautions that mixing research approaches can result in chaos if the researcher is not careful (Castellan, 2010). Tashakkori and Teddlie (2010, p.29) refers to the need for MM researchers to become “methodological connoisseur(s)”, requiring advanced research skill levels and competencies. One of the challenges of using MM in this research was the ability to justify how the differing methodological outcomes are tangibly interrelated, to allow mixing in deducing conclusions. In this regard, Bazeley (2004) argues that MM validity stems more from the appropriateness, thoroughness and effectiveness with which each method is applied and the thoughtful comparing and weighing of the evidence. From this perspective, this considered flexibility may allow MM to generate more valid outcomes than could the application of a particular set of rules or adherence to established traditions, which has been a criticism of single paradigm methods (Bazeley, 2004). Furthermore, offering different perspectives can help avoid the tendency to jump to premature conclusions and result in some congruence in the data (Armour & Macdonald, 2012). To minimise the potentially detrimental consequences of MM, careful consideration was given to the principles of MM in the planning of the overall research design and interview questions. Nevertheless, outcomes of MM are not always predictable: virtuous decisions may be made in advance, yet the resultant data generated can lead to unrealised potential and unanticipated consequences; weakening triangulation to only simplistic associations (Bryman, 2006, Tashakkori & Teddlie, 2010).

3.2.1 Observation

Observation is a widely used means of data collection in education research and can take a multitude of forms (Cohen et al., 2011). It is a method that is usually a systematic and organised process with purposeful structures and protocols that attempt to offer a more valid and reliable recording of phenomena as it takes place (Morley, 1995; Newby, 2014). Observations use the researchers' senses such as sight, smell, touch, taste and hearing, to record outcomes; therefore, the researcher themselves may be said to be the primary instrument (Somekh & Lewin, 2004; Newby, 2014). Observation was useful for this thesis as it offered the opportunity to gather 'live' data from naturally occurring social situations (Cohen et al., 2011) and was appropriate for learning about interactions when concerned with the behaviour of subjects, rather than the perceptions of the individuals (Morley, 1995).

One of the first considerations in observation design is the distance and position the researcher shall take when observing (Bernard & Ryan, 2010). Observation can be divided into two main practices of 'participant observation' and 'direct observation' (Gillham, 2008). Participant observation is usually implemented by developing a close interaction with members of a group or 'living' directly in the situation that is being studied (Patton, 2002; Morley, 1995). The researcher actually participates to varying degrees of engagement, in the events and activities under investigation within a study (Gillham, 2008; Cohen et al., 2011). This can allow observation to occur from an 'insider' perspective, enriching the researcher's view and gaining access to events that may have previously been inaccessible (Patton, 2002; Bryman, 2016). However, the limitations of participant observation can include: time ineffectiveness, difficulty in being in the 'right place at the right time', challenges in recording objective or reliable field notes and relying heavily on memory after an event. Furthermore, the researcher may become too immersed in a group so that objectivity may be difficult to maintain, possibly increasing bias and the researcher's direct engagement may distort the actual behaviours of participants or phenomenon under study (Cohen et al., 2011; Gillham, 2008; Patton, 2002; Morley, 1995). Participant observation was deemed inappropriate for this study due to these aforementioned weaknesses and lack of identifiable advantages for the research, particularly as the observation exposure was expected to be systematic and short in duration.

Mahar (2011) suggests that direct observation is the best method to observe students' on-task behaviour. Direct observation involves the researcher watching the subjects in their usual environment without altering that environment or directly participating (Holmes, 2013). It is sometimes referred to as non-participant observation or 'fly on wall, approach' (Sparkes & Smith, 2014). The strengths of direct observation include: high volume and quality of information can be gathered time efficiently; it requires unsophisticated equipment and recall from participant(s) is not necessary; thus it is less reliant on memory; and it is a relatively unobtrusive process (Johnson & Christensen, 2012; Gray, 2014; Newby, 2014). However, the presence of a researcher is still likely to distort behaviours (Morley, 1995); as the Hawthorne effect has shown, those being observed become conscious of monitoring and this, in turn, affects behaviour (Newby, 2014). The observer effect could increase or decrease certain behaviours; thus, what is observed may not represent typical behaviour and there may be a strong degree of performing to the observer (McCarney et al., 2007; Armour & Macdonald, 2012). These negative effects may have been reduced in the current study by explicitly explaining the purpose of the observations, how the observational data were to be used and who will be given access to the data to all participants prior to observations (Somekh & Lewin, 2004). Further attempts to limit observation effects followed guidance by Mahar et al. (2006) by not revealing when each participant was the focus of data collection as only six students in a classroom were observed per session.

Observations, can be either quantitative or qualitative depending on how open or structured the response options (Newby, 2014), yet it is also possible for observations to be more or less ‘structured’ without falling precisely into either paradigm (Dey, 2005). Since the observation method featured in this investigation was to categorise behaviour information to notational frequencies, the data produced is predominantly quantitative (Creswell, 2013). It is important to acknowledge that although quantitative output and strict systematic protocols used in this study may imply that direct observation is a precise and objective measurement, human interpretation and recording of behaviour is methodologically inherently subjective (Patton, 2002). In this regard, Somekh & Lewin (2004 p.138) comment that “what is observed is ontologically determined, that is it depends…how the observer conceptualises the world”. There is always the possibility of observer bias and interpretations drawn from observations may vary from observer to observer (Morley, 1995). Dey (2005 p.16) state that “the point is that any ‘data’, regardless of method, are in fact ‘produced’ by the researcher”. Observers ultimately decide whether to ‘count’ an observation as belonging to any category, in terms of whether it fits with a number of similar observations and comparing previous examples. This can lead to vagueness about the precise respects in which observations differentiate, particularly between observers.

To limit such subjectivity influencing the outcomes in this study, clear categorisation definitions with examples were adopted from the previous literature and a pilot study implemented (Rodwell, 2015) in which high interobserver agreement helped substantiate the observation methods reliability (see 3.4.5). In addition, the nature of the observation procedure offered restricted scope for bias. For example, the momentary time-sampling observation method used in this thesis involves a specific binary category (on- or off-task) being assigned at the very end of the interval, and not an interpretation over the full 10 second period of observation time (Schloss & Smith, 1998; Riley et al., 2015). Therefore, it is important to recognise that this method provides an estimate of behaviour rather than the documentation of every occurrence of on- or off-task behaviour. This strategy can thus underestimate behaviours since the student may engage in a behaviour throughout much of an interval, and then change just before the end when the category will be assigned. However, the use of clear observation criteria is likely to reduce ambiguity and this strategy has been deemed valid and ratified a number of times in the literature (see, Mahar et al., 2006; Mahar, 2011; Goh et al., 2016; Wilson et al., 2016; Goh, 2017).

3.2.2 Interview

Denzin and Lincoln (2011 p. 529) describe interviews as “accounts given to the researcher about the issues in which he or she is interested; the researcher can reach areas of reality that would otherwise remain inaccessible such as people’s subjective experiences and attitudes”. Interviews, therefore, can provide a 'deeper' understanding of social phenomena and may reveal more meaning than would be obtained from predominantly quantitative approaches such as a Likert scale survey or a questionnaire with only closed response options (Silverman, 2013; Kvale & Brinkmann, 2015). Interviews may be most appropriate where little is already known about the study phenomenon or where detailed insights are required from individual participants (Gill et al., 2008), such as in the current thesis. Thus, interviews can drive in unanticipated directions to the original intent of the interview questions and unearth important and unexpected factors worthy of consideration (Chambliss & Schutt, 2009).

However, it is important to recognise that interviews can be susceptible to inaccurate recall, bias, and poor articulation (Patton, 2002; Kvale & Brinkmann, 2015) as human memory can be prone to error, remembering some things more easily than others (Bernard & Ryan, 2010).

Once participants decide to be interviewed, they have a personal stake in the process and may try to answer all questions whether or not they know the answer (Creswell & Plano-Clark, 2011). Only when a number of differing interviews have been conducted around the phenomena and evidence corroborated with other sources can theoretical conclusions be drawn with confidence (Gerson & Horowitz, 2002). In addition, it is worth noting that no data “not even tape recordings are untouched by researchers’ hands” (Silverman, 2011 p.159); the role played by the interviewer in eliciting and shaping the data cannot be ignored (Dey, 2005). It is important to acknowledge researcher influence, which may be conscious or unconscious (Creswell & Plano-Clark, 2011). For example, the interviewers' feelings about the phenomenon and potential bias can impact on their approach to questioning in the interview process (Richardson, 1997). In the current thesis, the interviewer’s stance as an advocate and lecturer of PA-based degree programmes was acknowledged as a potential bias (this consideration is further addressed in 3.4.8 Interview Procedures). Additional attempts to limit interviewer bias included the critical involvement of thesis supervisors in the question and interview structure, and interviews were audio-recorded for later review by critical peers.

The interview structure relates to the level of interviewer direction and control over the flow of the interview. In unstructured interviews, questions are generally not pre-planned and participants are allowed to talk freely to yield in-depth information (Gray, 2014). However, “even the most non-directive interviewer must implicitly ‘direct’ an interview to some extent if it is to cover certain topics within the time available” (Dey, 2005 p.16). In semi-structured interviews, each participant is asked a set of similar questions whereas, in structured interviews, each interviewee is asked a set of identical questions; both are usually based on an interview guide (Bernard & Ryan, 2010). Semi-structured interviews were deemed most appropriate for addressing the current research questions as they offered the desired balance of ceding some control to the respondent over how the interview progresses, adding depth, at the same time enabling comparisons across interviews by asking more or less the same questions (Bernard & Ryan, 2010). Semi-structured interviews also allowed the researcher the opportunity to probe more deeply into participants’ responses and ask follow-up questions, possibly leading to richer, more robust data (Benes et al., 2016). Another common variation of interview method that could have been used was focus groups, interviewing a number of participants simultaneously (Johnson & Christensen, 2012). However, these were not used as the researcher was more interested in independent individual responses rather than a ‘collective’ response that focus groups can generate, with potential for some people to dominate and shape their opinions over others (Patton, 2002; Bernard & Ryan, 2010; Johnson & Christensen, 2012). The semi-structured interviews were implemented as a ‘discovery-oriented’ use of qualitative inputs, to reveal things that may have impacted the quantitative outcomes (Morgan, 2014). Interviews therefore were largely exploratory due to the original approach of this thesis aims and the population under investigation, with an element of unknown from what would arise from the students’ responses.

3.2.3 The Research Site and Physical Activity Intervention

The research site investigated was a city centre UK FE college. When this study began, almost all associated research literature focused on preschool and primary school students in other countries to the UK, most notably in the United States. The current study appears to be the first to explore PA and on-task behaviour in UK adolescent learners and colleges. UK Colleges differ from pre- and primary schools in a number of ways, the higher level of education and age of students is perhaps the most apparent; as a consequence, college learning may be said to be more autonomous and self-directed (Ecclestone, 2002; AOC, 2019). At the time of data collection, post-16 college participation was voluntary, unlike mandatory schooling, so individual student motivations may also be different. The structure of the learning week in colleges is usually different, with ~12 hours of lessons distributed across the week compared to the more congested school timetables of 18-22 hours of lessons per week (BBC, 2014; Weale, 2019). In addition to these differences, the specific differential characteristics of adolescent learners compared to young children also needs consideration, including those that may directly affect behaviours such as emotional, physical and socio-cultural discovery at this stage of maturation (Dolgin & Rice, 2011; Reyna, 2012; Bucx, 2018).

The specific college investigated featured a wide variety of vocational-related subject specialisms from construction and motor mechanics to hairdressing and mental health practitioners and core academic subjects such as maths and physics. A wide range of qualification levels was offered by the college from UK entry level one all the way the full bachelor's degrees, with approximately 8,000 students registered. In the previous three government inspections, the college had been rated as 'good' for performance. As the site was a city centre location almost no 'green space' or grassed areas for movement, teaching or relaxation existed and most students would drive or used buses to get to the college. Classrooms were characteristically small, designed for 18 to 25 students and containing desks, chairs and sometimes computer equipment. Therefore, available space for movement was often restrictive and classroom lessons were typically seated.

The chosen independent variable investigated was naturally occurring PA in lessons expected to feature high levels of PA, namely those that exclusively occurred in the college's drama studio and sports hall, these were termed 'PA-based lessons'. These PA-based lessons were considered to be 'naturally occurring' as they already existed and were planned to occur in learning programmes as part of the prevailing course curriculum. PA-based lessons typically lasted 60-minutes, occurred once a day and involved specific curriculum focus and/or learning objectives. Examples of PA that occurred in these PA-based lessons included playing and/or instructing sports such as soccer and basketball, a fitness testing battery, completing fitness tasks such as circuit training, or creating and practising dance routines. The overriding reason PA-based lessons were chosen was due to this study being initial and exploratory research into UK college adolescent participants and to minimally impact student learning. Thus, reducing the potential for harm or unanticipated negative consequences that may have occurred compared to implementing and imposing a study-specific PA movement intervention. Another reason for the selection of naturally occurring PA lessons was limited data existed on such lessons, almost all the literature investigates short 10-15-minute PA-breaks in a classroom. Looking at real-world implementations of PA is important because often research initiated interventions do not endure or translate well into practice, particularly if they are imposed or designed by researchers rather than practitioners (Carlson et al., 2017). An additional real-world consideration for naturally occurring PA investigation centres on the significant resource restrictions UK colleges are currently under (Weale, 2018). Any intervention that requires additional time, training, physical and staff resource are unlikely to be adopted in practice or pass gatekeeper permissions to be studied without first some initial and promising data that PA may improve on-task behaviour in college classrooms.

3.3 Sampling and Participants

Sampling is the process of selecting a few participants from a bigger group of a sample population, to estimate the prevalence of an unknown piece of information, situation or outcome regarding the bigger total sample (Kumar, 2014). Sampling can frequently be problematic in research and it is typically implausible and ethically undesirable to study every case of research interest (Becker, 2008). Selecting a subsample from the total population of interest is resource and time-efficient, but subsequently is a rational compromise that only allows the researcher to predict or estimate findings to the total population, therefore increasing the possibility of error in generalisation (Kumar, 2014). There are a range of sampling strategies available to researchers, but commonly these fall into random and non-random sampling categories. Random sampling, also referred to as probability sampling, is where all in the sample population has an equal and independent chance of selection to the sample (Thompson, 2012; Kumar, 2014). This was not applicable to the current study as not all students in the college were considered for sample selection. Non-random sampling was therefore applied to select only those that had relevance to the research questions being asked, in qualitative research, this is often termed purposive sampling (Patton, 2002; Teddlie & Tashakkori, 2009). Namely, college students would be selected who were timetabled to experience conditions central to the phenomenon under investigation (Creswell, 2013), in particular, those who had a timetabled PA-based lesson in either the college's sports hall or drama studio with a seated classroom lesson before and immediately after this PA-based lesson (N = ~420).

In attempt to minimise the potential for error, the sample size was deduced using estimation formulas via Creative Research Systems online software to help increase the likelihood of an adequate statistical power to detect changes in the primary outcome of on-task behaviour of the classroom observations (Dunn et al., 2012; Creative Research Systems, 2012). Previous findings were also considered when determining a suitable sample size: the aim was to approximately double the sample size of 62 used in Mahar et al. (2006). The rationale for doubling the sample size was the possibility of identifying more confounding variables compared to Mahar et al. (2006), including differing physical classrooms environments and module subjects between observations.

Mahar et al. (2006) also prescribed a standardised PA mode, whereas, in the current study, the PA lesson was naturally occurring; thus PA type and intensity varied, although duration was standardised to ~60-minutes. In addition, times of day varied between student groups, but remained constant within student groups in this study to minimise the potential of circadian rhythms influencing on-task behaviour (Crowley et al., 2007). After gaining gatekeeper consent from the college Vice-Principal and teachers of student groups that potentially matched the inclusion criteria characteristics, a non-random purposive sample of 146 college students aged 16-19 initially agreed via voluntary informed consent to take part in the study. Students were recruited by the researcher attending the beginning or end of a lesson, informing the participants of the study via a short presentation, followed by question and answer opportunities. Students were supplied both participant and parental consent documentation (Appendix 2) and the researcher returned at a later date to answer any additional questions and collect completed consent documentation from students who volunteered to participate.

For inclusion in the study students were aged between 16 and 19 and enrolled on qualifications classified as UK level 2 and 3 in sport and drama disciplines (Ofqual, 2013). This age range and qualification inclusion criteria were selected as this typically represents the largest majority of learners in FE colleges and was a further attempt to control confounders within student types. Exclusion criteria were that no student was allowed to participate if they had any diagnosed intellectual or behavioural learning disability or aged under 16, or aged 20 or over (Verret et al., 2012) as previous research has indicated pertinent variances specific to these populations, such as lower time-on-task and concentration in children with ADHD compared to children without ADHD (Gapin et al., 2011; Pontifex et al., 2013; Dekkers et al., 2017; Den Heijer et al., 2017).

Common with many investigations involving human subjects, attrition of the initial 146 participant sample occurred predominately due to student non-attendance or pedometer or accelerometer failure thus leading to smaller datasets. In the final study analysis,111 students, 70 male and 41 female participants with 97 sports students (35 level 2 and 59 level 3) and 17 level 3 drama students (see table 3.1 for further descriptive participant data), met the minimum inclusion criteria in the classroom observation of on-task behaviour (Wilson et al., 2016). Some observations were abandoned due to unplanned PA prior to baseline lessons, practice exams, assessed presentations, unscheduled room changes and/or low student class numbers (<12) as the researcher cannot depend on results if observation lessons are extensively inconsistent (McKenzie et al., 2001). Even with this attrition, the sample size in this thesis was still deemed suitable via estimation formula and at the culmination of the data collection was considerably higher compared to previous studies.

To gather student perceptions through interview, a random subsample of 36 participants (16 females and 20 males; 12 sport level 2, 20 sport level 3 and 4 drama level 3; see table 3.2 for further descriptive participant data) were selected from the 111 observed participants within 1-4 hours following their observations on the PA intervention day only. Sample size was determined by theoretical saturation (Morse, 2004). Saturation was considered to have been attained when, through continued sampling and analysis, no new data, unique themes or perceptions were emerging from respondents and those concepts that had appeared were significantly developed (Guest et al., 2006). While compared to the quantitative observations, the qualitative interview worked with a much smaller sample; this provided in-depth and context-rich cases for more meaningful analysis (Miles et al., 2014).

Only on-task data and requests for interview occurred in students who completed the consent documentation with most groups featuring >95% consent of total eligible participants. All participants were informed they could withdraw from the study at any point; no participant requests for withdrawal were received.

It should be acknowledged, that although using students with naturally occurring PA may be beneficial for an initial exploratory study to minimise potential for negative impacts, this hinders the transferability to students from courses that are not sport and drama students and/or have a PA-based lessons planned into their timetables. Drama and sports students have chosen to study a course with explicit active elements and there could be something unique about these students that leads them to choose such a course, and other students to avoid or choose courses with other characteristics. From reviewing the literature this was not an inquiry that has been well-addressed, but PA-based courses are likely to appeal to students who have a positive deposition, positive past experiences and enjoy PA in their learning (Carlson, 1995; Portman, 1995; Prochaska et al., 2003). This perhaps makes these students also different to most of the associated literature that researches school children who are required to attend school and study a range of differing subjects. The current sample population maybe considered to have ‘freely’ chosen attendance to a FE college and the selection of the type of course is also likely to be ‘free’ from a range of course specialisms rather than imposed. Consequently, where the study sample are inferred to as ‘college students’ in this thesis, it is acknowledged that this is a reference a non-random sample and recognises the associated limitations in application to the wider sample population of college students in general.

3.4 Data Collection Methods and Procedures

3.4.1 Descriptive and Anthropometric Measurements

Descriptive and anthropometric measurements were recorded and displayed here consistent with previous similar research designs. Race, birthdate and sex were self-reported by the students. Height and weight were measured on-site without footwear, wearing shorts and t-shirt during the first week of data collection. Height was measured to the nearest 0.1 centimetre using a stadiometer (Seca Stadiometer 222, Germany) and weight was measured with weighing scales (Seca 813 scales, Germany). During both measurements, students were instructed to keep their shoulders in a relaxed position, allow their arms to hang freely and their head aligned in the Frankfurt plane (Hauspie et al., 2004). Body Mass Index (BMI) was calculated using the World Health Organisation classification for adolescents (WHO 2013b; WHO 2014). After being anonymised student descriptive data were entered into Microsoft Excel and used to calculate means and standard deviations. Self-reported ethnic minorities of other than 'White British' was reported by 20 students (18%); this is consistent with 2011 UK census data stating that White British was the largest group at 80.5% of the population. This is important as a number of studies have suggested that such socio-cultural differences may be influential (Howie et al., 2015; Mullender-Wijnsma et al., 2015). Further descriptive data of the 111 observation sample participants can be seen in Table 3.1 and in the 36 interviewed subsample Table 3.2, indicating that the subsample of those interviewed had similar mean descriptive anthropometric measurements to the total sample of students observed. Although anthropometric and descriptive data proved to be superfluous and not specifically analysed as part of the thesis main findings, it proved important for completeness and to allow comparability in participant characteristics of previously published research when considering rationale for the outcomes of the current thesis.

Table 3.1. Descriptive Statistics of Observation Participants (N=111)

Descriptive	Mean	Std. Deviation
Height (M)	1.73	0.08
Weight (Kg)	69.5	9.8
BMI	23.02	2.45
Age (years)	17.1	0.8

Table 3.2. Descriptive Statistics of Interview Participants (n=36)

Descriptive	Mean	Std. Deviation
Height (M)	1.73	0.09
Weight (Kg)	69.6	9.2
BMI	23.04	2.32
Age (years)	17.2	0.6

3.4.2 Observation Design

The 111 students who met the minimum inclusion criteria were observed in four separate 30-minute observation blocks on two separate days, between 30-60-minutes prior to a PA lesson and in the lesson immediately following the PA lesson (termed the PA Observations Days [PAOD]), and on a differing day in a control condition 30-60-minutes prior to a non-PA lesson and immediately after the non-PA lesson (the Control Observations Day [COD]). The study featured a cross-over design to increase validity, with half of the groups observed in the COD control condition first and the other half in PAOD first. Both PAOD and COD observations occurred at the same time of day and where possible, involved the same subject and teaching staff, in an attempt to minimise variations (Crowley et al., 2007). Observations were not conducted directly following a long and unsupervised recess (>45-minutes) in which the participants may have engaged in PA.

All timings, structure and content of lessons were 'naturally-occurring' in the students' pre-existing timetable, without any involvement of, or requirement for modification from the researcher. This allowed students to be observed in the most natural ecological environment and helped minimise researcher disruption or influence (Newby, 2014). However, this was also a weakness in that the exact nature of the lessons was beyond the control of the researcher. Some lesson observations had to be abandoned as content was either an unplanned PA session, recess break or featured unsuitable practice for on-task observation, for example, end of term celebrations.

Classrooms contained on average 17-18 students, with a range of 12-22 students and all observations were conducted between November 2015 and May 2016. Lessons were selected for observation by the researcher through viewing pre-existing timetables and then negotiating with management and teaching staff around lessons that had a classroom-based lesson before and immediately after a PA-based lesson. Since the choice of lessons was dictated by the college timetable, the willingness of the staff and students to participate, this meant exact timings could not be controlled inter-class. However, this did allow a wide range of times to be evaluated, thereby not limiting the research outcomes to one part of the college day and associated circadian considerations.

3.4.3 Definitional Terms of On-Task and Off-Task Behaviour for Observations

Operational definitions of on- and off-task behaviour in the observations were as follows: on-task behaviour was defined as verbal or motor behaviour that followed the rules of the classroom and was behaviour appropriate to the academic activity assigned by the teacher (Mahar et al., 2006; Godwin et al., 2013; Riley et al., 2016; Goh, 2017). Examples of on-task behaviour included: working quietly at one's desk, having eyes on the teacher, engaging in group activities when appropriate, asking or responding to teacher questions, demonstrating activity to others when expected to do so, and engaging in class discussions when relevant (Mahar et al., 2006; Riley et al., 2015; Goh, 2017).

All other behaviour was considered to be off-task, which often featured behaviours unrelated to the narrative and curriculum of the lesson, and where no interaction with the lessons content was occurring (Mahar et al., 2006; Bartholomew & Jowers, 2011; Riley et al., 2016; Goh, 2017). Examples of off-task behaviours included: gazing off, placing head on the desk, reading inappropriate material, purposeless walking around the classroom without permission, and talking to other students on content not related to the lesson material (Wannarka & Ruhl, 2008; Grieco et al., 2009; Bartholomew & Jowers, 2011; Riley et al., 2015; Stylianou et al., 2016a).

3.4.4 Procedure for Observation of Behaviour

On- and off-task behaviour was systematically and directly observed using a momentary time-sampling method adopted from Mahar et al.'s (2006) study. The researcher used structured observation around a schedule prepared in advance with predetermined categories of behaviour and timings (Somekh & Lewin, 2004). The method involved a 30-minute observation period with the observer assessing on- and off-task behaviour of six students (equating to 5-minutes per student). Six students per observation were selected at random; neither students nor teacher were informed which students were being observed to minimise manipulation of the results (Fedewa et al., 2015; Riley et al., 2015). Selection bias of participants and observation order was minimised by using a web-based selection programme (www.randomizer.org). During observations, the observer positioned themselves in an inconspicuous place to minimise interference with the management and operation of the classroom and wore college sports clothing similar to the students that may help signal "equality of status with those being observed" (Somekh & Lewin, 2004, p.140).

The observer listened to a pre-recorded MP3 file via one in-ear headphone, indicating when to observe and when to record. In accordance with Mahar et al.'s (2006) study the MP3 file systematically beeped for observing of behaviour for a 10-second interval; after another beep, the observer had 5-seconds to record behaviour by recording on-task or off-task on an observation sheet. The category assigned was the behaviour at the very end of the interval, not over the full 10-second period of observation time (Schloss & Smith, 1998; Riley et al., 2015). After 1-minute of observing one student (four consecutive observations), the observer rotated to the next student. The rotation from student to student was repeated five times until all six students had been observed for a total of 5-minutes and twenty observations per student (Mahar et al., 2006). Observation sessions, therefore, totalled 30-minutes per lesson featuring 120 unique observations per lesson observation session (Mahar et al., 2006).

3.4.5 Pilot Observations

Piloting methods in advance of moving into the field can help minimise unanticipated problems before any considerable resources are invested and confidence that the method will be successful (Klein, 2012). The use of pilots can also help train observers and allow familiarisation with the method before definitive data is collected. Therefore, a series of eight pilot observations featuring 36 college sports students from the same college, but not part of the current study sample (20 male and 16 female, mean age 17.83 ± 1.08) were carried out. These were conducted to check the validity, sensitivity and reliability of the observation methods described above, with ethical considerations addressed (Rodwell, 2015). This was achieved by appointing a secondary observer with two years of teaching experience (age 43, female) to test interobserver validity and reliability. Both observers (primary and secondary) observed and listened to the same pre-recorded CD simultaneously according to the methods set out in 3.4.3 and 3.4.4 above. Reliability of observers was calculated in accordance with Mahar et al. (2006) by dividing the number of agreements on occurrences of on-task behaviour and off-task behaviour by the total number of observation intervals. This figure was then multiplied by 100 to record a percentage of agreement between observers. Resultant observation outcome measures were acceptable and comparable to previous reports on the validity of this method, with inter-observer agreement >95% (Mahar et al., 2006; Mahar, 2011; Rodwell, 2015; Wilson et al., 2016).

3.4.6 Physical Activity Measurement

PA was recorded in the lesson before, during and after the PA-based lesson or control lesson on both COD and PAOD. This was to establish that the PA-based lesson in the sports hall on PAOD involved significantly higher levels of PA than the control condition lessons on COD and compared to the classroom-based lessons before and after in both PAOD and COD. Both PAOD and COD involved similar classroom changes of a maximum of 400 metres walking distance. PA was monitored using Yamax pedometers (model SW-200, Yamax, Japan), the same as those used in Mahar (2006) and accelerometers (Technogym MyWellness Key, Technogym, Italy).

Pedometers can provide a valid and reliable measurement of students' PA in school settings (Crouter et al., 2003; Goh, 2017). The Yamax SW-200, one of the most commonly used and accurate pedometers available, has demonstrated the ability to measure step counts within 1% of actual steps (Crouter et al., 2003). Accelerometers were also used in this study based on advisory guidance from the associated literature (Singh et al., 2012; Carlson et al., 2015; Norris et al., 2015). At the time of writing, accelerometer usage in studies was infrequent possibly due to the higher price of these devices over pedometers. Accelerometers may offer more validity over pedometers due to internal mechanisms that offer the ability to record even discrete PA and additional forces and energy expenditure involved in movements such as accelerations, decelerations and changes in direction (Troiano et al., 2008; Bassett & John, 2010; Ainsworth et al., 2015). Previous research has shown Technogym MyWellness Key accelerometers to provide acceptably valid measures of PA when compared to ActiGraph model GT1M accelerometer (ActiGraph, LLC, Florida, USA), which is one of the most widely used wearable devices for PA measurement in clinical research (Herrmann et al., 2011).

Unfortunately, even though the two devices used in this thesis correlate 'reasonably' with the PA gold-standard measurement techniques of doubly-labelled water and oxygen consumption (Ainsworth et al., 2015; Lee et al., 2015). Both devices lacked the accuracy to deduce intensity and/or volume with high confidence. There is currently no single gold-standard wearable monitor to objectively measure PA (Ainsworth et al., 2015), but for the purposes of this study, both devices were considered appropriate for indications of PA volume estimation between PAOD and COD.

3.4.7 Interview Design

In designing the interview questions, careful consideration was given to increase trustworthiness and address issues of validity and reliability (Johnson & Christensen, 2012). The question format, language and order were thoughtfully designed in advance with the development of a semi-structured interview question guide (Patton, 2002; Creswell & Plano-Clark, 2011; see appendix 1) to help focus the interview, add consistency and control for suggestive questions (Kvale & Brinkmann, 2009; Benes et al., 2016). An initial question guide was pilot-tested with six participants of similar demographics to the final study sample, consequently resulting in some small refinement of question-wording in an attempt to increase clarity for adolescent participants. Piloting interviews also provided the opportunity to test assumptions, establish if the schedule was clear and understandable to students (Gerrish et al., 2010; Creswell & Plano-Clark, 2011).

The final question guide (Appendix 1) was used in all interviews; the initial questions were ones that participants could answer easily and then proceeded to more complicated topics (Pope & Mays, 2006). This helped put respondents at ease, built confidence and developed rapport through the interview, possibly leading to higher-quality responses in the later more challenging questions (Gill et al., 2008). After reaffirming verbal consent to interview, students were 'read-aloud' a definition of on-task behaviour by the researcher, the first two interview questions asked participants to recall the percentage (0-100%) of time they perceived they were on-task in the lesson before and the lesson after the PA-based lesson. The order of asking for the percentage of the lesson before and the lesson after was alternated between interviews to reduce biases that may present from the order of these two questions and student recall. Next, to address research question 2, participants were asked to explain their reasoning for the percentage responses to the first two questions. When it appeared that all reasons for the supplied percentages had been exhausted and clarified, the interview questions then changed emphasis to specifically ask if in general, and not just including the observed lessons in the past 1-4 hours, students believed a physically active lesson affects their ability to be on-task in preceding lessons and the rationale and reasoning for their responses. A closing question was asked to allow participants the opportunity to say anything else they thought was relevant or needed mentioning around the subject (Morley, 1995). Excluding the first two interview questions which yielded quantitative data, all other questions were open-ended, designed to record qualitative material and allow neutrality (Gill et al., 2008).

A specific function of questioning students for their perceived on-task percentages first was to get students to start reflecting on the observed lessons and their on-task behaviour. These questions were sequenced in an attempt to limit bias and avoid leading questions that focused on PA that might subsequently affect the impartiality of students' reasoning for the differences or similarities in on-task behaviour they perceived between the two lessons. Question sequencing was also designed to limit the extent to which participants might try to please the interviewer with responses they perceived the interviewer was searching for (Kvale & Brinkmann, 2015), specifically PA related responses.

3.4.8 Interview Procedures

After meeting the minimum inclusion criteria for observations, participants were randomly selected for one-to-one interview using the semi-structured interview guide to elicit individual insight of student perceptions. One researcher conducted all the interviews and this allowed for additional consistency in questioning compared to deploying multiple interviewers (Benes et al., 2016). The interview mode aimed to provide participants with the opportunity to express their opinions and experiences and allowed the researcher to ask follow-up questions based on each interviewee's specific responses for further clarification and elaboration. The interviewer used a variety of probes for example: 'can you tell me more about that', 'could you explain further about …, so to clarify….' and decided when the conversation topic had satisfied the question objectives to move onto subsequent questions.

An awareness of the power relations when conducting the research was considered in an attempt to select the correct research distance as a researcher and is further addressed in '3.7 Ethical Considerations'. The interviewer was a lecturer at the college as well as a researcher, which means the students may be seen as subordinates; such dynamics of power can impact responses and colour the entire research process (Klein, 2012), because teachers and lecturers may be perceived as having the power to assign grades and issue disciplinary procedures (Fryer, 2004). However, no student participant in the study was part of the researcher's own teaching practice or department, which may have helped to reduce this power imbalance to some extent. Interview location was also given some consideration: to minimise the inference of hierarchy, students were encouraged to suggest a suitable public environment within the college campus where they would like the interview to occur. Locations commonly included seating areas of cafes or other student communal areas. Prior to the commencement of an interview, each participant was given an explanation about the purpose and rationale behind the study via informed consent and recruitment presentations; in addition, participants were given assurances concerning the confidentiality of any data they would supply (Patton, 2002; Kvale & Brinkmann, 2009).

To best capture concurrent perceptions associated with the observations, all interviews occurred within 4 hours of the students being observed on the PA observation day (PAOD). Recording interviews is seen as helping to protect against bias and provides a permanent and accurate record of words said (Gill et al., 2008). Thus, interviews were audio-voice recorded using an audio recording device (ICD-PX333, Sony Corporation, Japan) and a backup device (Voice Tracer 1100, Philips, Netherlands) to offer protection against device malfunction or loss of clarity in recording (Kvale & Brinkmann, 2015). In addition, handwritten notes were made during each interview in case of total audio-recording device failure and to record any small detail about observations and additional thoughts that might then help in data analysis (Patton, 2002; Kvale & Brinkmann, 2009). Feedback was obtained from the participants by ‘checking back’ with them during discussions to ensure that their opinions and intentions were accurately recorded or clarified (Greene & Hogan, 2005; Martin & Murtagh, 2017b). Only two students asked to have a small part of the transcripts removed surrounding comments about their teachers. On interview completion, participants were thanked for their time and asked if there was anything else they would like to add. All audio-recorded voice files were uploaded into NVivo11 (QSR International, 2016) and verbatim transcribed (See Examples in Appendix 5). Participants were invited to review these final transcripts before analysis and allowed to remove or modify any comments; this served as a member check for increased data credibility (Thomas, 2006; Creswell, 2013; Benes et al., 2016).

3.5 Data Analysis

3.5.1 Physical Activity Data Analysis

Device-measured PA from the accelerometer and pedometers was designed to act as part of the study's manipulation checks, to establish if the intended independent variable of higher PA had occurred in the PA-based lessons compared to the classroom-based lessons (Thyer, 2001; Hauser et al., 2018). To be considered a physically active lesson, the lesson needed to feature a higher mean ($p<0.05$) PA recorded by accelerometer and/or pedometer using a t-test comparison to the classroom-based control lesson. On a number of occasions, an accelerometer or pedometer device proved faulty or unable to provide readings due to battery loss or other technical errors. Consequently, participants without at least one full PA data from either an accelerometer or pedometer and meeting the criteria of significantly higher PA were not utilised in the final data analysis; this accounted for 12 unusable student datasets. To further confirm more PA had occurred in the PA-based lessons compared to the classroom-based lessons on both the PA Observation Day (PAOD) and Control Observation Day (COD), two 3 (lesson) x 2 (day) repeated measures Analysis of Variance (ANOVA) were conducted as significant correlations between accelerometer and pedometer data were more than moderate in size (Chowdhury et al., 2015). PA data analyses were conducted within IBM Statistical Package for the Social Sciences (SPSS) Version 25.

3.5.2 Observation Data Analysis

A considerable amount of research associated with on-task and off-task behaviour considers both in analysis (Mahar et al., 2006; Webster, 2013;

Webster et al., 2015; Wilson et al., 2016; Snyder et al., 2017) and some only report off-task behaviour (Ma et al., 2014; Wiebelhaus & Fryer-Hanson, 2016). So in the current study, both on- and off-task data were analysed to allow full comparison to the literature. In addition, off-task behaviour data is not always merely the opposite of on-task data as there are examples in the literature where both on-task and off-task data have been reported with different significance values (Snyder et al., 2017). Therefore, scrutiny of both on- and off-task data may offer additional insight into the intervention effects and consider whether PA may also reduce off-task behaviour in college students, which could be important for teachers considering whether to include PA in a lesson and/or curriculum. Analysing the complete data is also desirable so as not to over-endorse the benefits of PA without at least considering all data variables increasing research integrity.

A student observation score for on-task or off-task behaviour was the mean percentage calculated by summing the number of intervals in which on-task behaviour occurred during the total 5-minute observation period and dividing by the total number of intervals (i.e., 20) and then multiplying by 100 (Mahar et al., 2006). A 3 (lesson) x 2 (day) repeated measures ANOVA was deployed to examine differences in on-task behaviour (dependent variable) between time points (independent variable), calculated separately for all conditions. Bonferroni post-hoc tests were used for within-subject contrasts with pairwise comparisons set at 5% ($p<0.05$). All observation analyses were conducted within IBM Statistical Package for the Social Sciences (SPSS) Version 25.

A number of studies in the primary research and meta-analysis literature often report effect size (Burns et al., 2016; Grieco et al., 2016; Li et al., 2017;

Watson et al., 2017). Indeed, some authors have suggested that effect size is so important, once significance is deduced that effect size is then “the main finding of a quantitative study” (Sullivan & Feinn, 2012 p. 207). Effect size can allow a more direct quantification of the size of the current study’s observed effects compared to the associated literature and is independent of the potentially misleading influences of varying sample sizes reported between studies (Fritz et al., 2012). Thus, to allow further comparability with other studies, effect size was also calculated using Cohen’s d effect size estimate for repeated measures, by dividing the difference between the baseline and the after PA-based lesson or after control by the average of baseline and the PA-based lesson or after control standard deviations (Portney & Watkins, 2013). Cohen’s d effect size was chosen to allow direct comparison as it appeared the most widely used effect size method in the associated literature. The criteria used to categorise significant effect sizes can be found in Figure 3.4 (Sullivan & Feinn, 2012; Warner, 2013). It should be acknowledged that, effect size, like many statistical synthesis measures and methods to refine data into numerical categories, is a complex and contested concept (Coe, 2002). Such detailed discussion of these inherent criticisms and shortcomings can be found in the literature and are beyond the scope of this thesis (see for example Fern and Monroe, 1996; Hattie, 2009 and Wrightly et al. 2018). With consideration to these factors effect size was still chosen as an appropriate reporting tool to indicate to the reader the magnitude of change and allow comparisons with previous authors work where it is also commonly deployed.

Table 5.2 ♦ Suggested Verbal Labels for Cohen's *d* (Correspondence Between Cohen's *d* and Other Effect-Size Indexes)

Verbal Label Suggested by Cohen (1988)	d	r	r^2 *or* η^2
Extremely large effect	2.0	.707	.500
Very large effect	1.5	.600	.360
	1.2	.514	.265
	1.0	.447	.200
	0.9	.410	.168
Large effect	0.8	.371	.138
	0.7	.330	.109
	0.6	.287	.083
Medium effect	0.5	.243	.059
	0.4	.196	.038
	0.3	.148	.022
Small effect	0.2	.100	.010
	0.1	.050	.002
	0.0	.000	.000

SOURCE: Adapted from Cohen (1988).

Figure 3.4. Suggested verbal labels for Cohen's D effect sizes (Warner, 2013, p.194)

Statistical outcome reporting in quantitative research commonly employs averages, but these can mask considerable differences among individual participants and previous research has identified the highly personalised nature of student variations in behaviour (Biddle et al., 2001). Thus, statistical data concerning means may offer little to help understand the individual reasoning and meanings behind variations (Patton, 2002). To counter this weakness, the Reliable Change Index (RCI; Christensen & Mendoza, 1986; Jacobson & Truax, 1991) was deployed to gain a fuller insight via investigating the on-task data further, indicating what direction and if a change of significant magnitude had occurred at an individual level when comparing the on-task behaviour levels before to after the PA-based lesson on PAOD, and on-task behaviour levels before to after the control lesson on COD. Principally, the researcher was interested to discover via this analysis whether an individual's level of on-task behaviour had increased, remained similar, or decreased in each of the 111 participants (Roberts et al., 2001; Zahra & Hedge, 2010; Warburton & Spray, 2016). RCI was calculated using Microsoft Excel consistent to Jacobson and Truax (1991) by:

$$\text{RCI} = \frac{\text{(individuals pre-treatment score)} - \text{(individuals post-treatment score)}}{{}^{s}\,\text{Diff}}$$

Where:

$${}^{S}\,\text{Diff} = \sqrt{2}(S_E)^2 \qquad\qquad S_E = \text{SD}\sqrt{1} - r_{xx}$$

^{S}Diff is the standard error of the difference and SE is the standard error of the mean (SEM). SD is the standard deviation derived from the normative sample of the baseline values and $R_{xx}$is the test-retest reliability coefficient (set at 0.95 from the pilot observations in 3.4.6).

The resultant individual RCI values provided a measure of the individuals' on-task behaviour change in a standardised unit. RCI values with a magnitude of 1.96 or greater in either positive or negative direction were considered a statistically reliable change at the $p<.05$ level (Jacobson & Truax, 1991; Zahra & Hedge, 2010). Thus, positive value RCIs over 1.96 were categorised as a reliable increase, whereas negative RCI values under -1.96 were categorised as reliable decreases, values within these parameters were considered as no change, i.e. no difference from baseline.

3.5.3 Interview Data Analysis

The estimated percentages of students' on-task behaviour in the lessons before and after the PA-based lesson yielded quantitative data which was then correlated to the individuals observed on-task percentage values using Pearson R product-moment correlation coefficient in IBM SPSS v.25, with significance set at $p<0.05$. Interview questions that followed the estimated percentages yielded qualitative data that was analysed through a thematic analysis inductive approach and the use of coding that emerged from the content of the interview responses (Morgan & Hansen, 2008). Inductive reasoning is reasoning that uses a number of specific examples to arrive at a conclusion; the researcher identified repeating and emerging patterns in the data (Morgan & Hansen, 2008; Kvale & Brinkmann, 2015). Inductively deriving a coding scheme formulated based on an examination of common thematic content from the students' interview transcripts allowed for any unanticipated themes to develop that may have supplied further useful analysis of the complete data-set (Roberts, 2019). Two illustrative examples can be found in appendix 5. Further patterns emerged as a result of several systematic readings of the interview transcripts (McMullen et al., 2014) and as coding themes progressed, more detailed code descriptors developed and were further revised into first- and second-order themes (Biddle et al., 2001; Jones & Gratton, 2015). Through this inductive process, the qualitative interview analysis data were divided into two emphasised sections with respective thematic maps (see Figure 4.2 and 4.3). Firstly, student responses were explored in relation to their rationale and reasoning for their perceived percentages of on-task behaviour in the two lessons observed on PAOD $\leq$ 4hours prior to the interview. Secondly, student responses to the more general final interview question of 'not just including today's lessons, does a physically active lesson affect your ability to be on-task in the following lesson after?' were analysed. This provided an exploration of student perceptions on specifically how a PA-based lesson might affect on-task behaviour.

To contribute to analytical rigour and to limit potential bias and increase validity, the data analysis was subjected to multiple viewpoints (Lincoln & Guba, 1985; Patton, 2002) through the involvement of a critical peer. This critical peer was educated to the comparable level of the researcher and a clinical practitioner in health care. The researcher discussed the initial code and theme operational definitions with the critical peer and any disagreements were discussed until consensus was reached (Borkan,1999). Based on this discussion to test the themes and codes, the critical peer and researcher re-analysed data from a sample of six interviews independently (Lincoln & Guba, 1985; Dinkel et al., 2017). Both researcher and critical peer largely discovered the same themes and codes in these interview transcripts with minimal variation and an inter-observer agreement consistent as acceptable with other similar studies, equalling 91.8% (Massey et al., 2017). The theme and codes were then adopted by the primary researcher who then reread all the interviews several times. To increase the trustworthiness of findings (Creswell, 2013; Benes et al., 2016; Dinkel et al., 2017), the researcher also carefully considered any deviant and/or negative cases where participant statements seemed to contradict emerging themes and with the help of the critical peer, either determined they were consistent with existing themes or noted these occurrences within the findings, often as new codes (Hodges et al., 2015).

All student interview coding analysis was conducted within NVivo11 software package (QSR International, 2016). To identify the most dominant themes and codes, occurrences were quantified by the percentage of students who mentioned factors related each theme (Morgan & Hansen, 2008). Simple quantifying procedures such as this may prove useful in analysing even the most idiosyncratic and unstructured data. This use of 'quasi-statistics' can enhance the rigour and power of a qualitative analysis "providing always that we keep in mind just what the numbers mean" (Dey, 2005 p. 29). However, within this thesis, these percentages are presented not as inferences or predictions but simply to report the frequency of participants in each theme to help inform readers of the research with a more comprehensive picture of patterns observed in the interview responses (Cohen, et al., 2007).

3.5.4 Triangulation Analysis

Two separate analytic instruments were used, one producing quantitative data and the other predominantly qualitative data around the same phenomenon

(Creswell, 2013). Consistent with the convergence model of triangulating data, once each data set was analysed independently, they were then converged during interpretation, a process in which the researcher compares, contrasts and merges results with the research questions in mind (Creswell & Tashakkori 2007; Creswell & Plano-Clark 2011; Anguera et al. 2012, see Figure 3.1). Mixing of data were facilitated by examination of common themes across differing methods with successive content analysis and theoretical frameworks that might emerge from themes in the data, to arrive at a multi-layered account (Elo & Kyngäs 2008; Creswell & Plano-Clark 2011). Teddlie & Tashakkori (2009 p. 300) "call this interpretation drawing inferences and meta-inferences". Inferences in MM research are "conclusions or interpretations drawn from the separate qualitative and qualitative strands of a study" (Creswell & Plano-Clark, 2011 p. 213) whereas, a meta-inference is a higher-level amalgamation or integration of a number of the researcher's inferences made from the qualitative and quantitative findings, concepts, or theories (Tashakkori & Teddlie, 2010).

Methods of mixing, analysing and interpreting qualitative and qualitative data together are still relatively underdeveloped in the literature, with a lack of well-established cross-comparison strategies, often limited to a comparison of isolated qualitative and quantitative methods in analysis (Creswell & Plano-Clark, 2011). In this research, integration of observation and interview data were possible because individuals were direct participants of the observation, and the integration of the findings could allow the researcher to address research question three 'Do student perceptions offer explanations for their observed on-task behaviour?'. Research question three was specifically 'the prototypical mixed-methods question' to be answered by triangulation of the measures from research questions one and two in examining the extent of convergence or divergence of qualitative and quantitative results (Creswell & Plano-Clark, 2011).

Two key elements were considered central to addressing research question three: firstly, do interviews support and/or validate observations and secondly, perhaps more importantly, to what extent do qualitative findings from interviews enhance our understanding of the outcomes from the quantitative observations. These inquiries call for systematic comparison techniques that are fully interconnected in design to avoid distinctly isolated and disparate collections of data (Edmonds & Kennedy, 2012; Creswell, 2013). By presenting the quantitative results and the qualitative findings together in a reflective discussion allows a means of conveying the merged results (Bryman, 2006; Creswell, 2013). In effect, the main measurement and processes of 'integrating' MM to address research question three analysis occurs as informed reflection of both observation and interview data in the findings and discussion sections, for example, how the qualitative illustrative quotes either confirm or contradict the quantitative results (Blatchford et al., 2002; Creswell & Plano-Clark, 2011). The researcher attempted to fully explicate the links between the rationale for the integration analysis of the research questions in the findings and discussion sections of the thesis. Another element of triangulation and mixing of methods in the analysis occurred in the direct comparison between perceived on-task percentages from the students' interviews and observed recorded percentages.

3.6 Validity and Reliability

Validity and reliability are essential properties in any study in increasing rigour and quality assessment in research (Johnson & Christensen, 2012;

Newby, 2014). In a MM design, Bryman (2006) identified a quality criteria model termed 'separate criteria' that involves the researcher applying quality criteria that are associated with each paradigm independently to each methodological approach. Subsequently, these criteria are viewed as applicable for improving the methodological soundness of each particular approach and the overall MM outcome. Specifically, validity criteria (e.g., internal and external validity, reliability, objectivity) were applied to the quantitative component and qualitative criteria (e.g., trustworthiness, legitimacy, subjectivity) associated with the qualitative paradigm was applied to the qualitative component (Bryman, 2006). The integration of findings then occurs in the analysis/conclusion stage of the study. This approach was adopted by the current study to address the differences across qualitative, quantitative and MM in relation to what constitutes rigour, the variation in substitute language used to articulate meanings of validity and how to achieve it (Collins, 2015; Denzin & Lincoln, 2017). The relative independence of the two approaches throughout the research process allows the application of separate validity criteria to each research question during data collection (Collins, 2015).

Validity is another word for truth, as in, does the method measure what it intends to measure (Gray, 2014; Silverman, 2013). Maxwell (1992) proposes three types of validity specifically for qualitative research: 1. Descriptive validity, the descriptive accuracy of what is reported; 2. Interpretive validity, the accuracy of interpreting what is going on in the minds of the participants and the degree to which the participants' views, thoughts, feelings, intentions and experiences are accurately understood by the researcher(s); 3. Theoretical validity, the extent to which the theoretical explanation developed fits the data and, therefore, is credible and defensible (Venkatesh et al., 2013). In reference to this study, the observation method adopted and the questions in the interview were selected to directly address the research questions. This approach is in-line with Teddlie and Tashakkori's (2003 p. 20) statements around MM whereby "pragmatist researchers consider the research question to be more important than either the method they use or the paradigm that underlies the method", as the research questions in this study are central to all design considerations. Validity also involves dealing critically with conflicting cases and not depending on a few well-chosen examples, sometimes referred to as the problem of anecdotalism (Silverman, 2013). Transparency is one of the most important conditions of validity, involving being clear about the methodological procedures and rationale for the research decisions, thereby allowing the reader to judge the research and conclusions for themselves and features heavily in trustworthiness (Newby, 2014).

In both qualitative and quantitative methods, it is difficult to achieve high validity without considering reliability (Gray 2009; Mertens 2015). Reliability refers to the consistency or stability of instrument recordings (Johnson & Christensen, 2012) and by this definition, arguably lends itself more easily to quantitative research. A more specific qualitative refinement for reliability could include "the degree of consistency with which instances are assigned to the same category by differing observers or by the same observer on differing occasions" (Hammersley, 1992, p. 67).

Reliability was considered in the quantitative observations using a pilot study (see 3.4.5) where inter-observer agreement was >95% and deemed acceptable for classroom on-task assessment and consistent with others who had tested the reliability of this method (Mahar et al., 2006; Mahar, 2011; Rodwell, 2015; Wilson et al., 2016). The nature of qualitative research, however, means it can be difficult to conform to reliability, but then, the goal of qualitative research is not to produce results that can be replicated exactly (Somekh & Lewin, 2004). Lincoln & Guba (1985) argue that reliability is a necessary condition for validity and that demonstrating validity in qualitative research may be sufficient to establish reliability (Venkatesh et al., 2013). Qualitative research is perhaps best when its practitioners embrace the subjectivity of data from individuals and consciously seek to produce meaningful interpretations, rather than conclusive results (Denzin & Lincoln, 2017). Both definitions of reliability are considered in the methodologies and subsequent analysis of this study where relevant. Reliability issues were further addressed in this study through the use of a critical-peer, member checking transcripts and the adoption of previously validated research approaches, considerate research design and piloting methods.

3.6.1 Trustworthiness

The terms validity and reliability have been argued to be more adept and broadly accepted for quantitative methods (Venkatesh et al., 2013). Qualitative research, however, does not have as widely accepted guidelines, definitive evaluation criteria or norms for validation (Lee & Hubona, 2009; Venkatesh et al., 2013). In this regard, trustworthiness has been offered as a combined term as an alternative for validity and reliability in the interpretive paradigm (Guba & Lincoln, 1989; Patton, 2002; Cohen et al., 2011; Sparkes & Smith, 2014) and involves the extent to which research can be defended when challenged (Venkatesh et al., 2013).

Trustworthiness is commonly reported to be made up of five key criteria, credibility, transferability, dependability, confirmability and authenticity. Credibility concerns internal validity (Bryman, 2016); this was considered with the interview questions focusing on specifically asking students about their perceptions related to the lessons that had occurred within 1-4 hours of the individual's observations on PAOD. Also, further respondent validation occurred in the form of participant member-checks (Lincoln & Guba, 1985; Patton, 2002). However, this was only done with interview transcripts and not with the final analysis as the students had graduated prior to completion of coding of themes, and thus may weaken the credibility of the analysis. Transferability is the generalisability to other groups and settings (Bryman, 2016), while the current studies transferability may only be limited to one college and adolescent students from sports and drama subjects that occur in a sports hall or drama studio, these descriptive characteristics and context of participants assists the reader/consumer in evaluating the applicability to other milieu (Lincoln & Guba, 1985). Confirmability recognises total objectivity is improbable in social research (Bryman, 2016). The researcher of this study acknowledges his bias and personal values, tried to act in good faith and not overtly allow these factors to sway the research findings. To parallel reliability in quantitative research, dependability has been suggested for qualitative methods where a study needs to fully inform the reader of its methods to be replicable and auditable (Lincoln & Guba, 1985; Bryman, 2016). The current study attempted to detail the methods to be clear for others to replicate and the use of member checks and critical-peer to code the transcripts to the category descriptions may have also assisted the dependability of the research (Thomas, 2006). Finally, authenticity, which Lincoln & Guba, (1985) extends with further sub-criteria of fairness, ontological authenticity, educative authenticity, catalytic authenticity, and tactical authenticity (Bryman, 2016). Fairness in Lincoln & Guba's (1985) authenticity criteria, was perhaps the most applicable to the current study and required that different constructions and viewpoints were solicited and honoured equitably from each participant interviewed (Morrow, 2005).

Further trustworthiness of this research can be assessed by comparison with findings from previous research, triangulation within the research such as feedback from participants and feedback from other users of the research findings (Maxwell, 1992; Thomas, 2006; Collins, 2015). The current study purposefully adopted similarly consistent definitions as previous research that has observed on- and off-task behaviour. In assessing academic behaviour, Sullivan et al. (2017) emphasise that such applications of consistent on-task measures are important for research comparability.

3.6.2 Legitimation and Inference Quality

Achieving validity in a MM study typically requires the appropriate validity standards found in the differing paradigms informing the multiple intellectual research communities within which the study positions itself (Onwuegbuzie & Johnson, 2006). MM validity, therefore, aims to offer a multidimensional hybrid of these terms and philosophies, adopting a common nomenclature that transcends qualitative and quantitative orientations (Tashakkori & Teddlie, 2010) However, limited guidance is available in the literature for validation in MM research (Venkatesh et al., 2013). Indeed, Creswell and Clark (2007, p. 145) note that “the very act of combining qualitative and quantitative approaches raises additional potential validity issues”. In MM research, the terms ‘inference quality’ (Teddlie & Tashakkori, 2009) and ‘legitimation’ (Onwuegbuzie & Johnson, 2006) have become popular with regards to validity. These terms are expressive of the process of designing and conducting high-quality MM research (Collins, 2015).

Inference is defined as “a researcher’s construction of the relationships among people, events, and variables as well as his or her construction of respondents’ perceptions, behaviour, and feelings and how these relate to each other in a coherent and systematic manner” (Tashakkori & Teddlie, 2010 p.692). Inference quality in MM research refers to the accuracy of conclusions from the researcher’s interpretations in a study (Venkatesh et al., 2013). Teddlie & Tashakkori (2009) suggest that inference quality consists of design quality (whether a mixed methods study adheres to commonly accepted best practices for both paradigms), and interpretive rigour (i.e., standards for the evaluation of accuracy or authenticity of the conclusion). Teddlie and Tashakkori (2009) also propose the term inference transferability to denote the generalisability of the findings, which comprises population transferability (i.e., transferability to other individuals, groups or entities), ecological transferability (i.e., transferability to other contexts or settings), temporal transferability (i.e., transferability to other time periods), and operational transferability (i.e., transferability to other methods of measuring behaviours). These conceptualisations present inference as an outcome; however, Onwuegbuzie & Johnson (2006) believe it needs some elaboration and extension with what they term legitimation (Collins, 2015). They view legitimation as a process and as such, quality checks should occur throughout the research process. However, over-emphasising inference quality as the primary outcome could lead to failure to scrutinise appropriately other steps of the research process (Onwuegbuzie & Johnson, 2006).

Legitimation in MM research should be seen as a continuous process, rather than as a fixed attribute, such that, in a sense, inference closure (being able to make definitive statements about the quality of inferences made) might never be fully reached within a particular study or even over a series of systematically linked studies (Johnson & Onwuegbuzie, 2004; Onwuegbuzie & Johnson, 2006). Ultimately “research needs to be defensible to the research and practice communities for whom research is produced and used” (Onwuegbuzie & Johnson, 2006, p.48) and allow the consumers of the research sufficient detail to be able to make their own conclusions about the quality of reported findings. Legitimation may be supported by following the steps identified by Mahar’s (2011) review paper as essential for generating credible data: adopting previous accepted definitional terms for on and off-task behaviour; training observers; determining type and length of recording, and assessing inter-observer reliability, all of which to varying degrees have been considered or addressed by the current study.

3.7 Ethical Considerations

Research is inescapably an ethical enterprise that should be ethically defensible and conducted scrupulously (Cohen et al., 2011). One of the first considerations of ethical issues is the worthiness of the research (Miles et al., 2014) and that participants should only be exposed to research of sound design (Silverman, 2013). Throughout the construction and decision making of the study’s methodology, ethical considerations were central. At all stages of the research process, adherence to ethical codes and guidelines of the British Educational Research Association (BERA, 2005; Robson, 2011) and The British Association of Sport and Exercise Sciences (Williams et al., 2015) were maintained. Thus, no student was allowed to participate if they had a diagnosed intellectual or learning disability or aged under-16. All sensitive and identifiable data, including voice recordings, were held in compliance with the 2016 General Data Protection Regulation of the EU (Newby, 2014; Information Commissioner's Office, 2018). Express permission was first sought from the Vice-Principal of the college, then line management and finally teaching staff, in their capacity of gatekeepers, before contacting student participants to seek their consent, examples of these letters can be found in Appendix 2.

The research received prior ethical approval by the University of East Anglia's School of Education and Lifelong Learning ethics committee as per university regulations (see Appendices 2-4). Ethical considerations are often a dynamic and continuous process, Floyd & Arthur, (2012) identify that this 'box-ticking process' of ethical approval can 'lull' a researcher into a false sense of security by addressing the external ethical engagement factors, i.e those that are easily identifiable at the start of research such as consent and anonymity (Cressey, 2012). Continuous thought was therefore given to insider-outsider perspectives of the researcher researching inside their own institution of employment during the research process (Sikes & Potts, 2008). Floyd & Arthur, (2012, p.4) identify "being an insider means being embedded in a shared setting (Smyth & Holian, 2008), emotionally connected to the research participants (Sikes & Potts, 2008), with a 'feel for the game and the hidden rules' (Bourdieu, 1988)". If the researcher is also an employed member of staff in the organisation in which the research is taking place, participants may deem them an insider and this may confer privileged access to information; this requires additional ethical considerations so as not to exploit participants (Smyth & Holian, 2008).

Ethical considerations regarding the autonomy of participants was implemented in the informed consent process in which participants were informed of the research purpose and procedure through a pre-approved participant information sheet (Appendix 2) and the researcher conducted a short presentation of the project outline and expected obligations to student groups, giving honest answers to all participant questions (Silverman, 2013; Denzin & Lincoln, 2017). Specifically highlighted to participants was that consent to participate was voluntary, they could opt-in or out and the right to withdraw at any time without reason (Patton, 2002). It was emphasised that there would be no implicit pressure to participate and that a student's decision not to participate would be fully respected and would not lead to any adverse consequences. If any participant or non-participant had concerns in this regard, they were informed of the appropriate persons to contact on the informed consent documentation as a safeguarding measure (Nolen & Putten, 2007). Consideration of autonomy was also given to teaching staff, the gatekeepers of the classrooms to be observed, who also agreed to the consent documentation (Appendix 2) and were informed of their right to withdraw or pause the study within their classrooms at any point (Creswell, 2013). Any constraint or inadvertent pressure on freedom felt by the participants may not only be an ethical issue, but is also likely to adversely affect the trustworthiness, validity and quality of the findings (Nolen & Putten, 2007).

Protecting the confidentiality of participants is another issue that needs consideration in reporting the results (Kaiser, 2009). Confidentiality may be compromised by the fact that participants in qualitative data may be easily recognised within the organisation, particularly as only a limited number of overall eligible classes in the population were observed; therefore, individuals within the community are likely to be able to identify key players and informants (Nolen & Putten, 2007). To counter this, confidentiality is maintained throughout this thesis by the use of pseudonyms for the names of staff, students and locations (Silverman, 2013; Denzin & Lincoln, 2017). In the reporting of the research, descriptors that could lead to untoward identification of participants have been avoided; for example, the content of the lesson and gender or subject specialism of teaching staff is hidden in any comments relating to teacher performance (Elliott, 1991).

It is also important to note that the researcher's position within the organisation may also act as a constraint, limiting who is willing to participate and what is revealed (Smyth & Holian, 2008; Floyd & Arthur, 2012). Face-to-face research methods such as classroom observations and interviews with participants used in this study can encompass numerous complex and shifting boundaries, relationships and power differentials (Ganga & Scott, 2006). Ryan, (2015) contends that researchers may occupy multiple identities and maybe simultaneously insiders and outsiders. Challenging the concept of an 'insider/outsider' dichotomy, Dwyer & Buckle, (2009) suggest an 'in between', as researchers may only ever occupy the space in between; neither truly insiders nor completely outsiders. While classification into categories is also perhaps too simplistic, Chavez, (2008) and Ryan, (2015) suggest further dynamism in multi-faceted research relationships: "a researcher can experience various degrees of insiderness and outsiderness given how she/he is socially situated to (and by) participants during the research process, which affects various stages and aspects of the study" (Chavez, 2008 p. 477). The researcher was not a directly associated teacher with the classes observed as the researcher teaches at UK level 4-6 and consequently not the population being studied. However, the researcher was often wearing institutional sports attire like the classroom's teachers and students, and a staff identity badge of the organisation was clearly visible as per college regulations. It is therefore, perhaps, not that easy to predict how the researcher was perceived by the participants and it is possible that identities of insider/outsider may have re-formed and re-shaped throughout the face-to-face encounters in observations and interviews, as various verbal and non-verbal clues were used to piece together a sense of researcher-interviewee relationship (Floyd & Arthur, 2012; Ryan, 2015). An awareness of these internal ethical engagement factors in planning and conducting this study was important to produce ethically sound research and credible data.

There were no significant identifiable risks of harm, stress or negative consequences as a result of participants partaking in this study either before, during or after the research (Robson, 2011). Other factors further contributing to low risk include: the PA was naturally occurring; interview foci and questions were not deemed to be of a sensitive nature; confidentially guidelines were adhered to; the form of observation used was passive-overt limiting detractions to the natural functioning of the classroom compared to participant observation method, and those students that volunteered were informed verbally and in writing of their right to withdraw at any stage (BERA, 2005; Robson, 2011; Denzin & Lincoln, 2017). Further ethical considerations and evidence of process can be found in Appendices 2-4.

Chapter 4 – Findings

4.1 Structure of the Chapter

To assist in the clarity of this study's mixed-methods approach and consistent to convergent mixed methods design (Figure 3.1), Chapter 4 presents the study's outcomes independently with the quantitative observation outcomes first, followed by the qualitative findings of the interviews. Further converged analysis is addressed in 'Chapter 5 - Discussion', allowing a more considered integration of findings and inferences, reflective of the study's mixed-methods design.

4.2 Observed On-Task and Off-Task Behaviour Between Lessons

4.2.1 Physical Activity Measures Between Lessons

As a key part of the study's manipulation check, a two 3 (lesson) x 2 (day) repeated measures ANOVA revealed a main effect for pedometer step-counts between lessons ($F(1,75) = 250.45$, $p < 0.001$) and a significant interaction effect ($F(1,75) = 287.15$, $p < 0.001$). Post-hoc Bonferroni comparisons signalled that the mean number of steps differed only on PAOD during the PA-based lesson ($p < 0.001$). No other lessons showed any statistically observable difference for condition (Table 4.1). Thus, the amount of PA as measured by step count was higher only in the PA-based lesson in the sports hall. Cohens d effect size for pedometer steps in the PA-based lesson on PAOD compared to those recorded in the control lesson on COD demonstrated an extremely large effect size of $d = 2.7$ (Warner, 2013; Cohen, 1962).

Table 4.1. Mean (standard deviation) number of recorded steps and Technogym MYwellness Key Moves® from students in the lesson before, during the PA-based lesson or control lesson and in the lesson immediately after.

	Baseline Lesson	PA-based / Control Lesson	Lesson After
COD Steps	37 (15)	35 (13)	34 (14)
PAOD Steps	35 (18)	3096 (1597) *	36 (20)
COD Moves®	24.5 (9.2)	26.4 (7.2)	24.8 (10.9)
PAOD Moves®	23.4 (8.6)	385.8 (171.3) *	24.3 (14.2)

Note: COD = Control Observation Day, this is the day students did not take part in a PA-based lesson. PAOD = PA Observation Day, the day of observations students had a PA-based lesson. * = significantly different to all other lesson conditions ($p < 0.001$).

Analogous to the pedometer data, a 3 (lesson) x 2 (day) repeated measures ANOVA revealed a main effect for accelerometer Move® counts between lessons ($F(1, 80) = 311.68$, $p < 0.001$) and a significant interaction effect ($F(1,77) = 591.05$, $p < 0.001$). Bonferroni post-hoc comparisons indicated the mean number of accelerometer recorded Technogym Moves® was higher only in the PA-based lesson on the PAOD, compared to all other lesson conditions ($p < 0.001$; Table 4.2); no other statistically observable differences occurred. In the PA-based lesson, an extremely large Cohens d effect size of $d = 3.0$ was witnessed for Moves compared to those recorded in the control lesson, further indicating that the PA-based lesson featured significantly higher PA compared to the classroom lessons (Warner, 2013; Cohen, 1962).

4.2.2 Differences in On and Off-Task Observed Behaviours

To address research question 1, regarding ‘do levels of on-task behaviour vary after a PA-based lesson compared to an inactive lesson, and if so in what ways’, a 3 (lesson) x 2 (day) repeated measures ANOVA was used to compare observed on-task behaviour in the differing lesson conditions on both PAOD and COD. This revealed a main effect of on-task behaviour between lessons ($F(3,330) = 7.65$, $p < 0.001$) and a significant interaction effect ($F(1,110) = 4.13$, $p < 0.001$). Bonferroni post-hoc analysis indicated that mean (standard deviation) on-task behaviour rose from 60.9% (18.1) in the baseline lesson before the PA-based lesson to 69.3% (18.9) in the lesson after ($p < 0.05$) on PAOD only. This was the only statistically significant difference between the mean percentages of observed on-task behaviour in the differing lessons, demonstrating a ‘small to medium’ positive Cohen’s d effect size of $d = 0.46$ (Warner, 2013). Mean on-task behaviour was similar on the COD with 61.1% (21.2) in the baseline before the control lesson and 58.0% (22.3) after; these two COD outcomes also showed no statistical difference to the baseline PAOD lesson ($p > 0.05$: see Figure 4.1).

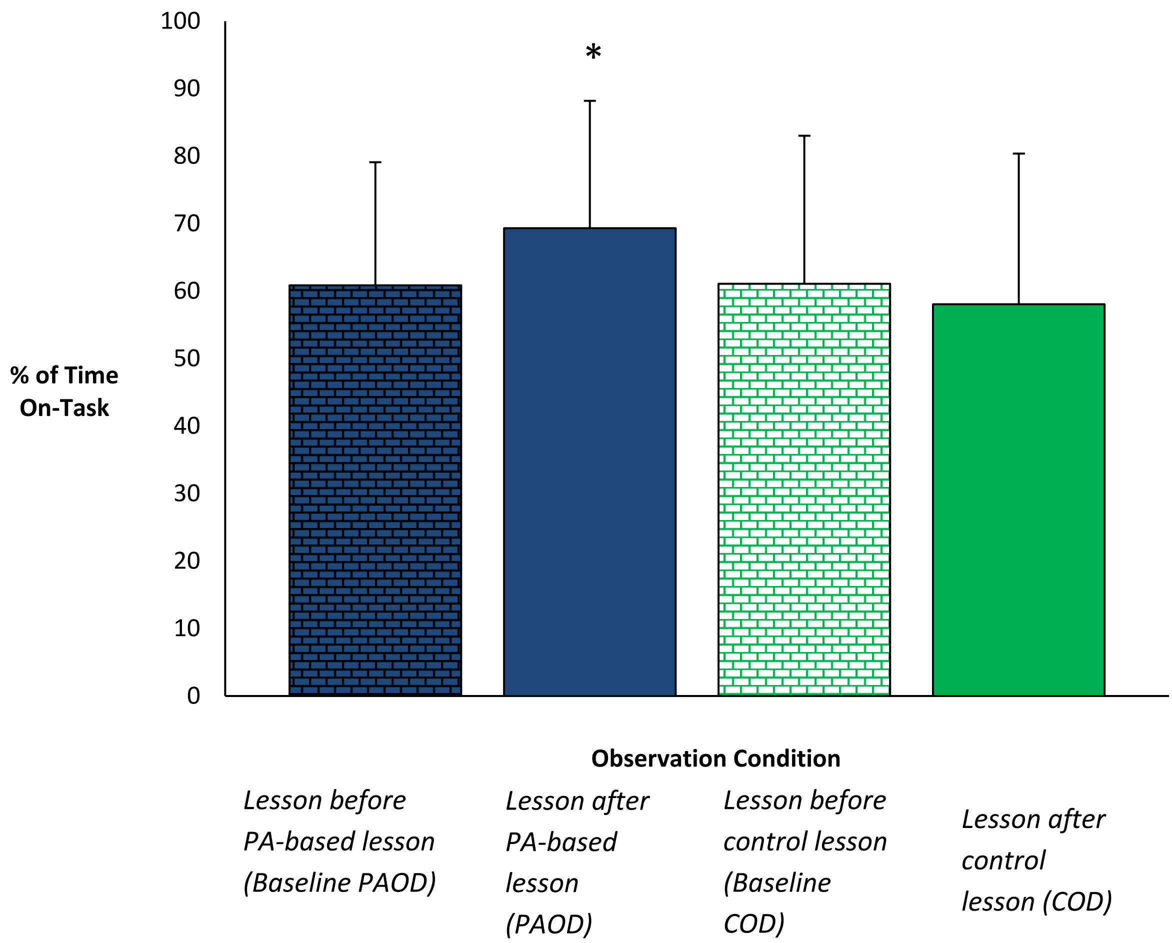

Figure 4.1 Mean student percentage of time observed on-task before and after PA-based lesson and control lesson. * = Significantly different to all other observation conditions $p < 0.05$.

Mean off-task behaviour scores using a 3 (lesson) x 2 (day) repeated measures ANOVA demonstrated a main effect between lessons ($F(3,330) = 7.60$, $p < 0.001$) and a significant interaction effect ($F(1,110) = 963.67$, $p < 0.001$). Bonferroni post-hoc comparisons demonstrated matching trends to the on-task behaviours, shown in Figure 4.1, with only the lesson after the PA-based lesson showing significantly less off-task behaviour of 30.8% (18.7) compared to all other lesson conditions ($p < 0.05$). This represents a negative Cohen's d effect size of $d = -0.45$ analogous to on-task behaviour, indicating a 'small to medium' effect (Warner, 2013). In the lesson before a PA-based lesson on PAOD or the control lesson on COD, observed mean off-task behaviour was 39.1% (18.2) and 38.9% (21.9) respectively and ANOVA analysis indicated this was not significantly different ($p > 0.05$). The lesson after the control lesson presented 42.0% (22.3) off-task behaviour and was not statistically significant to baseline on COD. Similar mean on- and off-task baseline values between condition days (COD / PAOD) may offer increased confidence in an observed treatment effect (Jarrett et al., 1998; Mahar et al., 2006); although observations were conducted on differing days, other intra-individual factors previously identified to influence on-task behaviour may have been relatively constant (Wannarka & Ruhl, 2008; Adolphus et al., 2013; Önder et al., 2014).

4.2.3 Within-Student Changes in On-Task Behaviour

The Reliable Change Index (RCI; Christensen & Mendoza, 1986; Jacobson & Truax, 1991) was deployed to investigate the data further, beyond solely considering mean on-task behaviour levels. Via this analysis the author was interested to discover if individual-level student on-task behaviour would increase, decrease or remain stable (no change) for each of the 111 participants. For simplicity and because of similar reported outcomes in the ratio data, only on-task behaviour data were used for this analysis (Table 4.3). The RCI data in Table 4.3 indicates the PA-based lesson offered an increased on-task performance of 27% more students than the COD. The RCI data also indicates that without a PA-based lesson, 22% more students demonstrated a reliable decrease in on-task behaviour and thus were more off-task; also, more students showed no change in on-task behaviour levels.

Table 4.2. The Reliable Change Index (RCI) of on-task behaviour in the lesson before compared to the lesson after the PA-based lesson on PAOD and the control lesson on COD, total and percentage of participants in each RCI category, N=111.

PAOD On-Task Behaviour Before -> After		**% of N**	**COD On-Task Behaviour Before -> After**		**% of N**
Increased	83	75	Increase	53	48
Decreased	15	13	Decrease	39	35
No change	13	12	No change	19	17
Totals	111	100		111	100

Note: COD = Control Observation Day, this is the day students did not take part in a PA-based lesson. PAOD = PA Observation Day, the day of observations students had a PA-based lesson.

4.3 Comparisons of Perceived and Observed On-Task Behaviour

Student reported percentages of on-task behaviour allowed the researcher to identify if the students perceived differences between their on-task levels in the lesson before the PA-based lesson and the lesson immediately after. Twenty-two of the 36 (61.1%) students interviewed reported a higher percentage of on-task time in the lesson after PA, compared to the lesson before activity; therefore, an increase in on-task behaviour in the lesson after PA was perceived. Conversely, eleven (31%) students considered the lesson after PA to be less on-task. Three (8%) students reported no change in percentage of on-task time between lessons. When comparing individual observed and perceived on-task values, a Pearson product-moment correlation coefficient indicated a significant correlation between observed and students' perceived percentage of time-on-task. According to Chowdhury et al. (2015), in the categorisation of the Pearson product-moment correlation coefficient values, the r-values indicate a moderate positive relationship in the lesson before PA (r = .47 p < 0.01) and a weak positive relationship in the lesson after PA (r = .36 p < .05).

4.4 Student Reasoning for Their Reported On-Task Lesson Percentages

After students had supplied a perceived on-task percentage at the start of the interview, the interview questions then focused on exploring students' rationale and reasoning for these percentages of on-task behaviour between the lesson before and after the PA-based lesson. Through inductive thematic analysis of interview transcripts a range of considerations reflective of broader factors related to learning and engagement and not just physical activity emerged from students for their reasons for variations in on-task behaviour. Four key themes and seven subthemes emerged, as outlined in Figure 4.2.

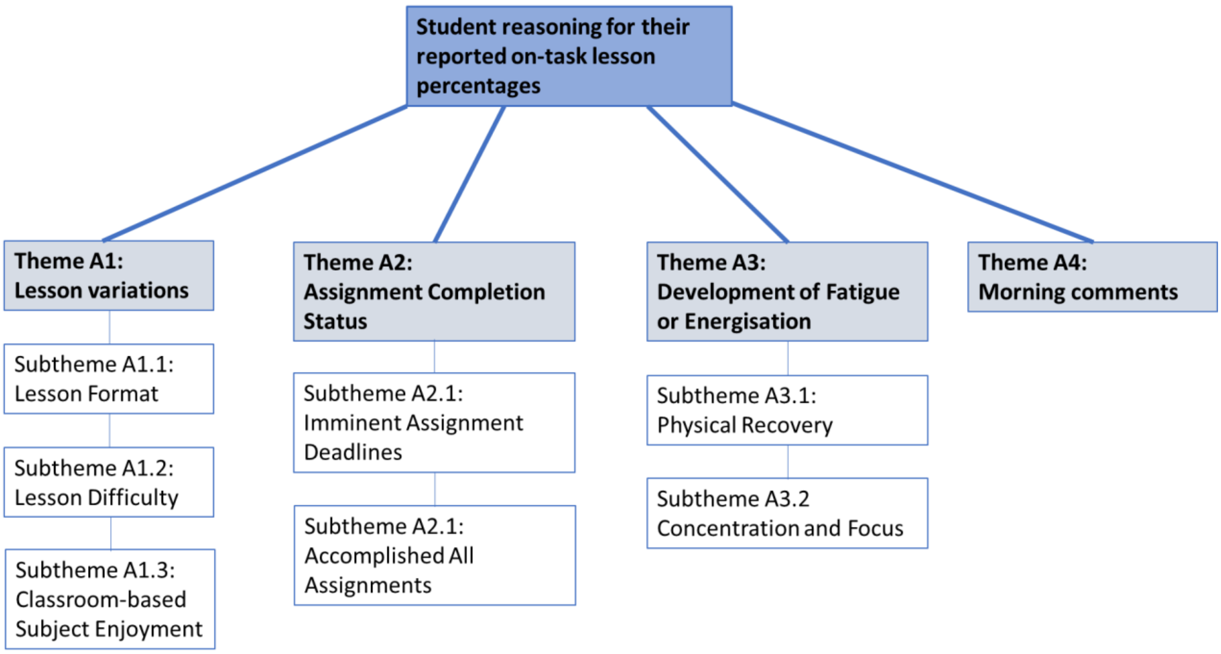

Figure 4.2 Final Thematic Map for Student Reasoning for Their Reported On-Task Lesson Percentages.

4.4.1 Theme A1: Lesson Variations

A total of 23 (61.1%) students suggested variations in their perceived on-task behaviour levels were in some part due to disparities around factors within the classroom-based lessons. Student responses appeared to directly compare and contrast the delivery, structure, content and enjoyment of their learning between the two lessons before and after the PA-based lesson as key influences of their levels of on-task behaviour. This was the most prevalent theme in the students' rationale for their on-task percentages and was further divided into subthemes of lesson format, lesson difficulty and classroom-based subject enjoyment.

4.4.1.1 Subtheme A1.1: Lesson Format

Sixteen students (38.9%) commented that the lesson format or type of lesson was different when comparing the lesson before to the lesson after the PA-based lesson. Comments regarding the format of lessons focused commonly on one of two classifications of lesson: classroom taught lessons or computer-based workshops. It was also subjectively noticed by the observer that students had been timetabled into two different lesson formats; one format involved "taught lessons on a PowerPoint...about general things, and knowledge" (John). These taught lessons featured tables and chairs arranged to focus on a singular whiteboard and projector; students in these lessons were largely expected to listen and follow teacher instructions from the front of the classroom and operate mostly on paper (Image 4.1).

Image 4.1 – Illustrative example of the “taught lesson” type classroom environment mentioned by students (Boston College, 2017).

The other ‘type’ of lesson was often called a “workshop” by a number of respondents. In this type of lesson students were seated in front of individual personal computers (Image 4.2) and students were largely allowed to complete BTEC coursework assignments with teacher support and supervision, as illustrated by Emily:

> “The thing is, that was a different lesson, the first lesson was a workshop, where we had to get on with assignments. Whereas the second lesson was sort of – *teacher X* wanted us to write down on paper ideas for trips” (Emily).

Image 4.2 – Illustrative example of the “workshop” type classroom environment mentioned by students (Seminole State College, 2017).

Although lesson format was not formally recorded by the observer nor was it an objective of the methodology, a retrospective analysis of the timetabled taught classrooms and computer workshops both before and after on PAOD and COD indicated approximately equal variation across both conditions, with 54% featuring computer-based rooms preceding PA-based or control lesson. Through the analysis of the interview transcripts, it was not possible to deduce that one lesson type was advantageous to on-task behaviour. Student responses indicated individual variation in personal preferences for each lesson type. Nine students suggested workshops helped increase their on-task behaviour, “we're just sitting there in front of the computers and getting into your work” (Alan), and

“I concentrate more on computers - than being told what to do” (Libby). Whereas seven students indicated workshops decreased students on-task behaviour levels compared to taught lessons, with comments such as: “I think because, in the workshop, you are just sitting there” (Chris) and “the first one we have is not, like, an actual lesson. So, in that lesson, we're not getting a lot of information. So that people will get put off-task” (John).

Thirteen students (36.1%) in this subtheme highlighted that variances in perceived lesson type also tended to result in a variety of teaching styles. For example, a student reflecting on a taught lesson stated that:

> “In the first lesson, we don't really get on with that learning style - by just like sitting there, not doing. I prefer to be more like actively doing things… [Teacher X] just tells us what it is and then just like explains it over and over again” (Andrew).

Several comments in this subtheme reported that on-task behaviour varied due to the guidance issued by teachers in each lesson type, referring to a taught lesson:

> “mainly because, in first lesson we got told, what we had to do - but then the second lesson was just like, finishing off work - and it was a bit more of a kind of left to your own devices” (Amy) and,

> “Teacher 1 would tell me, like, on the board, and I was concentrating on that. So, when he'd tell us to get on with the activity, then I would just do it… plus I think there's like more control of the class in the second lessons compared to the first. Because if there's conversations in the first, like, Teacher 1 didn't

> interrupt, whereas Teacher 2 is very like hot on when we're talking and your off-task" (David).

David went on to elaborate on more sophisticated pedagogical concepts such as "active learning" as another reason for variations in on-task behaviour between the observed lessons. Referring to the workshop lesson he commented:

> "you're still learning, but it's a different way. Like you're actively learning, whereas you're not just like sitting in a classroom, not reading through the textbooks or reading from the PowerPoints" (David).

4.4.1.2 Subtheme A1.2: Lesson Difficulty

Seven students (19.4%) offered comments relating to differing levels of challenge and difficulty of learning tasks between the two lessons effecting on-task behaviour. Six of the seven students in this theme indicated that one of the lessons' content lacked enough challenge, or new learning: "I, kind of, already knew what the lesson was about, so I felt like I didn't really need to take part in it as much as I could have" (Rosa). In contrast, one student reported that one lesson was more complex and this hindered on-task behaviour "the second lesson, it's a bit more complicated because we're doing our training sessions and I've got to work out what I'm gonna do" (Asad). Correspondingly, comments from three students (8.3%) related to confusion about the requirements of the learning tasks and the inability of the teacher to explain effectively, with statements such as, "there was a lot of confusion with that assignment" (Gemma) and "once teacher Y's explained her point, that's it. Teacher Y can't explain it a different way" (Luke).

4.4.1.3 Subtheme A1.3: Classroom-Based Subject Enjoyment

For seven students (19.4%), one reason why they perceived on-task behaviour varied between the two non-PA lessons was the "enjoyment factor of each lesson" (Emily). This was linked to enjoyment specific to the subject that was being taught in that lesson. Four students indicated that they enjoyed one lesson more than the other, with comments such as, "I'm more focused on what I've got to do in those lessons because I enjoy the subject" (Fred). Other students had similar views, although articulated differently, suggesting that one of the two non-PA lessons was less enjoyable and that this was related to subject of the lesson, "I don't enjoy the subject, and so I've got no motivation to actually go ahead and engage in the task" (Lisa).

4.4.2 Theme A2: Assignment Completion Status

The second most common theme featured whether students had completed their BTEC coursework assignments. These coursework assignments were an essential requirement for success in their studies. Assignment-related comments affecting on-task behaviour were characterised either as students being focused on completing work for a deadline or students' perception that they had finished all the required coursework. 19 students (52.7%) students indicated this as a possible factor to explain variations in why on-task behaviour varied between the lessons.

4.4.2.1 Subtheme A2.1: Imminent Assignment Deadlines

The need to complete an assignment before an impending deadline was mentioned by 16 students (44.4%) as largely attributing to the increase in their on-task behaviour later in the day. Students stated that “it's also the deadline for this particular assignment today, so I have to get my head down” (Sam) and “I was doing the work for the things today to hand in, that’s why I was on task, trying to get that done” (Murray). Imminent deadlines could also lead to on-task behaviour decreasing in other dissimilar lessons to the approaching deadline. Students commented that: “directly to what the teacher was asking us to do, the majority of the class probably wasn't on-task doing what she wanted to, because we had an assignment due in today” (Gemma), “If the assignment's got to be in that day then other people, you can see, just on their laptops just doing work. So, I feel like, you know, the [taught] class becomes pointless in one focus” (Rosa).

4.4.2.2 Subtheme A2.2: Accomplished All Assignments

This subtheme related to students who commented that on-task behaviour was affected because they had reportedly finished all current set assignments and tasks. Nine of the students interviewed (25.0%) offered this as a reason for the variation in on-task behaviour between lessons. This led some students to infer that their on-task behaviour decreased as a result of not having any teacher-directed tasks, “I had no assignments to do, but I did finish one assignment, but other than that, I had nothing to do” (Lee) and:

> “So, now that we've done that assignment, we're all sort of relaxed, other than a couple of people who still have it to do. So now I'm not really on-task at all because I haven't really got a

task to be done" (Luke).

These comments are encouraging as they arguably indicate that some students had adopted the operational definition of on-task behaviour supplied to them at the start of the interview.

4.4.3 Theme A3: Development of Fatigue or Energisation

When providing a rationale for the differences in the on-task behaviour between the two observed lessons on the PAOD, 15 (41.7%) students commented factors associated with either the PA-based lesson increasing their perceived energy or making them feel more tired and fatigued in the subsequent lesson. Five (13.8%) of the 15 students mentioned it had increased their energy and gave indications of being energised from the PA, "I think in the first lesson I was quite lethargic, but I thought, after we'd been exercising, I just felt more energetic and more willing to get involved with the group" (Mohammed). All five students that felt energised reported this was beneficial to on-task behaviour.

Ten (29.4%) students mentioned that the PA of the PA-based lesson led to them to feeling more fatigued or tired in the lesson after. However, not all students proposed that this was a negative outcome for on-task behaviour. Four students commented that this may facilitate on-task behaviour as there was "less energy to mess around and get into pointless conversations as they're being tired out by playing sports" (Callum). The notion of fatigue influencing energy levels and reducing the appeal of some off-task behaviours is an interesting one and is addressed further in 4.6.1 theme B1.1. Coupled with feelings of fatigue and energisation, students often directly associated physical recovery and/or effects on concentration and focus to the subthemes.

4.4.3.1 Subtheme A3.1 Physical Recovery

Eight (22.2%) students who mentioned fatigue suggested that they had not sufficiently recovered from the physiological demands of the PA-based lessons and that this could affect their on-task behaviour. All comments in this code indicated that this was a significant distraction and directly worsened on-task behaviour. In particular, six (16.7%) students reported feeling too hot and/or sweaty in the subsequent lesson and this negatively affected on-task behaviours: “after like a practical lesson, you're all like all hot and sweaty, so you're not thinking about, ‘Oh, I've got this lesson to do’, you are thinking, ‘Oh, I'm all hot and sweaty’" (Andrew). Some students added that strategies to get cool were distracting to on-task behaviour: “I was more concentrating on recovering after as I was sweating a lot. So I was sat near the fan. It was quite noisy as well” (Libby). These comments largely centre on the lack of a thorough and/or total absence of a structured cool-down to recover to near baseline physiological conditions as a possible factor for a decrease in on-task behaviours:

> “I think it was because after PA, we're all quite worked up and also, we're like trying to calm down properly, and we still want to keep moving and talking. I think that's just because we only got a few minutes to cool down. I don't think that's enough time, I reckon if we had more time, we'd be more calm and chilled” (Alan).

Insufficient cool-down was mentioned across themes, particularly in student comments on Theme B2: Structure and Timing of Learning Day.

4.4.3.2 Subtheme A3.2 Concentration and Focus

Eight (22.2%) students revealed that the activity of the PA-based lesson had increased or decreased their concentration abilities in the lesson that followed the PA-based lesson. Three (8.3%) students mentioned that the PA-induced fatigue and had detracted from their concentration abilities; one student commented that it was because they had done a 12-minute exhaustive fitness test after which they didn’t feel very well; another student described in the second lesson that she “zoned out” (Libby) due to fatigue and another reported feeling tired from circuit training, which negatively affected his concentration as he was tired.

In contrast, five (13.9%) students mentioned that in the lesson following PA their focus and concentration abilities had increased, with comments that after PA “I listen more, feel more attentive. I just feel more concentrated and, in the zone” (Coco).

4.4.4 Theme A4: Morning comments

Seven (19.4%) students referred to the first lesson before the PA-based lesson being in the morning and how this specifically affected on-task performance. The majority indicated that this time-of-day factor would have a sub-optimal impact for on-task behaviour, with comments suggesting a need to ‘wake-up’: “it was also the first hour of the day everyone's still trying to, still waking up, so they're not really like properly engaged” (Dan). Some students expanded their reasoning as to why morning lessons might affect on-task behaviour, with some discussing the need to ‘catch-up’ and welcome classmates in a social capacity: “it was my first lesson of the day and I was sort of a bit like wanting to catch-up with my friends and things” (Lewis) and:

> "I'd imagine because the first lesson was earlier on in the day and not particularly had time to wake up, it's the first thing, everybody's just got to college, people are excited to see each other." (Callum).

These points demonstrate that students considered the timing of lessons in the learning day as affecting on-task behaviour and this was also addressed in Theme B2 Structure and Timing of Learning Day.

4.5 Student Perceptions of How a Physically Active Lesson Could Affect On-Task Behaviour

In response to interview question five "In general, not just including today's lessons, does a physically active lesson affect your ability to be on-task in the following lesson after?", 16 (44.4%) students responded that they thought it could positively increase on-task behaviours. Five (13.8%) students considered PA to have a negative effect on on-task behaviours in subsequent lessons and five (13.8%) students considered PA to have no capacity to affect their ability to be on-task. Ten (27.8%) students reported that they considered PA-based lessons as both positively and negatively affecting their ability to be on-task. In almost all cases, students offered examples, rationales and justification for their judgements and stance; through these responses, three main themes and two subthemes emerged as outlined in Figure 4.3. Thematic Map.

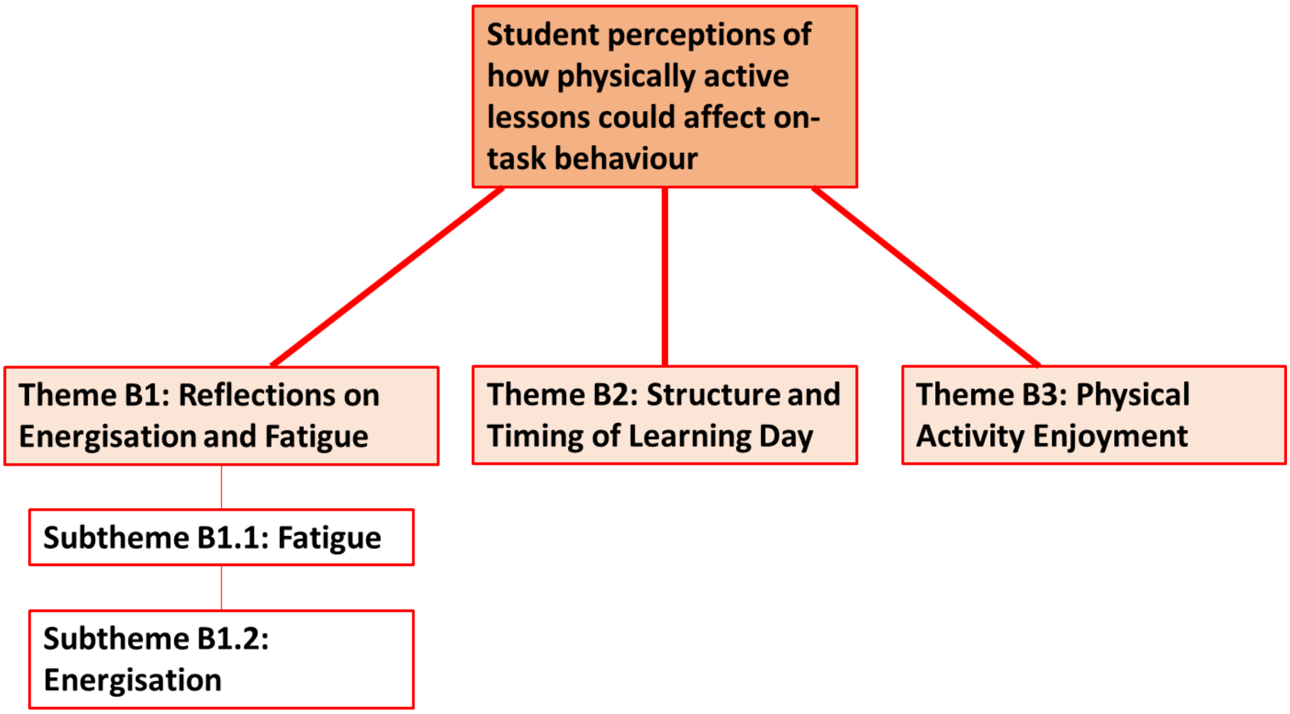

Figure 4.3 Final Thematic Map of Student Perceptions How a Physically Active lesson Could Affect On-Task Behaviour.

4.5.1 Theme B1: Reflections on Energisation and Fatigue

The most recurring theme to explain their reasoning behind their responses to how PA affected their ability to remain on-task was around becoming fatigued or being energised by the PA. Twenty-four (66.7%) of the 36 students interviewed mentioned changes in their perceived energy levels and/or feelings of fatigue or tiredness after the PA-based lesson compared to the lesson before. Students then either without a questioning prompt or after a follow-up question “how does that influence your ability to be on task?”, indicated whether it facilitated or hindered their ability to be on-task.

4.5.1.1 Subtheme B1.1: Fatigue

A total of 23 (63.8%) students indicated that a PA-based lesson made them feel fatigued “because, during the PA session, obviously we're doing lots of sports and I'm getting tired out quickly” (Paul). Rather than being acute and temporary, these feelings of tiredness appeared to remain and continued to influence the next lesson, even after the PA itself. Twelve (33.3%) of the 23 students in this subtheme suggested that having less energy or becoming more fatigued can facilitate improved on-task behaviour levels. Commonly, this was due to fatigue making off-task behaviour less desirable: “I think it affects it in a good way, because you have less energy, so you get distracted less, because you don't get involved, because you can’t be 'arsed’… just too tired” (Maddy) and:

> “Like, you've kind of like gotten rid of a lot of physical energy which stops you from being as physically active in the class. So if you're full of energy and, like in a classroom-based lesson, then you're kind of quite fidgety and energetic, and you're less focused on actually just sitting down and doing the work” (Gina).

Some students referred to a need to “blow-off” excess energy first to be able to be more on-task: “I think it gets you more on-task, because you get rid of your excess energy and then you have less chat and everything” (Maizey); “say if we haven't done any exercise in a while, we have quite a lot of energy saved up. Our group tends to just chat amongst ourselves. It's a way to blow it off” (Emily). Similar to Subtheme A3.2, some students indicated specifically that fatigue increased their ability to concentrate and focus: “Mainly because I'm knackered, and I just want to concentrate and just recover. I guess it's because I can't be bothered to talk, so I don't talk to my friends” (Mike) and “because it gets the hyper-activity out of you which therefore increase your focus” (Sam). Some students reflected on how reduced energy levels could improve mood states and reflected on the different interplays between physical fatigue and mental fatigue being separate entities, as demonstrated in this example:

> "I wouldn't say you're as mentally drained after doing PA. Whereas if you're just sitting down and doing work obviously most of the energy comes from thinking about what you have to write about. Whereas because you're just doing it in sport, and you're just physically moving, that's quite enjoyable, so it's more tiring on your body rather than your brain" (Lee).

Eleven (30.6%) students in this theme alluded to the notion that fatigue in the lessons after PA could hinder on-task behaviour. Five (13.9%) of these eleven students reflected on how reduced energy levels could decrease concentration, with statements such as: "we're just all shattered and we just can't concentrate" (Winston). Some students referred to similar analogous terms, such as attention "when you're tired it seems like you feel a little bit less attention" (John) and focus:

> "Sometimes I feel quite drained after, so I feel tired and I'm not as focused, like I'm tired mentally and physically. Physically I'm usually all right, can still keep going, but mentally I'm just thinking, I need to crash" (Jade).

A dominant consideration for fatigue levels identified by six students (16.7%) was the intensity of PA and that this may have a significant effect on on-task behaviour in subsequent lessons. Primarily, these comments concerned that too much or too intense PA could lead to more fatigue and thus have a negative effect on on-task behaviour, with comments such as, "it depends what you've done in the PA lesson… so say if you've done like, like an hour of basketball and you would be very fatigued" (Josh) and:

> "If it's a hard activity or an intense activity then a lot of people will put more effort on the physical part and when it comes back to the kind of mental part of their classroom work, they can just seem, even I feel, like I'm zoned out a bit" (Rosa).

4.5.1.2 Subtheme B1.2: Energisation

Five (13.9%) students mentioned that after a PA-based lesson, the feelings of energy levels could increase or be energised in subsequent lessons. Four (11.1%) of the five in this subtheme suggested that this could positively effect on-task behaviour. Students who thought increased energy levels facilitated on-task behaviour attributed this mainly to being more awake: "I feel like once I've done practical I'm more awake" (Steven) and more focused "I've got a bit of energy in the system and I was like able to just focus" (Lewis). Two (5.6%) students inferred that an increase in energy in the subsequent lesson may also lead to a negative impact on on-task behaviour due to students having too much energy from the PA: "sometimes after exercise I feel quite pumped and I'll be chatting" (Simon) and:

> "so, you go into the next lesson and other people probably have the attitude of us still in that [PA] lesson. It will take them a while to actually get out of it and they'll be all energetic and hyped up, which will cause them to, obviously carry on the energetic behaviour inside the classroom" (Lisa).

4.5.2 Theme B2: Structure and Timing of the Learning Day

Nine (25%) students proposed that the timetabled structure of the learning day and the PA-based lesson may be a key influence on on-task behaviour with a number emphasising when they thought PA would be best timetabled for optimum on-task behaviour. For example, four (11.1%) of these nine students indicated that PA may be best scheduled at the end of the learning day, mainly due to fatigue and recovery considerations: “it's better to have at the end of the day, because we have it at the start and it just wears us out for the rest of the day” (Florence). Some other students suggested that more time, or a timetabled break was needed for recovery after a PA lesson for optimum on-task performance, as students were “more concentrating on recovering after [PA]” (Libby).

Seven (19.4%) students stated a preference for on-task behaviours at certain points of the day, irrespective of PA: “I prefer doing work in the afternoon. Everything's in the afternoon for me. So more of what you might call an afternoon person” (Jason). While one (2.7%) student indicated that they found it harder to remain on-task in the later lessons of the day: “the last lesson we're all like, "Okay, I'm really tired now and ready to go home" (Gemma). These student perceptions indicate that the structure of when lessons and PA are placed in a timetabled day could influence on-task behaviours.

Interestingly, four (11.1%) students mentioned that the PA-based lesson itself offered a ‘break’ from the traditional classroom environment and was therefore beneficial to on-task behaviour:

> “I think it's good (for on-task behaviour) because I think if you're in a classroom - or on a computer all day then, motivation-wise,

> it can be a bit boring - just having that little bit of break in there just, it's like having a different type of lesson" (Rosa).

David stated that as well as affecting motivation, concentration was also improved as "you then concentrate more, because it does give you a break". In contrast, another student (2.7%) suggested that it was difficult to transition from learning in a classroom to PA and then back to classroom learning again: "It's just hard to do. So when you come into a classroom, you're like still talking about it, like how the football went, for example. Obviously, that puts you off what you're actually meant to be doing" (Lee).

4.5.3 Theme B3: Physical Activity Enjoyment

Seven (19.4%) students discussed that on-task behaviour could be affected by the perceived enjoyment of the PA in the PA-based lesson. Some indicated that if they enjoyed the PA, this could improve subsequent on-task behaviour. For example, one student commented: "when you've had quite a lot of fun, then sometimes people tend to have more ability to be quiet [referring to on-task behaviour]" (Katy). Four (11.1%) students specifically linked the enjoyment of a PA-based lesson to an increase in their motivation for on-task behaviour, with comments such as: "I love PA. It just keeps me motivated" (Darren) and "I feel my motivation for it is quite low, but if it's like a sport, like football or something, I feel like my motivation might go higher" (Dan).

Conversely, some students reported that if PA was unenjoyable, this could detract or not promote increased on-task behaviour levels in the following lesson; however, those who suggested PA could be unenjoyable often gave it as a comparison point to validate how PA enjoyment helps:

> “If you'd just done PA that you don't enjoy, you're then not gonna be in the mood or be all ready to take part in the section afterwards because you're going to be annoyed, aren't you? However, if you've done a session that you really enjoy and then in theory afterwards, you're more likely to be more engaged” (Josh).

Overall, outcome data from student interviews offered a differing insight into the classroom observations and broadening of scope of the investigation away from a focus specific on physical activity influences, helping providing a more nuanced picture of the on-task behaviour variations witnessed in observations and between lessons. These findings from the study’s differing methods are now converged and considered collectively in chapter 5.

Chapter 5 - Discussion

The current study sought to identify if a naturally occurring PA-based lesson could influence adolescent learners' subsequent on-task behaviour in a FE college and explore potential reasons 'why' any possible variations might exist from students' perspectives. A number of cross-over themes were identified in the explanation's students gave for their reported on-task percentages between lessons on PAOD and how a PA-based lesson might affect their subsequent lesson on-task behaviour. Where cross-over themes emerged, these have been discussed concurrently, as represented in the merged thematic map of Figure 5.1 where subthemes have been removed for simplicity, but were still fully considered in discussion. While exploring the key findings from Chapter 4 this discussion chapter sought, where appropriate, to 'integrate' the mixed methods (MM) research, interfacing the quantitative research with qualitative research (Creswell & Plano Clark, 2011) in order to attempt to explain and/or expand on the outcomes witnessed.

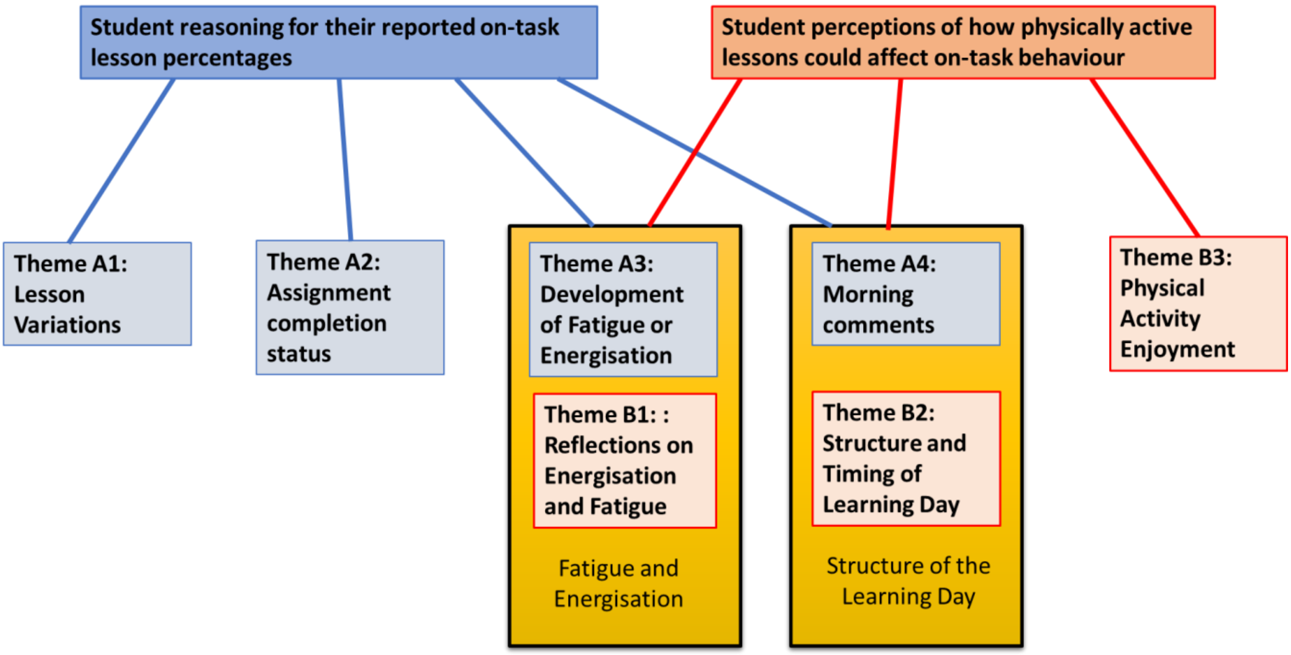

Figure 5.1 Merged Thematic Map of Student Interview Responses (yellow boxes indicate cross-over merged themes in discussion).

5.1 Establishing Differences in Physical Activity Levels Between Lessons

Physical activity levels were significantly higher during the PA-based lessons in the college sports hall compared to the classroom-based lessons with accelerometer and pedometer data indicating large effect sizes. It is possible, therefore, to conclude that PA-based lessons featured significantly more PA compared. This manipulation check data is critical to the validity of the argument made in this thesis that PA is a potential factor in any subsequent reporting of differences in on-task behaviour. It is also interesting to note that the classroom lessons featured some minimal PA and students were occasionally observed walking around the classrooms during lessons. Thus, these classroom lessons were not totally absent of PA. While recognising the specific weaknesses of each PA recording device, the use of two different measures demonstrating similar increases in magnitude offers data triangulation, thereby strengthening the claim that a tangible PA difference in the PA-based lesson exists (Bassett & John, 2010).

To the authors' knowledge, no other published studies have reported PA in either sports halls or classroom-based lessons in a UK FE college featuring 16-19-year olds. Comparisons with other similar research designs in other educational environments may, however, offer some relative insights into the volume of PA recorded in this study. The mean steps recorded in the PA-based lesson in this study appears to be particularly high, with other studies reporting much smaller step volume increases of up to two-thirds lower in similar intervention conditions (see for example, Bartholomew & Jowers, 2011; Burns et al., 2016). The lesser volume of steps in these studies is perhaps to be expected, as much of the comparable literature deploys PA that only lasts between 10-30-minutes in duration, compared to the hour-long PA-based lessons observed in this study. Another explanation may be that the sports hall and drama studios may offer a larger space for increased PA compared to ‘classrooms’ used in a number of similar studies.

It also appears the current study features more intense PA, as the number of steps per minute is greater compared to much of the literature. However, the accuracy of step counts to intensity is highly questionable as step counts per minute are deemed to be a poor proxy of intensity (Marshall et al., 2009). Thus, intensity comparisons only using pedometers are impractical. Accelerometers have been suggested as a more suitable device to record intensity data than pedometers and more reliable in recording even discrete PA (Bassett & John, 2010; Norris et al., 2015), hence they were deployed in this study. At the same time, the accelerometers used in this study were relatively new devices with unique unit data outputs, thus no comparable studies in college or school locations using these accelerometers could be found. The present study is also unique in its use of naturally occurring PA-based lessons, rather than implementing a researcher-led PA intervention such as a movement integration (MI) programme within classrooms (Snyder et al., 2017).

The PA data from this thesis appears to indicate a PA-based lesson may also support students in meeting the current UK PA daily guidelines for children and young people aged 5–18 years to engage in at least 60-minutes of moderate to vigorous-intensity PA and that young people should minimise the amount of time spent being sedentary and sitting (Department of Health, 2014). This is important as only small numbers of the UK adolescent population are thought to be meeting these PA guidelines (Booth et al., 2013; Shennar-Golan & Walter, 2018). The study data, therefore, provides some insight into a previously underexplored construct of PA occurring in college lessons and offers confirmation that PA-based lessons can significantly increase PA levels, which may, in turn, be beneficial to student health parameters (Biddle & Asare, 2011).

5.2 Effects of Physical Activity on Observed On- and Off-Task Behaviours

Quantitative observations of adolescent college students from drama and sports programmes demonstrated that the inclusion of a 60-minute PA-based lesson significantly improved on-task and decreased off-task behaviour in the subsequent lesson. These outcomes are consistent with a large number of similar studies that investigate on- and off-task behaviour and PA in younger school participants (see: Mahar et al., 2006; Howie et al., 2014; Mullender-Wijnsma et al., 2015; Szabo-Reed et al., 2017). However, the results are not unequivocally consistent with all comparable literature. For example, a significant decrease in on-task behaviour without PA in the control conditions as reported in Grieco et al. (2009) and Goh et al. (2016) was not seen in the current study. Thus, PA in college students may not be needed to maintain or prevent the decline in on-task behaviour seen in other studies. Yet, from the current thesis design, it is only possible to suggest that this applies to 2.5 consecutive hours of classroom-based learning. The outcome that on-task behaviour did not significantly decline adds to the literature, in that adolescent college students appear to be able to maintain previous on-task levels even with 2.5 hours of sedentary classroom time.

It may be that if the duration between PA finishing and observation was longer, on-task behaviour levels might decrease further, as on-task behaviour and sustained attention (an important ability for on-task performance) has been shown to decrease with increases in sedentary instructional duration (Middendorf et al., 1996; Godwin et al., 2016b). This is a common weakness of the current literature, with most studies either observing within 0-60 minutes of lessons that follow PA or in longitudinal designs, compare differing days with observations at set-time points in the learning day (Burns et al., 2016; Wilson et al., 2016; Maykel et al., 2018). Time-course interactions with PA is therefore an area that needs further investigation.

5.2.1 The Extent of the Physical Activity-Based Lessons Effect

The present study reported a ‘small to medium’ effect size on PAOD for both on-task behaviour with a positive Cohen’s d effect size of d = 0.46, and off-task behaviour a negative Cohen’s d effect size d = -0.45 (Warner, 2013). These similar effect sizes may be anticipated with outcomes represented as a ratio. Similar significant small to medium effect sizes for on-task behaviour was also found in Howie et al. (2014) d = 0.45 and d = -0.45 and when looking at off-task behaviour in Snyder et al. (2017). However, stronger positive effect size increases in on-task behaviour of strong to moderate effect have also been reported (Stylianou et al., 2016a). A review paper by Martin & Murtagh, (2017a) calculated that data from Riley et al. (2015) had a notably large effect size of d = 0.90 when compared to the change in students’ on-task behaviour between intervention and control groups recorded in this study. Yet, similar to the present study, Riley et al. (2015) and Stylianou et al. (2016a) reported initial baseline figures of ~60% before the intervention. Significantly, Riley et al. (2015) and Stylianou et al. (2016a) were longitudinal studies comparing pre- to post-intervention over six continuous weeks of PA sessions. This may in actual fact be encouraging for the current study’s acute outcomes, as PA of 60-minutes on a single occasion produced similar improvements to interventions over multiple weeks and bouts of PA.

This naturally leads to the question; would a longitudinal design or repeat PA-based lessons on multiple days lead to an increased effect? When examining the literature to address this question, a majority of longitudinal research designs appear to suggest that chronic PA interventions over a number of weeks may not offer additional benefit compared to acute bouts (Goh et al., 2016; Riley et al., 2016). For example, Mullender-Wijnsma et al. (2015) over 22 weeks witnessed medium effect sizes of treatment condition, midway through the intervention period (d = 0.60), and at the end of the PA intervention (d = 0.59), compared with the baseline observations. These effect sizes do not appear to be a considerable improvement over acute bouts witnessed in this study or other acute studies that compare to baseline on the same day; for example, Mahar et al.'s (2006) study also had a reported effect size of d = 0.60, so it may be concluded that evidence is far from robust. Nevertheless, the current study is unique in investigating naturally occurring PA rather than an imposed MI programme intervention commonly found in the comparable literature. This may be relevant to acute and chronic considerations, as this study may inadvertently be investigating a chronic effect. The college students used in this study had already been experiencing similar PA-based lessons for over 4 to 6 months, with a PA-based lesson planned most days into their timetables. This may be seen as a strength of the current study, given that one criticism levelled at similar studies has been the lack of familiarisation with PA interventions and therefore, learning or novelty effects may confound others results (Li et al., 2017). This could also offer some additional insight as there is perhaps no diminishing returns or participant acclimatisation to PA's positive effect with subsequent PA sessions over a period of time. All students observed were reported by teachers' registers to have at least 75% attendance for their academic course. However, the format of the current study was not designed to be able to address this analysis specifically as PA was not recorded in all sessions, but this is a possible research avenue for consideration in future research designs.

It is also insightful to survey comparable ecological means, which in the current study demonstrated an 8.4% mean improvement in on-task behaviour in lessons that followed the PA-based lesson. This appears comparable to mean improvements reported by some other authors, for example: 8.4% (Mahar et al., 2006), 10.5% (Howie et al., 2015), 12% (Riley et al., 2016), and 7.2% (Goh et al., 2016). However, it could be argued that an 8.4% mean improvement in on-task behaviour is underwhelming, particularly as the PA in this study was 60-minutes in duration, compared to more commonly used shorter PA interventions lasting 10-15-minutes. Also, other PA studies commonly occur within a classroom environment, rather than moving all class members to a sports hall or drama studio environment, using fewer physical resources than the current study. This leads to questions about efficacy, with the current study providing additional insights in the pursuit to determine the optimum volume of PA for behavioural benefits (Pontifex et al., 2015; Dickinson et al., 2016; Peruyero et al., 2017; Li et al., 2017). It appears through the reporting of similar or in some cases higher effect sizes and ecological improvements, that even though shorter duration classroom-based interventions may offer less PA, they appear to be as effective as a sports hall-based 60-minute PA-based lesson.

Greater insight into the optimal duration of instructional activity for maintaining high rates of on-task behaviour in FE college classrooms would be valuable for teachers and curriculum planners. Previous studies have suggested that there is probably a minimum duration in which the effects of PA on academic behaviours exhibit, but as there are few differences in the magnitude of effect among studies utilising various durations ranging from 10 to 40-minutes, it appears likely that much shorter durations of PA than 60-minutes may have the potential to be more resource-efficient (Kubesch et al., 2009; Sullivan et al., 2017). This is important as teachers typically have considerable autonomy when planning and determining how instructional time is allotted. Curriculum constraints could make shorter duration PA preferable and more likely to be repeatedly implemented (Gately et al., 2013; Howie et al., 2014; Hodges et al., 2015; Carlson et al., 2017). However, such conclusions and effects concerning PA durations are yet to be investigated in adolescent college learners, making it difficult therefore to make such recommendations for the current population. This is an area that needs further research to deduce guidelines as to the optimum duration, mode and intensity for adolescent learners.

Interestingly, baseline classroom on-task behaviour in this study appears to be 10-20% lower than in several previous studies. For instance, the current study's baseline on-task behaviour of 60.9%, standard deviation (SD) ±18.1 compares to 70.9%, SD ±15.2 (Mahar et al., 2006); 79.9%, range 71.9-87.8 (Riley et al., 2016) and 82.3% SD ±4.5 (Goh et al., 2016). Consequently, the classrooms in this study may be seen to have greater 'scope' for potential gains in the percentage of on-task behaviour as they had lower baselines and, therefore greater room for improvement, as previous studies have found that the most off-task students appear to benefit the most from PA (Grieco et al., 2009; Mahar et al., 2006). To compound this further, it is arguably unrealistic to have 100% on-task behaviour in a classroom as few students are able to hold attention and focus on the learning tasks for the entirety of a lesson (Worthen et al., 1994). So, the scope for improvement in some of the highly on-task lessons may be even smaller in relative terms. The low baseline on-task behaviours are however not unique to this study; for example, Stylianou et al.'s (2016a) study reported

61.82% SD ±6.56 on-task behaviour and Webster, Wadsworth, and Robinson (2015) reported on-task behaviour of 65.3% SD ±19.0. Yet, increases in these papers appear to demonstrate larger ecological mean increases in on-task behaviour ranging between 15% and 17% compared to this study's 8.4%.

Similarly, studies that report exclusively off-task behaviour also show similar divergences to the off-task behaviour found in this study appearing to be higher (Webster, 2013; Ma et al., 2014; Webster et al., 2015). Off-task behaviour means ranged between 30.8% to 42.0% on PAOD and COD conditions in this study. Extended comparison to other educational research has estimated that children spend between 9% and 50% of their time off-task in classrooms (Baker et al., 2004; Godwin et al., 2013; Rideout et al., 2014). Thus, although the off-task behaviour in this study seems high compared to closely associated studies that examine PA effects, it appears within previously reported limits of the wider literature.

The relatively low on-task and high off-task levels in this study might reinforce the argument that interventions to address off-task behaviour are needed and worthy of further resource consideration in FE colleges, as previous studies have recommended that a classroom should display at least 80% on-task behaviour as a benchmark to sustain an academic environment conducive for optimal learning (Greenwood et al., 1979; Mitchem et al., 2001; Burns et al., 2016). This proposed criterion for an effectively managed classroom was not met in any observation conditions on either PAOD or COD. Although the 80% on-task behaviour goal suggested by these authors could be argued to be arbitrary, it does suggest that a fully on-task classroom is perhaps unrealistic and that higher on-task behaviour than witnessed in this study could be conducive for improved learning (Mitchem et al., 2001).

Lower baseline on-task and higher off-task levels in adolescent learners witnessed in the current study may also be surprising when compared to the associated literature that largely focuses on much younger student populations. Younger participants may be expected to have shorter attention spans compared with older students, as basic attention increases with age until around 11-12 years, when it is thought to become more stable (Dias et al., 2013; Sullivan et al., 2017). Also, other factors that may possibly facilitate on-task performance have been identified as improving as young people move towards adulthood, such as working memory and inhibition control (Diamond, 2013). Sustained attention develops rapidly through-out childhood, before beginning to plateau into adolescence (Betts et al., 2006; Adolphus et al., 2013; Wilson et al., 2016). Wilson et al.'s (2016) paper suggest that younger children have greater capacity for improvements in on-task behaviour from PA due to their underdeveloped behavioural and cognitive aptitudes. This may offer some explanation for the smaller effect sizes and ecological increases in the current study's adolescent population when compared to studies featuring younger participants. However, the literature is currently lacking median reference on-task behaviour values characteristic of the FE sector and adolescent population, so it is not possible to deduce if these on-task scores are indeed typical.

While it is not clear why the on-task values and improvements in this study appear underwhelming when compared to the literature, it could be a consequence of disparities in study design, methods and data analysis. For example, disparities in the definitions and thresholds of on- and off-task behaviour have been highlighted by Mahar (2011) as contributing to variance across studies, and equally studies often do not recognise the multifactorial nature of PA (Haapala, 2013). Several more recent studies have reduced observation intervals from 10-seconds to 5-seconds to increase data reliability since there is a lower probability for more than one behaviour to occur within shorter intervals and this allows for the observation of more intervals in a given amount of time (Burns et al., 2016; Goh et al., 2016; Stylianou et al., 2016a). The current study did not use 5-second intervals as data collection had already commenced when these stipulations were published; this could lead to further variations in outcomes. Some comparable studies have also deployed video recorders in the classroom as well as an observer, which may allow confirmatory observations and enhance reliability, but may lead to problematic behavioural implications when observing pedagogical lessons and behaviour (Coleman & Briggs, 2002; Howie et al., 2014; Wiebelhaus & Fryer-Hanson, 2016). For example, if participants are aware their behaviour is being videoed, this may influence their behaviour as a comprehensive recording of the classroom is taking place. Still, the observer effect or Hawthorne effect may have indeed been present in the current study due to the use of an observer, but the use of additional camera equipment may intensify the observation effect in a classroom further (McCarney et al., 2007). This could partially explain the higher baseline on-task behaviours witnessed in some studies such as Wiebelhaus & Fryer-Hanson (2016).

Another substantial disparity in the current study compared to much of the literature was the absence of prescribed PA. In the current study, all lesson content and PA was naturally occurring in the students' timetables and the researcher had no influence over its delivery or content. This may offer greater ecological validity but consequently lose the ability to attribute the effects specifically to PA, compared to other studies with stricter levels of control. For example, Riley et al. (2016) claimed in a reflective analysis of their study outcomes that they were unable to determine if improvements in students' on-task behaviour were a result of increased PA or the varied approach to learning during PA. Riley et al. (2016 p. 203) suggested that the integration of PA into subject-specific learning may actually enhance "connectedness for students by providing real-life applications of academic concepts to enable students to view learning as significant and meaningful" and therefore be more engaged in subsequent lessons. This could apply to the current data as the PA-based lessons were timetabled curriculum featuring learning objectives with PA. For example, the PA-based lesson could have learning objectives based on principles of fitness training and the subsequent lesson reflection and further development of the same topic. This is thought-provoking as with the current study design, it is not possible to be sure that the PA is the main influencing factor, particularly with student interview data indicating a range of other factors arguably unrelated to the PA perceived to be influencing on-task behaviour, such as assignment deadlines (see 5.5.2). It is clear that there are disparities between the data generated by this study and the available research literature. At the same time, it is encouraging nonetheless that comparable studies using variations in interventions, observational methods, behaviour definitions and coding, analysis techniques and differing sample populations by age, country and education system, largely report similar outcomes. This may offer further reassurance that a positive relationship between a PA-based lesson and behaviour exists, thereby encourage colleges to value and make time for PA-based lessons across curricula.

5.3 Within-Student Changes in On-Task Behaviour

A high number of students showed a Reliable Change Index (RCI) increase in on-task behaviour on the PAOD after PA, triangulating with mean data that the PA-based lesson led to more students being on-task more often in the succeeding lessons. If changes in participant on-task behaviour was random, then it would be anticipated that the distribution of RCI scores to be random in line with the way RCI is calculated, with approximately 2.5% of students showing a decrease in on-task behaviour and 2.5% showing an increase and 95% of students demonstrating no change. Data in this thesis, however, shows discrepancy from this expectation offering some additional confidence of genuine individual-level changes between on-task behaviour of comparison classrooms.

The RCI data demonstrated that not all students at an individual-level showed a trend consistent with that indicated by the mean level changes. Following the PA-based lesson, some students witnessed a reliable decrease in on-task behaviour, demonstrating that not all learners improved their on-task behaviour. Possible indications for these negative outcomes appear in some of the student interview responses. For example, three of the students who saw RCI decreases in on-task behaviour, considered that they had completed all the learning tasks, so choose to disengage with the lesson (see 5.5.2) and six students reported fatigue as hampering their on-task performance (see 5.5.3.3). This is a specific finding that is unique to this study; no comparable literature to date has deployed RCI analysis and/or direct associations between PA and individual-level decreases in on-task behaviour. From the literature, it appears that PA will either have a positive or null effect on externally observable on-task behaviour (Sullivan et al., 2017).

Another noteworthy outcome unique to the RCI data in this study was that high numbers of students showed a reliable increase in on-task levels as the day progressed, regardless of whether students were seated in a lesson for two-plus hours on COD or participated in PA on POAD. This is interesting since a significant mean overall improvement in on-task behaviour in the lessons that followed the control lesson was not detected. This outcome may be because the students that demonstrated a COD increase and decrease in on-task behaviours did so with a differing magnitude than on PAOD. RCI increases in on-task behaviour in both COD and PAOD, may in part be due to assignment completion and time of day factors, as reported by student interviews and discussed further in 5.5.2 and 5.5.4.

Further influence on observation means may have occurred due to the thirteen students who showed no change on RCI on-task behaviours after the POAD PA-based lesson, but more students demonstrating no change in the control condition on COD. There are limited examples in the literature of null outcomes with PA interventions and on-task behaviour; where these do occur, they have been attributed to insufficient PA (Wilson et al., 2016; Kubesch et al., 2009) and small sample sizes (Grieco et al., 2009). The reasons for no change from the RCI results are unclear, but further analysis from the student interview responses may offer possible explanations, such as five of the thirteen students on PAOD who showed no change reported variations in lesson type and three mentioning fatigue from PA as influencing on-task behaviour (see 5.5.1 and

5.5.3). A design with additional repeated data on individuals over several COD and PAODs may have been more revealing and detected clearer intra-individual trends via RCI analysis.

The RCI data from this study is hard to relate with comparable findings as almost all of the published literature centres mainly on mean-level change (for example, Mahar et al., 2006; Webster et al., 2015; Wilson et al., 2016). Only two papers were found to deploy some form of systematic individual-level analysis. In a longitudinal study over 22 weeks, Mullender-Wijnsma et al. (2015) reported using a multilevel analysis that showed the time-on-task of 'all' students was significantly higher after PA intervention than the time-on-task after regular control lessons. Specifically how this analysis was carried out was, however, absent in the paper as was a full account of individual-level results. Again, dissimilar to the current study, using a longitudinal design featuring observations over six-weeks Stylianou et al.'s (2016a) study implemented some rudimentary individual-level analysis by visually analysing plotted graphical data of on-task behaviour from a before-school walk/running program. Procedures of visual analysis were not detailed, but the authors claimed no differential effect of the treatment was found when focusing on individual students and this null outcome was a function of their relatively small sample size of 77 participants. Collectively, graphs were stated to provide evidence that mean on-task behaviour levels were higher on days students participated in the before-school programme compared to days they did not and further statistical modelling in this paper also confirmed these visual observations. One additional study commented on individual on-task outcomes in their discussion, specifically, noticeable individual outliers in baseline data that indicated students were capable of achieving comparable on-task behaviour levels to those achieved following PA, without having actually participated in PA (Maykel et al., 2018). However, Maykel et al.'s study (2018) did not use any individual systematic analysis in their method, limiting these outcomes to visual observations within the data. Still, these observations are comparable to some of the variations witnessed in the current study's RCI data, but Maykel et al. (2018) recorded more repeat observations, and the variability in this repeat data suggested students did not achieve these high rates consistently without the PA intervention. This suggests that on-task behaviour with similar conditions can fluctuate significantly at the individual-level and highlights again that the RCI data recorded in this study may have been strengthened by multiple repeat observations of PAOD and COD.

5.4 Students' Perceived and Observed Time-on-Task

The indication in this study of a modest correlation between student internal perceptions of their percentages and observed percentages of on-task behaviour by an external observer may offer increased confidence that observations may also reflect what was occurring in relation to levels of student on-task behaviours internally (Robson, 2011). Although increased confidence may be limited as these are two distinct and separate measures, this is highly significant, as a common criticism of on-task observation methods is researchers can only observe externally exhibited behaviours, while students may actually be mentally disengaged with classroom tasks. One example is the student who appears to be performing the desired behaviours such as directly looking at the teacher or material but maybe thinking about off-task material. This may be heightened further when students are aware that their on-task behaviour is being observed (Robson, 2011; Creswell, 2012).

As student perceptions and externally observed on-task behaviour are two distinct measures, inter-individual discrepancies are to be expected. This was evident in the data as over a third of student perceptions were not in agreement with their observed on-task variations. Such discrepancies between observations and student reported perceptions does raise the question, ‘can student perceptions be fully relied upon?’. Yet previous research has posited that students can be self-aware enough to accurately perceive and reflect on their abilities to pay attention (Mantzicopoulos, 2006; Wiebelhaus & Fryer-Hanson, 2016). One rationale for these divergences could be the structure of the observation method. Observations involved a time-sampling technique that moved the observation between participants in 10-second intervals and this may have led to an inaccurate representation of an individual’s time-on-task in the lesson. Another possible reason for these variations may relate to the wording of the interview question “Considering the two lessons I came in and observed your class today, what percentage of time do you consider yourself on-task in the first/second lesson?”. The question did not specify the 30-minute observation window and some students may have referred to the whole lesson that sometimes was 60-90-minutes in length. This may further explain some of the variances between the observed data and students’ perceived percentages witnessed. On reflection, this question could have been altered to specifically focus on the observation time to minimise this potential for variance, but equally, it may also be hard for students to attribute their on-task behaviour perceptions purely to the observation window.

The only attempt the current author could find to associate on-task behaviour observations with participant perceptions in the literature was by Wiebelhaus & Fryer-Hanson, (2016) who compared teacher-conducted observation frequency charts with student perceptions. Wiebelhaus & Fryer-Hanson, (2016) reported that students' perceptions of themselves were not always consistent, with one out of three participants unable to accurately identify how well they performed during a lesson. This ratio demonstrates a similar alignment to the 63.9% of respondents in this study who reported the same directional change; however; a direct comparison is perhaps impracticable as Wiebelhaus & Fryer-Hanson's, (2016) methodology featured only three students and analysis comparing percentages was not involved. In addition, queries over whether teacher-conducted observation frequency charts are indeed an accurate measure, as the authors appeared to specify, were not fully addressed. It is important to mention, in the current thesis, observation was not recognised as a 'superior' measure of on-task behaviour compared to student perceptions, due to aforementioned limitations but rather, as an equally useful methodological tool.

5.5 Discussion of Student Perceptions

5.5.1 Lesson Variations

From the qualitative interview responses the most prevalent rationale that students gave to explicate their on-task percentages centred on differences between the lessons before and after the PA-based lesson, rather than specifically the PA or the PA-based lesson. Distinctive subthemes emerged within these explanations as to the ways in which the lessons were perceived to vary and affect on-task behaviour, namely: lesson format, lesson difficulty and classroom-subject enjoyment.

Perceived differences in the format or type of lesson were the most frequently mentioned variation. Commonly, this focused on what students identified as ‘workshops’ compared to ‘taught lessons’. Other key factors that appeared to influence the difference in these classroom types was the availability of Information and Communications Technology (ICT) in the form of personal computers (PC) in the workshops, and a different classroom environment and seating arrangement (Image 4.1 and Image 4.2). Student responses with regards to whether on-task behaviour was facilitated by using ICT in the form of PC’s in workshops were mixed and individualised, with no clear pattern discerned, as almost equal numbers suggested access to PCs either facilitated or hindered on-task abilities. The sparse literature on ICT use and on-task behaviour also seems to reflect this ambiguity, with some studies demonstrating that PC use can improve on-task behaviour (Worthen et al., 1994; Waxman & Huang, 1996), while others demonstrate more on-task behaviour in traditionally taught lessons of the control groups that did not use ICT (Smeets & Mooij, 1999). Classroom seating arrangement has also been previously proposed as an influential factor in on-task behaviour (Wannarka & Ruhl, 2008; Haghighi & Jusan, 2012). Most of the associated literature indicates that there is no one optimal seating arrangement for on-task behaviour, but rather, that teachers should arrange the class appropriate to the planned learning activities (Wannarka & Ruhl, 2008; Haghighi & Jusan, 2012). This may have been occurring in the lessons observed in this study, as students’ perceptions did not highlight seating arrangements as being inadequate. Rather, they sensed changes in the structure of the lesson, identifying it as either being teacher-focused with the teacher lecturing at the front of the classroom, or the focus of the lesson on individual student PC use. These variations were perceived as being strong influencing factors to whether students were on-task or not.

Lack of consensus between students on the preferable lesson format in this study may be further explained by student comments around variations in learning tasks and teaching styles between the two lesson formats. Students identified that the structure of the learning tasks was often different for the taught lessons, in that the taught classroom was more teacher-led and teacher-centred. Specifically, students indicated that teacher-led structure was beneficial to their on-task behaviour as it was easier to follow teacher instructions. They acknowledged that these lessons featured more regulation of behaviour by the teacher with prompts to be back-on-task. This was described in contrast to the workshop lessons, where students reported being expected by the teacher to be working on assignments and where they were left to their own devices. These perceptions around teacher monitoring and behaviour management strategies between the two lesson formats suggest that a more a learner-initiated or laissez-faire approach was occurring in the workshops (Mosston & Ashworth, 2008). This consequently meant students needed to self-regulate their own learning and on-task behaviour more in workshops. Studies have indicated that this can be a challenge for some students (Schunk & Zimmerman, 2008; Wolters & Hussain, 2015) and so the identification by students in this study that a lack of regulation and the freedom to complete the assignments as potentially leading to more off-task behaviour, is consistent with these studies.

Conversely, a small number of students reported a preference for completing the assignments on PCs as this allowed more concentration and consequently, more on-task behaviour. Some students referred to this as ‘active learning’. Active learning is a difficult pedagogical concept to define. Students appeared to match the widely cited characteristics of active learning outlined by Bonwell & Eison (1991), principally the involvement of higher-order thinking activities of completing assignments, rather than listening to the transmission of information from the teacher. This perhaps demonstrates that some students were reflecting on their learning and on pedagogical experiences beyond simple descriptive recall.

The reported variations in teaching style may have in effect been a consequence of the lesson format, as the availability and use of computers in the workshops has implications for both teaching and teaching methods, and may often require an altered teacher role (Smeets & Mooij, 2001; Norlander et al., 2005). The use of ICT can be used to stimulate active learning, to become more student-centred and lead to improved student attention compared to teacher-centred pedagogies (Smeets & Mooij, 1999; Bunce et al., 2010). Students appeared to be detecting this possible shift in teaching style and strategy when PC access was made available. A large part of the practice-orientated literature advocates student-centred pedagogies and active learning being superior for learning (Wilson & Peterson, 2006; Chiu & Cheng, 2017). Yet, students perceptions of on-task behaviour effects in this study did not wholly reflect this pedagogical thinking, but were more in line with other studies that advocate the use of a range of strategies and styles across pedagogical continua, especially to accommodate differing learner needs and tasks (Wilson & Peterson, 2006; Elen et al., 2007; Uiboleht et al., 2018).

Another significant factor in why on-task behaviour differed between the two lessons, according to the students, was the varied difficulty of learning tasks. Comments focused on tasks either not being challenging enough or being too difficult, largely due to a lack of clarity about the requirements of the learning tasks. This is interesting as only limited research has directly addressed task difficulty and on-task behaviour. Studies by Goldhammer et al. (2014) and Naumann & Goldhammer (2016) indicate that harder tasks can increase time-on-task effects; however, which specific task features drive this effect is unclear and may be a reflection of individual skill. For example, Goldhammer et al. (2014) reported a positive on-task behaviour effect with increased task difficulty and this decreased with individual skill level in problem-solving tasks. However, in reading tasks the on-task behaviour effect was negative with easier tasks and with increasing individual skill level. This link to skill level was tentatively reported by students in this study by their relation to previous task performance, with students referring to the tasks being 'self-explanatory' and therefore leading to less stimulation and on-task behaviour.

Some student comments about task difficulty related to a lack of clarity from the teacher, specifically students who found the learning tasks too difficult. Teacher clarity has been implicated as an important factor in learning and can lead to students experiencing increased apprehension if learning instructions are not clear (Chesebro, 2003). This can act as a barrier to effective learning and may have been a factor in the students reporting that confusion about the learning tasks led to more off-task behaviours (Chesebro & McCroskey, 1998;

Fuller et al., 2006). Comments from students about lesson difficulty indicate that teachers need to consider the balance between the learning-task level of challenge to create appropriate stimulus and clear instructions for optimal on-task classrooms.

Increased enjoyment of a subject taught in one of the non-PA classroom-based lessons was another reason students' cited for a change in their on-task behaviour. The link between enjoyment and increased learning is a longstanding and debated hypothesis (Blunsdon et al., 2003; Harris & Haydn, 2006; Joldersma, 2008). Limited evidence specifically links classroom on-task behaviour and enjoyment; however, Hofer (2007) has suggested that unenjoyable learning may lead to more off-task behaviours and it is perhaps reasonable to believe that unenjoyable and boring learning tasks will negatively affect on-task behaviours. The student comments mentioning enjoyment as a factor may relate to a more established link between enjoyment and motivation, particularly as motivation forms part of the necessary circumstances for optimal on-task behaviour (Frenzel et al., 2009, Gomez et al., 2010). Thus, to potentially minimise off-task behaviours, teachers may wish to consider strategies that help make learning enjoyable, particularly in subjects that often attract student aversion. This is another aspect of the study lacking in previous literature, as often comparable on-task behaviour studies control, or do not specifically mention a change in lesson subjects (Mahar et al., 2006; Mullender-Wijnsma et al., 2015).

The current study was designed with ecological validity in mind, as often colleges and schools use a variety of learning environments and deploy a number of diverse teaching staff to teach different modules with differing subject specialists. However, the use of different physical classrooms, teaching staff and taught module subjects between lesson observations could also be regarded as a threat to the validity of the thesis. For example, a range of variables concerning the structure and environment of classrooms such as temperature (Guardino & Fullerton, 2010), lighting (Dunn et al., 1985), acoustics (Norlander et al., 2005; Haghighi & Jusan, 2012), and classroom cosmetic condition (Earthman, 2000) may influence student behaviour. Some of the variables that students in this study perceived as affecting on-task behaviour were unforeseen influencers between comparison classrooms at the beginning of data collection. Although such circumstances in educational research are not uncommon and other researchers looking at PA and on-task behaviour have also reported similar issues (Bunce et al., 2010; Snyder et al., 2017), it was impossible and unrealistic from the current study design to address and quantify all potential influencing factors. Yet, even in the presence of anticipated and unanticipated factors that might have separately influenced on-task behaviours, a significant trend for increased on-task behaviour was only evident following the PA-based lesson, consistent with other studies that have controlled for such factors (Mahar et al., 2006; Howie et al., 2014; Riley et al., 2015). Thus, perhaps PA's positive impact on classroom on-task behaviour in this population is robust and consistent, even with variations in other possible influencing factors.

5.5.2 Assignment Completion Status

The second most commonly cited theme around the effect of assignment progress and deadlines highlights the intricacy and variety of factors that may affect student abilities, such as student motivation and decisions to be on-task.

As previously mentioned, pre-2017 BTEC diplomas involve almost exclusively coursework-based assessments, which means that students are required to produce a significant number of written tasks over the academic year (BTEC Nationals Sport 2016; Connolly, Allen-Collinson, and Evans, 2016). The presence and timing of BTEC assignment deadlines in this study was not controlled for or recorded, as this was not an anticipated factor before student interview analysis began. Nevertheless, the current study still saw trends similar to other studies on PAOD and COD, without identified deadline considerations. These assignment considerations may also offer some explanation for the variances observed in the individual RCI data that appeared to conflict with the mean observed on-task behaviour trends.

Students reported either an impending deadline or that they had completed all assignments and learning tasks as affecting their on-task behaviour. Deadlines can be pervasive and exert strong coercive power over student allocation of time and expenditure of effort (Amabile et al., 1976) and could potentially skew on-task behaviour in the current research design. Studies have indicated that individuals are likely to increase on-task activity before the deadline arrives in order to complete tasks and attain the overall deadline goal (Lim & Murnighan, 1994; Waller et al., 2002). This could have occurred more often on PAODs and have become a more powerful influence on on-task behaviour in lessons later in the day, as deadlines were often implemented at 5pm. Thus, students may perceive less time and do more work as the deadline approaches at the end of the day. This may be a reflection of Parkinson's Law where “work expands so as to fill the time available for its completion” (Gough, 2011 p.24) and suggest that people choose their effort levels appropriate to the tasks at hand and the amount of time they have available to accomplish those tasks (Peters et al., 1984). This is relevant to those students who mentioned impending deadlines and students that considered themselves finished, as Brannon et al. (1999 p. 155) expanded Parkinson's Law to consider situations where unexpected excess time arises, consequently concluding "more unexpected time people have, the more they dally".

It must be stressed that the students who reported that they had completed all assignments had not actually completed all coursework needed to complete their studies, because once students have completed the course, they do not attend these sessions. Instead, these students perceived themselves on-schedule or ahead of schedule in their course progress. Arguably, these students could be proactively working or researching other future assignments, but instead, appear to be 'dallying' or more often referred to in the research literature as procrastinating (Brannon et al., 1999; Madhan et al., 2012). Procrastination has been defined as a trait or behavioural disposition to postpone or delay performing a task or making decisions (Milgram et al., 1998; Madhan et al., 2012). Commonly, procrastination is thought to be detrimental and has been shown to adversely affect college students academic performance and success (Solomon & Rothblum, 1984; Akinsola et al., 2007; Madhan et al., 2012) and has been described as "rampant" among college students (Madhan et al., 2012 p. 1393). Some estimates put it as high as 95 per cent (Ellis & Knaus, 1979); hence, attempts to minimise procrastination should be seriously considered by teachers.

Students appeared to associate greater procrastination in the self-paced workshop lessons that required more self-regulation in learning and on-task behaviour focusing on BTEC coursework, possibly as the teacher was not directing and guiding the class (Solomon & Rothblum, 1984; Van Eerde, 2000). Previous student procrastination with their time may also have been a significant reason why some students reported that an approaching deadline was affecting their on-task behaviour. This appears archetypal of ‘academic procrastination’, described by Solomon & Rothblum, (1984) as doing homework, preparing for exams, or writing term papers at the last minute. These students generally described themselves as working more intensely to achieve the deadline and may have been miss-pacing their workload in accordance with Parkinson’s Law and/or previously procrastinating on the assignment task and now perceive time to be short, thus increasing their on-task behaviour. It has also been shown in previous studies to be possible to work faster and more intensely for a short period with tight deadlines and these often lead to a more rapid work pace than loose deadlines in both laboratory (Bryan & Locke, 1967) and field conditions (Brannon et al., 1999; Locke & Latham, 2002).

The specific individual reasons for academic procrastination were not explored in the questioning or design of this study, but is likely to involve a complex interaction of individual behavioural, cognitive and affective components and not simply poor study habits or time management (Solomon & Rothblum, 1984; Flett et al., 1992; Madhan et al., 2012). One deduction that may be inferred from interview responses, and is commonly associated as a component that influences procrastination, is that students appeared to be motivated due to a fear of failure of missing the impending deadline (Ferrari, 1992; Van Eerde, 2000). Fear of failure is the motivation to avoid failure in achievement tests, and involves cognitive, behavioural, and emotional experiences; it can also be detrimental to motivation, progress and outcomes (Atkinson, 1957; Martin &

Marsh, 2003; Alkhazaleh & Mahasneh, 2016). Motivation independently has been suggested as a primary attribute for on-task behaviour, as the application of incentives can turn academic learning time into engagement and on-task behaviour (Becker, 1992; Worthen et al., 1994). If teachers are aware of these factors in student decisions to be on-task, they may be better able to utilise strategies of motivation to help increase on-task behaviour.

A trade-off between time pressure and intensity of effort appears to be reflected in the students' interview responses. All students that reported impending deadlines as a factor indicated that this was an enabling influence for on-task behaviour of the assignment the deadline related to; however, situational factors such as time pressure do not necessarily have a linear effect on performance (Andrews & Farris, 1972). For example, as time pressures become increasingly more severe, this may result in increased stress and decreased performance in decision-making accuracy and creativity, which could subsequently influence the ability to be on-task and sub-par BTEC assignments being submitted, thereby increasing the chances of failure (Peters et al., 1984; Kerstholt, 1994; Brannon et al., 1999). Moreover, in a small number of cases, impending deadlines actually led to more off-task behaviour, using this study's operational definition of on-task behaviour, specifically; 'following what the teacher would expect you to be doing?': a small number of students reported choosing to work on impending assignments that were not related to the current lesson's topic or focus, mostly when students were tasked by the teacher to use computers in a learning activity. They reported that instead of doing the learning activity set by the teacher, they were, in fact, writing an assignment for another lesson/subject's deadline. This raises an interesting question about cognisant choice and on-task behaviour: students appeared to make a conscious choice to attend the lesson and then a subsequent conscious choice to not engage and be on-task with the lesson's learning material. From the data available in the current study, it is not possible to comment further than highlight this as an interesting proposition to appear in student responses. It does highlight that student engagement using computer ICT and laptops in lessons creates a specific challenge for teachers in terms of limiting the potential distractions that come with the use of such technology (Baker et al., 2004; Bulger et al., 2008; Kraushaar & Novak, 2010). This is also noteworthy, as unless the observer can see the content of each students' computer screen, these students could seem to be on-task and appear as though they were following the teacher's instructions when they are not. This is one of the problems associated with on-task classroom observation protocols, in that students could appear on-task, but may actually be off-task and vice-versa (Bulger et al., 2008; Mullender-Wijnsma et al., 2015).

The student comments about assignment deadlines may be useful for teachers to further understand the factors that may be influencing on-task behaviour in their lessons and to take into account goal-setting deadlines in other learning tasks. Deadlines in this study appeared to help safeguard against excessive procrastination and to increase on-task behaviour for that particular assignment, but were also a distraction from learning in other lessons (Amabile et al., 1976). In some instances, it was clear that teachers needed to perhaps increase their progress checking of learning tasks in lessons to ensure that on-task behaviour was relevant to the current lesson. This would also help those students who are more likely to procrastinate in general on their assignments. Arguably of more concern are the students who considered themselves to have finished and had nothing to get on with. This may also be a more immediately achievable and easier to address issue for teachers by offering extension materials to begin learning for forthcoming deadlines. These findings could also stimulate improved timetabling and teacher planning of learning on deadline days to help students synergistically utilise these increased capabilities to be on-task and avoid the negative distraction witnessed in this study in other subject lessons.

5.5.3 Fatigue and Energisation

In explaining how PA might affect their on-task abilities, one of the most common themes was that a PA-based lesson could make them feel either more fatigued or energised in the succeeding lessons. This theme appeared both as a student response to justify their perceived on-task lesson percentages in the observed classrooms and in reflections about how students thought PA affected classroom on-task behaviour in general.

5.5.3.1 Fatigue

Almost all the students who mentioned fatigue and/or energisation as a factor referred to fatigue as an important consideration for on-task behaviour. Fatigue is one of the most complex human responses to investigate due to the difficulties of objectively quantifying fatigue, its non-specific nature, lack of theoretical frameworks and an absence of a widely accepted definition that covers the complexity of its characteristics (Barofsky & Legro, 1991; Tiesinga et al., 1996). The word 'fatigue' can be used to describe chronic conditions of exhaustion that cannot be relieved by rest or sleep; however, the students in this study appear to be referring to ‘acute fatigue’ that typically relates to temporary feelings of decreased capacity for work (Barofsky & Legro, 1991; Tiesinga et al., 1996; Lou, 2009). A definition by Jensen & Given (1993 p. 182) offers a close description that reflected the acute fatigue reported by students in this study:

> "Fatigue is a subjective feeling existing at one point in time on a continuum from weariness to complete exhaustion, resulting from physical, mental or emotional activity. Acute fatigue is most often caused by excessive physical or mental exertion and can be relieved by rest".

In the student responses fatigue was often recognised as differentiated into physical and mental covariates when discussing its effects (Meijman, 1997; Lou, 2009). Physical fatigue is the transient inability of muscles to maintain optimal physical performance and is made more severe by intense PA (Gandevia, 1992; Hawley & Reilly, 1997; Lou, 2009). Whereas mental fatigue is a term to cover the deterioration of mental performance due to the preceding exercise of, mental or physical, activity, characterised by subjective feelings of tiredness and lack of energy, and is a complex concept, which cannot be measured by a single indicator (Meijman, 1997; Boksem & Tops, 2008; Marcora et al., 2009).

It may not be surprising that students mentioned fatigue as a potential factor, as the quantitative PA data indicated significant and large increases in PA in the PA-based lesson. Thus, consistent with Jensen & Given's (1993) definition, the PA-based lessons may have featured excessive PA and been significantly fatiguing compared to the classroom lessons. What is perhaps surprising, however, is the student perceptions that fatigue from PA can both facilitate and/or detract from on-task behaviour.

5.5.3.2 Fatigue Facilitating On-Task Behaviour

One of the most insightful and perhaps original findings that emerged from the student responses was that half of all the students who reported fatigue as a factor, suggested that this fatigue aided on-task behaviour or could have the potential to facilitate on-task behaviour in the lesson that followed the PA-based lesson. This was surprising as wisdom would perhaps indicate that a fatigued state would negatively affect on-task behaviour capacities. The small number of studies that have investigated fatigue and on-task behaviour also support such a hypothesis (see: van der Hulst et al., 2001; Lorist et al., 2002; Boksem et al., 2005; Head et al., 2016). However, these are typical laboratory-based studies that assess a specific mental performance task in clinical conditions. This study presents a phenomenon that has limited parallels with previously published outcomes, in that reporting feelings of fatigue as explicitly helping on-task behaviour is not discussed in the associated literature.

Interestingly, students who reported that fatigue had a faciliatory effect were almost exclusively students who also reported that the PA led to physical fatigue related feelings only, suggesting that mental fatigue was not occurring at a high enough level to be a negative influence. Physical and cognitive fatigue has been thought to independently affect performance and together, contribute to a multi-dimensional construct of total fatigue (Barker-Steege & Nussbaum, 2013). Linked to the absence of mental fatigue in these responses, students who commented that fatigue could be facilitatory also frequently detailed that concentration and focus improved and associated these psychological abilities as important components that directly enhanced their ability to be on-task. Students in Finn & McInnis (2014) and Ferrer & Laughlin (2017) also reported that PA helped them to feel more alert, focused, and better able to concentrate on learning activities. Findings in studies that record teachers' subjective opinions concur that PA can increase student focus, concentration and attention in the lessons after PA (Maeda & Randall, 2003; Webster et al., 2017; Martin & Murtagh, 2017b). These studies offer little further analysis other than to state that teachers believe this may help on-task behaviour and engagement. A surprisingly small number of studies have directly investigated the effects of PA on student concentration and attention, with all of these indicating that PA can enhance these abilities (Caterino & Polak, 1999; Kubesch et al., 2009; Donnelly et al., 2016). However, none of these studies explicitly relate to fatigue as such or suggest that fatigue might enhance concentration and focus. Some authors in the wider literature have suggested a parallel response to physical fatigue whereby mental performance may be preserved by compensatory mechanisms that allow an investment of more mental effort (Meijman, 1997; Wang et al., 2016; Yung et al., 2017). These theories are yet to be developed in a manner that could be applied further but provide stimulating considerations that may, in part, explain the faciliatory effects on on-task behaviour that students reported with feeling physical fatigue only. Also, further caution must be taken before encouraging PA that avoids mental fatigue. For example, previous research outcomes have indicated cognitively demanding PA can enhance situational interest and motivation in students (Chen et al., 2001). This may be particularly important to students who dislike PA, and cognitive engagement in PA-based curricula is necessary for learning content and motor-skill development (Alexander & Murphy, 1999; Schmidt & Lee, 2011).

Another common explanation students' gave for why fatigue might improve on-task behaviour is the need to ‘’blow-off’ or release excess physical energy before feeling ready to be fully on-task within lessons. The idea that children need PA recess to ‘blow-off steam’ has been proposed by both parents and educators and linked to ‘surplus energy theory’ (Smith & Pellegrini, 1993; Pellegrini & Bohn, 2005; Waller et al., 2017). There are variants of surplus energy theory, but in essence, it proposes that when students sit for prolonged periods of time, they accumulate surplus energy; this excess energy needs to be spent and PA allows students to ‘blow-off steam’ or use up the energy necessary for renewal of attention, so that they can then concentrate on the more sedentary tasks of the classroom (Smith & Pellegrini, 1993; Evans & Pellegrini, 1997; Nieman, 2002; Ridgway, 2004). Surplus energy theory’s validity has been questioned by critics, particularly as its foundations appear unsound and children are not always drawn to PA in school recess (Smith & Hagan, 1980; Evans & Pellegrini, 1997). For example, our current understanding of physiology does not support the building-up and discharging of energy as described in the theory. There is also a lack of definition regarding what a ‘surplus of energy’ might be (Jarrett et al., 1998; Ridgway, 2004). However, the theoretical explanation of surplus energy appears to correlate closely to the rationale given by students in this study who reported feelings of excess energy would accrue with long periods of inactivity, leading to the need to discharge this energy through PA.

Another associated theory proposed as an alternative to the surplus energy theory is ‘play deprivation theory’ or just ‘deprivation theory’ (Pellegrini et al., 1995; Ridgway, 2004; Waller et al., 2017). This also appears to be reflected in some of the student responses that identify the need to socialise, to be active and to release excess energy and is also further addressed in 5.5.4.1. This theory differs from surplus energy theory by predicting a rebound hypothesis in which the longer students are deprived of opportunities to engage in socially and physically vigorous activities, the stronger the rebound or the need to compensate with even higher levels of social interaction and PA when given the chance(Smith & Hagan, 1980; Burghardt, 1984; Pellegrini et al., 1995; Ridgway, 2004). Behind this hypothesis is a view of childhood as a period during which social skills and cardiopulmonary functions are naturally developed and young children are often compelled, almost driven by instinct, to engage in social and physically vigorous behaviours in order to develop these functions (Smith & Hagan, 1980; Fagen, 1981). Although the students in the current study were 16-19 years old and considered adolescents, differing levels of maturity may mean some of these students might still be transitioning from childhood needs (De Bellis et al., 2001; Ford et al., 2011).

Despite evidence of the importance of socialising and removal of energy in preparing for on-task behaviour (Smith & Hagan, 1980; Smith & Pellegrini, 1993; Ridgway, 2004), reference to surplus energy and deprivation theories as concepts is relatively sparse, especially in relation to the current level of debate around PA and academic improvements (Pellegrini et al., 1995; Ridgway, 2004; Camahalan & Ipock, 2015). This may be due to the questionable validity of these theories that appear to be based on reportedly outmoded concepts linking energy and motivation (Smith & Hagan, 1980; Smith & Pellegrini, 1993). These theories also do not explain why individuals who are tired and have been engaged in an abundance of physically active play, still play in the presence of interesting stimuli (Burghardt, 1984; Ridgway, 2004). Even without reference to these theories and where such observations are mentioned, studies in the literature give limited if any discursive attention to justify mechanisms or explain such feelings. Perhaps the student responses in the current study could provide further stimulus into such research in this area, as although student perceptions are subjective, it seems that concepts of deprivation and surplus energy continue to underpin such perspectives and so cannot be entirely dismissed as possibly affecting learning and on-task behaviour. Yet, with surplus energy theory originating in literature the since 19th century (Evans & Pellegrini, 1997) and still remaining largely unevidenced, it is also impossible to rule out associated student comments reflecting both deprivation and surplus energy theories may be a consequence of socialisation and cultural factors (Bandura, 1977; Akers et al., 1979). For example, it is not uncommon for children from a young age to be told that PA is good for them in terms of health and fitness, and they may be encouraged to 'burn off excess energy' from a number of significant others such as parents (Raudsepp & Viira, 2000) and governmental and media outlets who regularly promote the importance of PA and sport in an attempt to encourage lifelong PA behaviours (Buckingham, 1999; Wakefield et al., 2010; NHS, 2013). Children may take on these beliefs, which then become part of discursive postulation, and this process, may therefore, be a factor that needs to be considered when asking questions around the benefits of PA. In fact, a number of the student responses to the later interview question, "does a physically active lesson affect your ability to be on-task in the following lesson?" appear to reflect this socialisation with regards to the benefits of PA. Indeed, these ideas may have been acquired through taking part in their BTEC sports/drama courses rather than arising from 'genuine' experiences or feelings (Randall & Phoenix, 2009). It is also worth bearing in mind that the interview method can lead to some individuals giving socially desirable responses to please the interviewer or when not knowing or having an truthful answer resorting to speculating (Ross & Mirowsky, 1984; Waterman & Spencer, 2001). In hindsight therefore, this question could have been worded differently to avoid such discursive postulation influencing student responses. On the other hand, its role in in the interview was a failsafe capture-all question that was asked at the end of the interview process to at least stimulate some thought and comment from students regarding the PA and on-task behaviour interactions. In this sense, the question proved to be effective, as over half of students' initial rationale for their on-task behaviour did not supply material arguably related to PA effects or the PA-based lesson, which was the specific focus of the investigation.

Several students who mentioned physical fatigue as facilitating on-task behaviour often also suggested that it consequently made off-task behaviour less appealing as they were 'too tired to mess around'. The uniqueness of these interview responses means that there is limited comparable literature. Tentative parallels do exist in some other findings; for example, in Mueller et al. (2017), teachers reported the benefits of PA in relation to student self-regulation in the classroom, in the sense that it was seen as contributing to students' ability to regulate their emotions in the management of anger, fatigue and restlessness. All of these have been found to negatively affect on-task behaviour and readiness to learn (Mahar et al., 2006; Ratey & Hagerman, 2008). Camahalan and Ipock (2015) also reported that students were more able to self-regulate after PA and displayed increased abilities to work independently, requiring less teacher prompts to be on-task. A number of studies from the cognitive research literature have demonstrated that PA can facilitate increased inhibitory control, increased focus and an improved ability to resist distractions (Hillman et al., 2017; Peruyero et al., 2017). Some student experiences reported in this study appear to confirm similar facilitating effects in a more ecological classroom environment as opposed to controlled laboratory conditions, possibly demonstrating some transferability of these previous findings to real-world settings (Mueller et al., 2017). In relation to future research considerations, explorations of students reporting fatigue facilitating abilities to be on-task is a finding distinctive to the current study. So, initially perhaps, needs further confirmations from similar interviews of students' perceptions in comparable and associated research designs to understand this complex more fully, and to inform the construction of experimental designs that could be deployed to examine credibility and mechanisms of such hypothesised concepts.

5.5.3.3 Fatigue Hinders On-Task Behaviour

Half of all students who reported fatigue or tiredness as a factor conveyed that this hampered or could hamper on-task behaviour in the lesson after the PA-based lesson. Only a limited number of studies have investigated fatigue and on-task behaviour, but rather than being conducted in the classroom environment, these studies usually feature laboratory-based cognitive testing (see for example, van der Hulst et al., 2001; Lorist et al., 2002; Boksem et al., 2005). Students in this study who felt that fatigue hindered on-task behaviour frequently mentioned being concurrently physically and mentally fatigued. This could be a possible reason why fatigue negatively affected a sub-sample of students; the wider literature has shown that when a cognitively fatiguing task is coupled with a physical task, this can intensify feelings of fatigue and decreased cognitive abilities (Green & Helton, 2011; Head et al., 2012; Epling et al., 2016; Yung et al., 2017; Kao et al., 2018). The PA-based lessons in this study were not solely physically stimulating as commonly indicated in a number of directly associated studies (Howie et al., 2014; Ma et al., 2014; Wilson et al., 2016; Maykel et al., 2018). Rather, the PA-based lessons had specific learning objectives and material; thus, there could have been a dual-task synergistic effect of fatigue on some students which was both mental as well as physical, thereby limiting the cognitive resources available to process the learning tasks in the lessons that followed (Green & Helton, 2011; Head et al., 2012; Fischer et al., 2013). This has been suggested as a potential problem, especially for students who struggle with the cognitive demands of learning, as some students may lack the tools with which to cope and persevere with mental fatigue, weakening cognitive processing abilities, concentration and on-task performance (Klein, 2004; Kao et al., 2018).

A further explanation many students gave for fatigue negatively effecting on-task behaviour was that they had not sufficiently recovered from the physiological demands of the PA-based lessons. Students thus became distracted on prioritising homeostasis rather than on the learning content of the lesson (Maslow, 1943). Previous research has reported getting hot and sweaty as a negative of school PA programmes (Tannehill et al., 2015; Webster et al., 2017) and on-task behaviour can be affected by feelings of thermal stress (Beshir et al., 1981; Seppanen et al., 2006). Limited comparable comments could be found in the literature that reported recovery issues in PA and classroom on-task behaviour, beyond Martin & Murtagh’s (2017b) study where students expressed PA made them thirsty; no further discussion or detail was given, highlighting this too is perhaps is an area that needs further investigation if it is directly hindering students in classrooms.

Students who reported that they had not yet recovered from the PA often specified finding it difficult to transition to the classroom. Teacher reports in a number of other studies have expressed similar concerns about the threats to on-task behaviour posed by PA and the transition back to seated classroom environments (McMullen et al., 2014; Stylianou et al., 2016b; Dinkel et al., 2017; Webster et al., 2017; Martin & Murtagh, 2017b). One theory for this possible negative relationship is that PA contributes to arousal, which interferes with concentration (Klein, 2004; Owen et al., 2018). The correct level of arousal for the demands of various classroom activities has been identified as important to student self-regulation and PA is thought to have the unique ability to energize hypo-aroused students and to discharge energy for hyper-aroused students (Ratey & Hagerman, 2008; Tranter & Kerr, 2016). This may help to further explain the inter-individual variations students seem to experience, with some feeling energised by PA, some finding the fatiguing effects of PA facilitating and others finding them debilitating. These variations may be linked to their initial arousal and energy levels, although the data presented in this study is not strong enough to present this as anything more than an associated postulation.

Some students suggested that fatigue effects depended on the intensity and volume of PA. Principally, these comments centred around the concern that too much or too intense PA relative to their fitness could lead to a negative effect on on-task behaviour. Although fitness was not assessed in this study, physical fitness can affect the magnitude of fatigue (Stone et al., 2007; Cunanan et al., 2018). The efficiency of physical recovery of individual students may offer an additional explanation for the variation in student responses regarding fatigue, including why many students did not consider fatigue a problem even though high amounts of PA were indicated in the PA-based lesson. Some ‘fitter’ students might not have reported fatigue as a factor, as the PA was not sufficiently fatiguing for their individual fitness levels and/or may have then included adequate time for them to recover to baseline homeostasis (Dickinson et al., 2016). Again, this highlights the multifactorial complexity of fatigue as a factor in classroom on-task performance.

These comments around fatigue and recovery appear to highlight in practice a need for a structured cool-down and adequate recovery time after PA. Many students in this study had no gap in their timetable and indeed, this was part of the selection criteria for the study, mainly to allow more comparability to similar literature that commonly observes immediately after a PA intervention or mentions no break before the following observation. In addition, the college sports hall and drama studio is a scarce resource, with a large number of courses requiring its use; this limits teaching time in the sports hall and combined with student changing times, means perhaps that there was not enough time for a full cool-down and a break to allow students to fully recover. The use of a cool-down is often good practice in that it is thought to help participants to recover faster and return to a calmer state (Van Hooren & Peake, 2018). Arguably, teachers need to be aware or reminded of the importance of recovery and cool-downs for the transition to classroom learning.

5.5.3.4 Energisation

Some students mentioned the PA-based lesson increased their energy levels in the subsequent lesson, with almost all considering this as beneficial to on-task behaviour. These students perceived that the reason energisation improved on-task behaviours related to improved attention and concentration abilities, such as feeling more ‘awake’ and more able to focus. In two of the small number of studies that have qualitatively investigated student perceptions of a classroom PA intervention, students similarly reported that they felt ‘energised’, less tired and more alert after the active lessons, but no further comment was given by the authors other than that this was a positive outcome (see Finn & McInnis, 2014; Martin & Murtagh, 2017b). Previous teacher perceptions have also reported increases in student energy levels, accompanied by increases in engagement and student focus (Webster et al., 2017).

A small number of students, however, inferred the contrary; they reported that an increase in energisation in the subsequent lesson negatively impacted on-task behaviour due to students having too much energy and struggling to settle to be on-task, suggesting that the transition to a seated classroom can be problematic, particularly with regards to concentration. These students appeared to suggest that they may not have returned to a resting state in the following lesson, thus showing some similarities to the insufficient recovery and cool-down concerns mentioned by students in fatigue considerations (see 5.5.3.3). Another theory offered in Tranter and Kerr (2016), where strategies to help with student self-regulation were considered, is that PA interventions can be an important ‘up-regulating’ strategy that teachers could use when students slip into a hypo-aroused state, start to daydream and lose focus. The authors claim that this can energize hypo-aroused students and renew their focus and concentration abilities. The interview responses in this study echo this finding, as some students who may not have been hypo-aroused prior to PA may have become hyper-aroused. This was inferred by the small number of students who reported that energisation might have negative effects with too much energy (Ratey & Hagerman, 2008; Shanker, 2013; Mueller et al., 2017).

Student perceptions in this study around energisation are particularly insightful, as large volumes of research around the purported benefits of exercise regimes commonly report being energised by PA and yet provide little consideration around the mechanisms involved in this process (Louw et al., 1995; Coulson et al., 2008). It is difficult to infer with absolute clarity these mechanisms from this study's data, as increases in concentration abilities were also reported by students as a result of fatigue. Perhaps these variations between student responses further demonstrate the individual nature of fatigue and energisation effects (Jarrett et al., 1998; Howie et al., 2015; Sullivan et al., 2017). Furthermore, the perceptions from students that fatigue and energisation can enhance concentration abilities suggests that perhaps both are attributable reasons for facilitated on-task behaviour after PA.

5.5.4 Structure of the Learning Day

Students proposed that the timetabled structure of the PA-based lesson within the learning day could influence their on-task behaviour. These considerations relate closely to the 'circadian rhythms' often mentioned in the literature, which comprise of temporal fluctuations in physiological and behavioural functions usually displaying a cycle over a 24-hour recurring time period (Montaruli et al., 2017). Circadian rhythm effects have been shown to have many physiological and psychological correlates such as body temperature and alertness (Tankova et al., 1994; Randler & Schaal, 2010). Over 100 other human functions have been shown to vary in accordance with circadian rhythms (Klein, 2004). It is therefore rather surprising that there is a lack of research into circadian effects on classroom on-task behaviour.

Most, but not all students that considered time of day to be an influencing factor in the current study, indicated either the morning or afternoon as less favourable for on-task behaviour. Other studies have suggested a similar split in student learning preferences (see for example, Rayneri et al., 2003; Rayneri et al., 2006). Individuals can often associate either with being 'early birds' or 'larks', as terms for morning preference individuals, or 'night owls' for those who perform better in the afternoon and this is usually based on individual feelings and past performances (Dunn et al., 2002; McElroy & Mosteller, 2006; Kudielka et al., 2006; Fabbri et al., 2007). These variations in circadian learner preferences have been linked to 'circadian typology', sometimes termed 'chronotype', which categorises individuals according to their diurnal preferences and sleep-wake pattern into either morning-, neither-, and evening-type individuals (Natale et al., 2003; Prat & Adan, 2013; Önder et al., 2014).

To offer a mechanism for such differing preferences, some authors have linked these diurnal performance variations to an individual's preference as a dominant right or left cerebral hemisphere thinker, affecting learning effectiveness at differing times of the day (Natale et al., 2003; Klein, 2004; Fabbri et al., 2007). It has been reported that the function of the left hemisphere is dominant in the morning and the right hemisphere in the afternoon and this may therefore further facilitate those of left and right preference thinkers at these times of day (Klein, 2004; Fabbri et al., 2007). This further highlights the individual nature of circadian effects with circadian typologies and may also help explain some of the intra-individual differences witnessed in the RCI quantitative outcomes, where some students' individual data showed a higher on-task behaviour in the morning lessons, regardless of a PA-based lesson.

Notably, several students' RCI data in this study and overall means between the first observation and the second observation later in the day on COD, showed no difference. This suggests that although students perceive 'time-of-day' as affecting on-task behaviour, its tangible influence may be minimal. Studies in the associated literature that look at morning and afternoon observations of on-task behaviour and detail time of day are scarce. In Goh et al.'s (2016) study, a rare direct consideration is made to circadian rhythms, concluding that time of day did not impact students' on-task behaviour, as classes observed before lunch showed no difference in on-task behaviour from classes that were observed after lunch. Similar outcomes have been witnessed by other authors (Mahar et al., 2006) and this appears true of the mean control quantitative outcomes. Most associated study designs either observe at the same time of day to control for circadian effects or observe a short 5-15-minute PA intervention; so both before and after observations are often completed in under 60-minutes (Grieco et al., 2009; Ma et al., 2014; Maykel et al., 2018). This highlights a potential limitation in the current study compared to other previous studies as circadian effects were not completely controlled for. Yet, it also offers some ecological validity as PA-based lessons are commonly placed at differing times of the day and this design characteristic separates this study from much of the published data while still showing similar quantitative outcomes.

A large number of students highlighted that the baseline observation lesson being earlier in the morning was a factor that decreased their on-task behaviour levels and abilities. In the wider related literature that investigates other learning measures, contrasting opinions are put forward with respect to the most effective hours for learning and attention (Davis, 1987; Barron et al., 1994; Andrade & Menna-Barreto, 1996; Klein, 2004). According to Randler & Frech (2006), for example, preferences may vary with maturation as students shift their time of day preferences from ‘morningness to eveningness’ during the age of puberty and adolescence and this may be reflected in the adolescent students of the current study. At the same time, measurable effects may not extend to on-task behaviour, as this was not reflected in the mean quantitative data on COD.

Frequently mentioned by students in the current study was a need to ‘wake-up’ to be ready for learning and associated tiredness in the morning lessons. Adolescent individuals have been reported to require about 9 hours of sleep every night (Noland et al., 2009) and due to diurnal changes, are usually alert later in the evening and go to sleep late (Randler & Frech, 2006; Noland et al., 2009). Therefore, ‘early’ college start times may have a negative influence on evening preference students functioning, with morning preference students reported to perform better in school achievement (Randler & Frech, 2006). For example, to start college for 9am, several students in this study travelled long distances and therefore may need to get up early, possibly incurring a sleep deficit. This can directly affect a student’s ability to be on-task, as sleep deficits can increase fatigue, lower attention levels, impair memory potential and lessen abilities to deal with complex tasks (Wolfson & Carskadon, 1998; Fulda & Schulz, 2001).

Teachers and staff who plan timetables could perhaps consider students’ predominant chronotypes to create solutions and activities that might help energise learning and improve on-task behaviour. Starting the learning day at a later hour for adolescents is currently a topical debate, with UK MPs set to debate later school start times for adolescents in 2019 (BBC, 2019), yet the studies that have investigated this option have reported mixed outcomes. For example, in Kubow et al.'s (1999) study some teachers reported improvements in students' attention and discipline, but more teachers reported a deterioration in the performance of their pupils and decreased motivation.

Another solution that has been proposed is flexible timetables to meet the diverse needs of both morning and evening preference students (Klein, 2004). This is where students choose courses at hours that they feel would be most efficacious for their learning (Kubow et al., 1999). Ammons et al.'s (1995) study found that students were usually accurate in identifying the hours that were optimal for their own progress; however, the information amassed to-date about the connection between the hour of study and academic accomplishment is still limited in scope. In addition, Klein (2004) has suggested that the circadian rhythms of teachers could also possibly impact their students. This may, therefore, have been a factor in the student reporting of teaching style differences between lessons in this study. This link has not been studied and could offer new insights into diurnal changes in learning and on-task behaviour. Overall, the relationship between the structure of the learning day and on-task behaviour should be investigated on a more comprehensive empirical basis as an area of future research that may offer even more valuable insight into understanding the nature of on-task behaviour in college students.

5.5.4.1 Physical Activity-Based Lesson Acting as a ‘Break’ from the Classroom

Some students proposed that the PA-based lesson offered a ‘break’ from the classroom and that this was beneficial to on-task behaviour. Interestingly, the PA-based lessons in this study appear to have similar effects as those witnessed in a number of studies that focus on student recess opportunities. For example, Mahar (2011) calculated Cohen's d effect size values from the data provided in Jarrett et al.’s (1998) paper that looked at free-play recess breaks in 8-11 year olds and demonstrated that differences in on-task behaviour were of medium effect size, close to the effect size witnessed in the current study. Thus, there can be some debate as to whether it is the PA or simply a faciliatory break from classroom learning that may have been the largest influencing factor in this study.

The idea that students may benefit from periodic changes in sedentary classrooms may also be rooted in psychological theories that have been previously cited to explain such findings (Pellegrini & Davis 1993; Pellegrini et al. 1995). For example, student observations that a break from the classroom facilitates on-task behaviour could be linked to the aforementioned deprivation theory (Pellegrini et al., 1995a; Ridgway, 2004; Ärlemalm-Hagsér et al., 2017). It may be sedentary classroom learning acted as a deprivation period where inattention increased as a function of time. Goh et al.’s (2016) discussions offer a similar rationale for an increase in off-task behaviour in a control condition in which students tended to become more restless after going through prolonged periods of academic instruction without a break. It is possible that the PA-based lesson provided a rebound through socially and physically vigorous activity (Smith & Hagan, 1980; Smith & Pellegrini, 1993; Ridgway, 2004).

Related to deprivation theory, students mentioned the need to ‘catch-up’ and socialise, especially in the morning lessons. These students appear to be suggesting that on-task behaviour was negatively affected because they did not get sufficient opportunity to meet these needs. Other researchers have explored this and have looked at the potential for morning meetings that consider and plan time for greeting activities, to offer opportunities for students to share news about their lives (Bondy & Ketts, 2001; Kriete & Davis, 2014). These studies have purported added benefits to students, such as galvanising a sense of belonging to a learning community alongside increasing motivation, academic performance and positive student interactions in the classroom (Bondy & Ketts, 2001; Kriete, 2003). Research on such greeting activities, however, has only centred on children between the ages of 5-12 years old (Bondy & Ketts, 2001; Schoaf, 2017). Research on similar interventions with college students would, therefore, be valuable to explore whether these could enhance classroom on-task behaviour, particularly in morning lessons where several students reported difficulties in being on-task.

Other psychological theories, such as novelty-arousal theory and massed versus distributed practice effects (Pellegrini et al. 1995; Evans & Pellegrini 1997), may help explain the student reported benefits to on-task behaviour that PA-based lessons might offer in providing a break from the sedentary classroom. Novelty-arousal theory, sometimes just termed novelty theory, suggests that persons function better when they have a change of activity or a shift in routine (Ellis, 1984; Jarrett et al., 1998). When engaged in activity long enough to become habituated, they become bored and seek novelty to satisfy the increased need for stimulation (Nieman, 2002; Owen et al., 2018).

Novelty theory links to neuroscience claims that the brain actively seeks new stimuli in the environment from which to learn. A change of learning format and inclusion of PA may, therefore, help offset monotony and stimulate other areas of the brain (Gregg, 1995; Wilson & Peterson, 2006). Students in this study may have become habituated to classroom activities over time, leading to inattention and off-task behaviours, and thus, seek novelty in a different activity (Ellis, 1984). The PA-based lesson may be providing this novelty, as its characteristics differ to the classroom's and therefore creates resistance to habituation. Novel characteristics in the PA-based lesson may include: differing room type (sports hall/drama studio), differing equipment, differing teacher learning outcomes and learner tasks, and more freedom to be creative in movement (Bournelli et al., 2009).

Students may likewise become habituated to the PA-based lesson as a function of time and seek novelty in a different activity, such as classroom learning. This theory could, therefore, explain increased on-task behaviours in the subsequent classroom after PA partly due to the change in stimulus (Smith & Pellegrini 1993; Pellegrini et al. 1995; Wilson & Peterson 2006). As already mentioned, on-task behaviour in the control group on COD in this study did not improve with time of day, module subject or classroom. Possibly the PA in the sports hall/drama studio was novel enough, whereas just a change of classroom, teacher and/or subject was not sufficiently stimulating to provide such benefit to on-task behaviour.

Principles underpinning the massed versus distributed practice theory could also explain the positive effect that classroom breaks might have on learning performance (Pellegrini, 1996; Seabrook et al., 2005). These principles assert that learning improves when it is spaced and distributed over time, with spaced intervals of rest or another different activity, rather than massed into an extended continuous block (Donovan & Radosevich, 1999; Seabrook et al., 2005). Based on this theory, the PA-based lesson could be functioning as the spacing element between various learning tasks, thereby serving to distribute learning opportunities, which may then increase students' concentration and on-task performance (Jarrett et al., 1998; Pellegrini & Bohn, 2005; Owen et al., 2018). However, studies of massed versus distributed practice in classroom parameters have been less convincing than those conducted in the laboratory: when comparing distributed conditions over massed conditions, outcomes have been mixed (Donovan & Radosevich, 1999; Seabrook et al., 2005; Rogers, 2015). Further investigation into the distribution of learning and on-task behaviour could be insightful for further clarity around the extent of PA's influence, as compared to the notion that PA-based lessons offer the same benefits as a break, reducing novelty and helping to distribute learning.

Even if PA-based lessons do act as breaks that help on-task behaviour, it is unclear how best to utilise this in the learning day because it is unclear how long students pay attention in lessons before their attention declines (Bunce et al., 2010; Bradbury, 2016). Some authors suggest that the period of time before concentration declines can be quite short, between 10-20-minutes; thus, maybe additional PA breaks more often would be even more effective (Sousa, 2016; Bradbury, 2016). The specific positioning of PA has only been addressed in a limited number of studies and is often based on students' cognitive functioning. These studies suggest that PA should be scheduled earlier in the day when students are less fatigued and/or before important subjects and not at the end of the learning day, which has been reported as common practice (Kubesch et al., 2009; Travlos, 2010; Li et al., 2017). This is interesting as four students in this study suggested the contrary, stating that PA would be best scheduled at the end of the learning day, mainly due to fatigue and recovery considerations. While limited conclusions can be drawn from the restricted data available, future research is warranted that may offer more understanding of on-task behaviour, PA and its distribution around learning.

5.5.5 Physical Activity Lesson Enjoyment

Students reported that desire to participate and enjoyment specifically in the PA as factors that can help both on-task behaviour and wider learning. This is consistent with teacher and student qualitative responses in a large number of studies (for example, McMullen et al. 2014; Stylianou et al. 2016b; Mueller et al. 2017; Carlson et al. 2017) and is an important finding as an absence of enjoyment has been reported as one of the main reasons for students failing to achieve their potential (Harris & Haydn, 2006; Goetz et al., 2006; Shernoff et al., 2014). Some students in this study elaborated further, stating that the enjoyment of PA-based lessons led to greater motivation in the lessons that followed. Enjoyment of PA as positively increasing academic motivation has also been identified in previous research (Vazou et al., 2012; Martin & Murtagh, 2017b). This could facilitate on-task behaviours as more motivated students are thought to pay attention longer and have higher levels of self-regulated learning than less motivated students (Bunce et al., 2010; Ronconi & De Beni, 2014; Snyder et al., 2017). Enjoyment of PA may also decrease boredom, increase the desire to learn, and assist with attentiveness and staying on-task (Pellegrini et al., 1995; Ladd & Dinella, 2009;

Tempelaar et al., 2012; Ferrer & Laughlin, 2017). Enjoyment may also have more far-reaching consequences, such as helping improve the connectedness of school and the classroom (Juvonen, 2007; Bowling et al., 2017).

Despite PE being a popular subject among many students, an age-related decline in its popularity and school-based PA enjoyment is common as students get older (Prochaska et al., 2003; Webster et al., 2017). The findings in the current study are not consistent with this: a majority of the participants indicated that enjoyment was common and facilitated on-task behaviour. Yet, this may not be representative of the whole college student population and may be unsurprising given that students featured in this study were those who had freely chosen to study courses involving high levels of PA i.e sport and dance/drama students. As Prochaska et al. (2003) have posited, students who enjoy PE (and its PA) are more likely to enrol on physically active courses. It may be that students from other less active courses would make fewer positive associations between PA and enjoyment.

The potential for a PA-based lesson to affect enjoyment, irrespective of classroom behaviour, is significant because students tend to obtain less PA as they age (Troiano et al., 2008). Enjoyment has been considered a key component of acceptability and a dominant motivational element for student attitudes to engage in future physically active lifestyles, in and outside of education (Allender et al., 2006; Finn & McInnis, 2014; Martin & Murtagh, 2015; Riley et al., 2016). Some authors have associated this to students' PA self-efficacy which can determine their participation in PA, with enjoyment being acknowledged as the primary mediator of this self-efficacy (Trost et al., 2001; Lubans et al., 2008; Martin & Murtagh, 2017b).

Enjoyment is also crucial to the potential sustainability of any PA intervention to improve on-task behaviour, as student 'buy-in' has been highlighted as important for teacher approval and implementation of PA interventions (Cothran et al., 2010; Howie et al., 2014; McMullen et al., 2014; Hodges et al., 2015; Benes et al., 2016; Webster et al., 2017; Martin & Murtagh, 2017b). Identifying innovative and enjoyable ways for students to take part in PA, especially older children, is vital to not only improve their PA and health, but also possibly their academic outcomes (Snyder et al., 2017). At the same time, more research is needed on the demographics and mechanisms of students who do not want to participate in PA in order to help increase enjoyment and motivate these students (Dinkel et al., 2017).

While enjoyment may be important to on-task behaviour for some students in the current study, Carlson et al. (2017) implied student attitudes consider enjoyment to not always be a major barrier to PA participation, thus enjoyment in some circumstances can be sacrificed. In addition, it is perhaps unrealistic to expect learning and lessons to be enjoyable all the time; indeed, a possible tension may arise, between enjoyment as a right and enjoyment conceived as a tool possibly in conflict with learning performance targets (Harris & Haydn, 2006). Sometimes the metaphor 'teacher as entertainer', is used to describe the characteristics of a teacher and has been met with criticism (Prendergast, 2008). This may also be particularly significant in FE colleges where students are being prepared for lifelong learning and entry to the workplace. It could be argued that their work lives will often not be fun nor entertaining, so learning that is not always enjoyable may also help student readiness and skills for future life success. Also, enjoyment is a highly individualistic, changeable and multifactorial concept; thus, what may be enjoyable on one day could be experienced as tedious on another (Gorard & See, 2011; Noyes, 2012; Aubusson et al., 2014). Nevertheless, the student perceptions of enjoyment in this study build on previous research that does suggest that student PA enjoyment can further promote the beneficial effects of PA interventions and that where students do not experience enjoyment, this may have an adverse effect. This finding is of particular relevance to policymakers and practitioners who promote PA and on-task behaviour as a way of increasing academic performance (Harris & Haydn, 2006; Martin & Murtagh, 2015).

5.6 Summary: Inferences on Physical Activity-Based Lessons and On-task Behaviour

When reviewing the MM data generated in this study on the value and attributions of PA, the author as a teaching practitioner and researcher, considered several questions. Firstly, was an 8.4% increase in on-task performance worth detracting from classroom lessons for an hour or would an hour of taught input be more beneficial to learning and academic outcomes? This is less of an issue in the current study as the PA-based lessons that were observed were naturally occurring and already timetabled, featuring learning outcomes and content related to the respective qualifications. If a similar PA intervention was deployed in other subject areas where integrating PA could possibly be challenging, such as English A-level classes, would such an intervention be worth it in an FE sector with scarce resources? As already discussed, shorter durations of 10-minutes and upwards might be better in such circumstances but needs further investigation. The current thesis's positive outcomes offer ethical credibility in implementing and exploring purpose-built and prudent PA interventions in FE college environments with adolescent learners in teaching practice and research.

When reviewing the whole data, one of the most pertinent findings for this was that students commonly mentioned factors that were perhaps unrelated to PA and the PA-based lesson when supplying reasons for their perceived on-task behaviour percentages. Reasons such as impending assignment deadlines at the end of the learning day were seen as strongly influencing on-task behaviour levels, thereby may have significantly skewed the data towards an improvement in on-task performance in a lesson later in the day and closer to the deadline. The questions and order of interviews were designed to avoid leading questions, ultimately directing students to responses focused on PA; but lack of attribution to PA in students' responses was still surprising. Particularly given that all students had been given the informed consent documentation and attended participant briefings where the study's focus on PA was clearly explained. When asked to justify their perceived on-task percentages, over half of the students did not even mention factors arguably associated to PA's influence, such as changes in feelings of energisation, fatigue, recovery and concentration. It was only when prompted by later more general question about how PA might affect their on-task behaviours that these students made specific references to how a PA-based lesson might affect their on-task behaviour.

This raises the question, is PA the most influential factor to the improvements in on-task behaviour witnessed in the quantitative outcomes of this thesis? Within the current research design and outcomes, it is impossible to answer this question. On the other hand, it is worth reemphasising that the data still saw trends that are common to multiday research designs and in elementary schools where such consideration may not arise, such as the absence of BTEC coursework deadlines. As this is one of the first studies to investigate student adolescent opinions and on-task behaviour concurrently in this manner, it is difficult to find many comparable examples to see if this is a common occurrence. Linked to these issues, it is impossible to rule out that the PA-based lesson may have been acting as a break from the monotony of a lesson and as a novel stimulus in the change of learning format, rather than the effects of the movement in PA, a factor that only a small number of students in this study attributed to the benefit of PA. This ambiguity is a characteristic of this research area. Riley et al.'s (2016) paper concluded that they were unable to determine if improvements in students' on-task behaviour was a result of increased PA or learning through the PA as an innovative approach. Previous evidence suggests that long periods of sedentary classroom time without a break may be counterproductive to academic behaviours (Pellegrini & Davis, 1993; Jarrett et al., 1998). Conversely, Pellegrini and Bohn (2005) noted that students were more attentive even after an indoor recess with minimal PA. In another related example**,** Bunce et al. (2010) found that switching pedagogies from lecture to a student-centred non-lecture format within a sedentary class may help engage students, whereas Grieco et al. (2016) witnessed a positive effect to on-task behaviour from a sedentary competitive classroom learning task.

The inclusion of PA-based lessons explored in this study likewise may be helping offset monotony and stimulate other areas of the brain, irrespective of PA (Gregg, 1995), thereby supporting theories of attentional reset (Evans & Pellegrini, 1997). PA may have simply been a break from sedentary classrooms, providing variety and a novel opportunity for an attentional shift to refocus attention and on-task behaviour in subsequent lessons (Sylvester et al., 2014). Research has suggested that experiencing variety stimulates interest (Silvia, 2006), and thus, may also explain the benefit of a PA-based lesson, regardless of the presence of PA (Grieco et al., 2016). This has important implications for classroom teachers, academic managers and policy planners when considering implementing changes. It may be better to just have a break or frequently switch the nature of lesson tasks, as this would be less demanding on teacher planning, resources and space than implementing planned PA breaks. On the other hand, PA interventions could be worthwhile retaining purely on the basis of the potential positive impacts on student physical and mental health. Which may also synergistically further help improve learning and on-task performance. This should not be overlooked when investigating the benefits of PA on specific factors as it is widely accepted that PA can have multiple, significant and wide-reaching benefits to individuals beyond just on task behaviour improvements. Possible future research in this population is needed, to control and compare changes to task, learning breaks and PA, so as to offer more informed evidence of the true mechanisms involved in PA's relationship with on-task behaviour in adolescent learners.

Chapter 6 - Conclusions and Recommendations

6.1 Summary of Findings

The central emphasis of this mixed methods thesis was guided throughout by the three research questions; thus, they are now addressed in the conclusion. In relation to research question 1, *"Do levels of on-task behaviour vary after a physically active lesson compared to an inactive lesson, and if so in what ways*?", the present thesis quantitative outcomes indicated strong support for PA having a positive effect on subsequent mean levels of classroom on-task behaviour. The classroom observations carried out in this study demonstrated that a 60-minute PA-based lesson led to significant and immediate mean-level improvements in on-task behaviour in adolescent UK FE college learners, consistent with previous research with younger school children (Mahar et al., 2006; Howie et al., 2014; Webster et al., 2015). The PA-based lessons in the college sports hall or drama studio increased PA considerably with 'extremely large' effect sizes compared with seated sedentary classrooms. This strengthens the case for PA as a strategy to promote on-task classrooms in adolescent learners.

One of the unique factors of this study was that 'real-world' naturally occurring PA was investigated, compared to most previous on-task studies that investigated researcher-led and designed interventions lasting ~10-15-minutes (see for example, Mahar et al., 2006; Goh et al., 2016; Maykel et al., 2018). However, even though the duration and intensity of PA was greater, only a small to medium effect size increase in on-task behaviour was found in this study, which may be viewed as underwhelming compared to some previous studies in which greater increases were found with only ~4-15-minutes PA (Riley et al., 2015; Stylianou et al., 2016a). This may suggest that there is a limit to the duration of a PA that will have positive effects and that more minutes are not necessarily better.

Also from the variety of PA types investigated in the preceding literature, and PA in the current study varying in dose and modes (for example learning dance routines, fitness testing and practicing of differing sports), it seems that the form PA takes may not be a limiting factor. The real-world application of this research may also offer some elucidation to the question posed by Bublitz & Rhodes, (2017) regarding whether on-task behaviour benefits continue with PA use over an extended period of time and once the novelty wears off. As the PA-based lessons investigated in this study had been implemented for several months prior to the research, it seems likely that the positive effects on on-task behaviour observed in the study continue over the long-term.

When investigating the data via reliable change index individual-level analysis (RCI), several students exhibited a decrease in on-task behaviours following a PA-based lesson. This is one of the first studies to deploy systematic individual-level analysis to on-task behaviour and report negative consequences of PA through quantitative outcomes. Although negative cases and non-responders frequently are found in studies involving human subjects, there is a lack of research that highlights why or how PA may positively, or indeed negatively, affect students' subsequent on-task behaviour. The mixed-methods approach in this thesis, specifically from the qualitative interview data, have offered possible insights for such inter-individual discrepancies discovered in the quantitative data.

In relation to research question 2 *"What are student perceptions of their on-task classroom behaviour before and after a physically active lesson?",* students commonly reported perceiving there had been changes in their on-task levels between lessons before and after a physically active lesson. A number of students indicated changes in a similar direction and magnitude to changes recorded their observed on-task levels. Rather surprisingly, many students gave reasons for their perceived on-task percentages that were arguably independent of the PA-based lesson or PA influences with themes such as classroom format changes, differing lesson structure and enjoyment, preferences with regards to time of day, and whether or not they had an impending deadline, or they considered themselves to have completed all required work at that point. These responses appeared to feature no direct link to PA and when the students discussed these themes, they did not mention the PA or the PA lesson directly. Indeed, the inductive nature of the thematic analysis process surrounding the student interviews appeared to have led to an unexpected broadening of scope of the investigation away from a focus specific to physical activity as envisaged when constructing the original research questions that governed the thesis. This was a valued and conscious process outcome that led to a much more inclusive analysis of factors that affect students' on-task behaviours in the college's classrooms.

The most mentioned factors to explain variations in on-task behaviour between the lesson before and the lesson after was differences in classroom design, teaching style and activities set by the teacher. One would expect there to be research that explores the impact of these factors on on-task behaviour, but research is, in fact, limited and requires additional investigation (Godwin et al., 2013).

From the interview responses, there was no clear trend in terms of lesson format that was likely to increase on-task behaviour; instead, it was a matter of individual preference and other factors such as students self-perceived progress on completion of coursework assignments. Self-perceived progress appeared to both facilitate on-task behaviour in students who faced an impending deadline and decrease on-task behaviour in students who perceived they were ahead of schedule and knowingly procrastinated as a result. In other words, some students consciously decided to be off-task, rather than any factor inherently affecting their ability to be on-task. Herein lies an interesting and underexplored consideration in on-task behaviour research, a complex juxtaposition rarely acknowledged in the on-task behaviour literature which may interlink to more developed motivation and goal-setting theories (Worthen et al., 1994; Godwin et al., 2013). However, further exploration of this interesting construct was outside the scope of the semi-structured interviews and the study's research questions. In addition, linked to motivation, enjoyment of lessons was given as an important reason for variations in on-task behaviour, a factor that has been discussed in previous research (Godwin et al., 2013; Martin & Murtagh, 2017b). This study, therefore, concurs with literature that emphasises the importance of making learning enjoyable, even though this presents its own challenges, given that enjoyment is an ever-fluctuating construct and that teachers have to meet potentially unenjoyable learning objectives (Harris & Haydn, 2006; Goetz et al., 2006).

A smaller number of students mentioned reasons that can be arguably relatable to the PA and the PA-based lesson, such as varying levels of energisation, fatigue, and ability to concentrate and focus. In discussing these themes, students often concurrently referred to PA. Perceptions that PA can energise students' energy levels, focus and concentration have been reported in previous studies (see for example, Evans & Pellegrini, 1997; Caterino & Polak, 1999; Ferrer & Laughlin, 2017), yet more detailed studies into energisation mechanisms are necessary.

The most common student responses to how the PA might affect their classroom on-task behaviour largely centred on feelings of fatigue and tiredness engendered by the PA-based lesson. Such feelings of fatigue and tiredness from PA may not be a remarkable finding, yet the supplementary commentary given by students around how this fatigue affected on-task behaviour provided unexpected and novel insight. Of those students who reported fatigue as a factor, approximately half reported this would negatively impact on-task behaviour, yet potentially the more interesting and novel finding was the other half of those who reported fatigue as a factor, saw this as facilitating on-task behaviour in the lessons after PA. This was an unexpected and seemingly counter-intuitive finding. Several students seemed to be suggesting that they needed PA in the day to release surplus or stored-up energy, to be in an optimum frame of mind for being on-task. Some students explained further that fatigue made off-task behaviours less appealing, as students reported having less energy to 'mess-around' and also improvements in concentration.

When investigating the literature to explore possible explanations for these perceptions it was surprising how little is known about fatigue beyond physiological responses. In this study, those students who saw fatigue as having a positive effect often referred solely to physical fatigue, while those who reported that fatigue had a negative effect referred to both mental and physical fatigue. Negative fatigue comments were also associated to a lack of recovery time or cool-down after a PA-based session, interfering with students' ability to be on-task in subsequent lessons, possibly underscoring the importance/requirement of such practices for improved on-task behaviour.

Another finding was that students reported the time-of-day when a lesson occurred affected their on-task behaviours; this may be a feature of human diurnal circadian rhythms (McElroy & Mosteller, 2006; Montaruli et al., 2017). Early morning lessons were particularly highlighted as sub-optimal for on-task behaviour, which may reflect the adolescent aversion to early morning (Randler & Frech, 2006). As students were asked to compare the lesson before PA to the lesson after, their focus on time consideration may be expected. Yet, comparative quantitative observations on the control day showed that on-task behaviour in morning lessons was the same as that observed later in the day. Which raises questions about whether on-task behaviour was hindered in morning lessons.

Student interview responses also specifically helped address question 3: "*Do student reported perceptions offer possible explanations for their observed on-task behaviour?".* Many of the interview responses discussed possible rationalisations for a difference in on-task behaviour levels between the lesson before compared to the lesson after PA-based session. This proved highly valuable as if the thesis was monomethod with only the quantitative observation data like a number of previous studies, conclusions may have been made that the PA-based sessions were likely the predominant factor for the increased on-task behaviour levels witnessed. The interview data, however, identified a range of additional factors for consideration that further questioned the importance and the possible interrelations of PA to these factors on the apparent improvement of student on-task behaviour after the PA-based sessions. Within the current thesis design or interview responses, it was not possible to deduce the specific significance of PA in effecting on-task levels. Yet, students commonly identified other factors as seemingly primary reasons for variation in on-task behaviour, thus PA may not have been the principal factor or in itself have the power to override other such influential factors to on-task abilities. Especially where students appeared to be making more conscious decisions to be more on- or off-task. In such circumstances, for example, where a student decided to be more on-task due to an imminent deadline, it may be doubtful the presence of a PA-based lesson would fully compensate to similar levels of on-task behaviour without such a deadline. The interview data also did not appear to explicitly indicate an interrelation or synergy of these factors with PA. Student responses largely conversed factors as independent considerations for their on-task levels.

The differing mixed-methods perspectives from this research offers a more comprehensive picture of the interactions between PA and on-task behaviour. Reinforcing that numerous variables are likely to influence the amount of time-on-task students spend in lessons. What was unanticipated was that the most common explanations given by students were not directly related to the influence of PA or the PA-based lesson. This possibly indicates that although PA in the literature is shown as consistently effective in increasing on-task behaviour compared to a control, students themselves do not consider PA to be the most influential or important facilitating element in their on-task behaviour. The reason for these seeming anomalies in student responses is unclear, but it is possible that students reflected on the sedentary lessons as the question requested, rather than the PA-based lesson, so gave descriptive accounts around those lesson learning activities.

The current design is also vulnerable to the affects of novelty theory or distributed learning (Pellegrini & Davis, 1993; Seabrook et al., 2005), according to which a change in the environment and learning approach of the PA-based lesson cannot be discounted. However, the findings of this study contribute to the knowledge about on-task behaviours and provide some new insight into factors that may influence on-task behaviours in college classrooms, regardless of PA.

6.2 Practical Implications

This study offered a different perspective to previous studies involving purposefully designed PA interventions, due to the course subjects of students investigated (drama and sport) and thus the PA required no extra resourcing, time or modification of students' learning programmes, unlike much of the comparable research that involved purposefully designed PA intervention programmes in school populations. However, this may also be a weakness to this study's transferability to the wider college student population, as the sample was a non-random purposive sample of drama and sport students (see 3.3). Yet, in the absence of any comparable data and the reporting of similar trends witnessed in cross-curricular students from previous studies, the current study's outcomes may be applicable, but this is clearly an underlying consideration and limitation for the direct application of this data to whole college populations and indeed other college sites.

The freedom for teachers to implement PA as they saw fit may be advantageous as it allows teachers to make active classrooms their own, focusing on the needs of the curriculum and individual learners (Williams, 2009; Braniff, 2011). Piloting research with minimum inconvenience to students and teachers is arguably good ethical practice before there is indication or confidence of a positive affect. Even though some scholars have proposed sufficient evidence already exists to institute educational PA policies for improved academic outcomes (Brownson et al., 2010; Webster et al., 2013). If this is endorsed before definitive conclusions are established, it may be difficult to reverse any negative consequences and perceptions that may ensue, whether for staff or students (Hyatt, 2007; Howie & Pate, 2012).

Colleges by their nature have a captive audience and therefore, the opportunity to provide students with the information on how to lead active lives and to create positive PA experiences that improve on-task behaviour (Ferrer & Laughlin, 2017). PA has been shown to be related to the opportunities students have to be active and colleges may provide accessible PA environments as they often have specialised facilities, staff and equipment (Mahar, 2011; Webster et al., 2017; Dinkel et al., 2017). This is especially pertinent in the college studied as student PA opportunities have been noticeably eroded over the past 10-years to the point where extra-curricular opportunities for PA have almost become non-existent, primarily due to budgeting restraints from central government funding streams (Jones, 2013; Weale, 2018). Tangible examples of reductions include removal of almost all competitive college sports teams, closure of student access to the college gym and reduced sports staff. The findings from this study may provide a convincing case for reversing this trend and for retaining such PA opportunities in FE colleges.

Crucially, this thesis does not unequivocally advocate the implementation of 60-minute PA-based lessons in a college sports hall or drama studio to be 'rolled-out' to all classrooms in the FE sector. Rather, the foremost aim of this research is to validate further discussions of PA in college learning in three main areas: firstly, to invite teaching practitioners in colleges to experiment with PA around classroom learning; secondly, to encourage more practical research into how PA may benefit classrooms and be feasibly realised across college curriculums; thirdly, to stimulate further consideration at management and national-policy level in the FE sector about how the systematic implementation of PA opportunities might improve not only on-task behaviour and academic achievement, but also student health, well-being, and life-long PA. It is of the authors view that PA opportunities in FE colleges is important not only for the gains it may or may not bring to the classroom, but for the encouragement and adoption of life-long PA and associated benefits. Thus, in terms of practical implications, the next stage of this research could be the design and assessment of purposefully designed PA interventions for a wider range of college classrooms, since previous PA intervention programmes in on-task research have been designed for elementary and pre-schooler curriculums. It is hoped that the findings from this research might inform the creation of novel PA strategies that specifically consider the unique needs and acceptability for older adolescents (Martin & Murtagh, 2017a).

Acceptability to teachers is also crucial to any potential long-term sustainability (Martin & Murtagh, 2015). Teachers often complain about the time constraints they experience due to overloaded curriculum demands and expectations in meeting academic achievement targets (Coe et al., 2006; Gately et al., 2013; Carlson et al., 2017). Teachers in previous research about PA have indicated that they need more time to incorporate PA into their lesson plans (Gibson et al., 2008; Benes et al., 2016). Consequently, teachers may resist efforts to include PA in curriculum despite this being potentially a false economy, given the research evidence that active engagement through on-task behaviour can result in increased learning and academic achievement (Carroll, 1963; Marzano et al., 2010; Goh, 2017).

Benefits reported in this thesis are also more likely to be realised in colleges where PA is supported by senior management (Howie et al., 2014; McMullen et al., 2014; Dinkel et al., 2017). In the pursuit of increased academic outcomes, management are more likely to buy in to the concept of sacrificed teaching delivery time and adjusted workload models, so as to consider the need for teacher planning and also teacher autonomy in delivering PA (Carlson et al., 2017; Dinkel et al., 2017). Clearly, at this stage, such a move would be a 'leap-of-faith' and challenging for managers of FE colleges who have suffered severe fiscal constraints. Consequently, any standardised PA programme would ideally require no or minimal cost to be a viable and attractive option for college administrators (Choi & Cheung, 2016).

The effect seen in this study with 60-minute PAs was similar to the outcomes reported with much shorter ~10-minutes PA (Mahar et al., 2006; Goh et al., 2016). Logically, if a 10-minute PA had similar benefits in adolescent college classrooms, this would be more cost-effective and attractive to time-deprived teachers. Another suggested way to counter time constraints and restricted budgets may be to 'integrate' academic content and learning materials skilfully with PA, rather than 'adding' PA onto a curriculum (Gibson et al., 2008;

Goh et al., 2017). Teachers can then use PA within learning, to reinforce, revise, supplement and practice classroom taught learning material. However, in this regard, previous work from McMullen et al. (2014) and Benes et al. (2016) suggests that teachers sometimes lack the confidence in how to use PA to promote learning, and as a consequence may be reluctant to implement such approaches (Dinkel et al., 2017). Hence, it may be helpful for prospective trainee teachers in teacher education programmes, and current teaching staff through in-service training sessions, to be introduced to the benefits of integrating PA and provided with examples of how they can modify their own lessons to fit PA into learning, regardless of academic subject (Goh et al., 2017; Snyder et al., 2017). Riley et al.'s (2016) commentary claimed that integrating PA with learning in other subjects may also enhance connectedness for students by providing real-life applications of academic concepts, while Field et al. (2001) argue that movement anchors new information and experiences into the brain; however, there is limited evidence to support such claims of a specific connection between procedural knowledge and PA (Jensen, 2000).

As ecological PA was observed in this research, its findings may be more generalisable and transferable to similar real-world practice, such as UK secondary schools, where Physical Education (PE) lessons are mandatory and provide arguments to refrain from reducing PE time (Kubesch et al., 2009; Carlson et al., 2015). Such PA opportunities are not mandatory in the FE sector and consequently, it is perhaps then, this context that PA may be most beneficial. However, any policy recommendations would need to be evaluated and easily implementable by teachers, acceptable for adolescents and provide evidenced of its benefits in terms of improving a range of parameters including on-task behaviours, academic achievement and health/well-being (Goh et al., 2016; Wilson et al., 2016). Care is needed because getting this wrong could have a significant impact, as negative experiences of PA can lead to life-long sedentary behaviours (Goudas & Biddle, 1993; Troiano et al., 2008; Biddle et al., 2010; Dinkel et al., 2017).

Student responses reported in this thesis may also have implications for the structure of college days and the scheduling of PA opportunities. Colleges may want to consider later start times, as commonly students reported that lessons early in the morning hindered on-task behaviour. The results of this research also indicate that scheduling PA at the end of the day may be a missed opportunity in terms of harnessing the positive effects of PA for classroom on-task behaviour. Student interview responses additionally indicated teachers should consider cool-downs and transition activities from PA to sedentary lessons to minimise recovery issues and help students settle. With additional research, colleges and policy planners may be more encouraged to resource PA in the curriculum, if presented with persuasive evidence that it may not only help educational outcomes but also supplement other efforts to promote PA and well-being (Bublitz & Rhodes, 2017). This is particularly important as student well-being is becoming an increasingly important policy focus in education and a heightened external performance metric in the quality ratings of colleges (Ofsted, 2019).

6.3 Thesis Limitations

The author was a sports lecturer at the college investigated, aware of the previous research outcomes in this area and an advocate of PA, thus conceivably more likely to be inherently persuaded of the benefits of PA. Furthermore, as a child, the author had a history of off-task disruptive behaviour, resulting in exclusion from school and late in this doctoral journey was diagnosed as affected by ADHD, a disability that has been repeatedly shown to be positively affected by PA (Gapin et al., 2011). On reflection, enjoyment and enthusiastic participation in PA and sport may have inadvertently been part of a self-managed strategy to help the author’s behaviour and concentration, thus adding further unconscious bias in the research approach and interpretation of findings (Pontifex et al., 2013). However, several strategies were used in the research to limit bias effects, for example, the use of a secondary reviewer when thematically analysing the data, discussions with supervisors and the ethics process itself. Still, the likelihood of unconscious bias cannot be underestimated or eliminated and is perhaps a common limiting feature of many researchers investigating areas of personal interest (Denzin & Lincoln, 2017).

Potential for bias may have been exacerbated by the inability to blind the researcher or students to the conditions between control on COD and treatment on PAOD, thereby increasing the possibility of the Hawthorne effect in that students may have changed their behaviours because of an awareness that they were being observed in the classrooms by another member of teaching staff (Adair, 1984; McCarney et al., 2007; Burns et al., 2016). In an attempt to minimise these effects, the order of observations was counterbalanced, and each individual student group received between 20-30 observation sessions with the same observer. This may have worked to lessen the presence of the observer as a factor influencing student behaviour, but the disadvantages of Hawthorne effect are likely to persist throughout all observations (Weinrott et al., 1978; Goh et al., 2016).

Several limitations also exist around the sample used in this thesis. Firstly, the college was not randomly selected. Although single-site designs have been deployed in similar studies, the use of one UK FE college limits the generalisability of findings to other similar educational establishments (Martin & Murtagh, 2015; Carlson et al., 2017; Dinkel et al., 2017). Secondly, student interview responses are likely to have been affected by the specific culture of the college (Ma et al., 2014; Goh et al., 2017) and limited in scope to the perceptions of a relatively small number of homogeneous student groups from active subjects such as sport and drama. Thereby limiting the generalisability of the findings to other student groups and settings. Students featured in this thesis are those who agreed to participate and were from BTEC subjects that featured PA at their core, so these students may have been positively disposed to PA and to a degree, shapes the applicability of the thesis. Finally, the thesis was conducted in a region of the UK that is not particularly diverse. More research could be conducted in colleges with expanded diversity, including racial and ethnic make-up as well as a wider range of socio-economic levels, as these have been previously identified as factors influencing student behaviour (Mullender-Wijnsma et al., 2015; Burns et al., 2016; Massey et al., 2017; Bublitz & Rhodes, 2017). The limitations in the research design and analysis may restrict the study’s ability to make causal inferences about the impact PA on on-task behaviour in college students. However, the research was specifically designed to encompass a MM approach in attempt to generate deeper insights to further explain PA interactions with on-task behaviour rather than purely causal inference (Lincoln & Guba, 1985; Wiebelhaus & Fryer-Hanson, 2016; Webster et al., 2017).

The qualitative data focused on students' perceptions and it is known that there can be clear discrepancies between what is perceived by an individual and what is actual (Lichtenstein & Burton, 1989). Students were aware of the nature of the investigation and this may have further influenced their responses, particularly with media and government messages frequently promoting the positive benefits of PA (Wakefield et al., 2010). Furthermore, although the author did not lecture the students who participated, it is possible that in the future he would be assigned to teach one of their modules, so may be considered as being in a position of power over the participants (Fryer, 2004; Klein, 2012). This could have increased the intensity of the researcher effect in that students in the interview might have felt inclined towards giving information they thought the researcher wanted to hear (Haydn, 2014; Dinkel et al., 2017).

As discussed previously, the PA considered in this thesis was purposefully naturally occurring. This resulted in the researcher not having control over PA type (mode), duration or intensity; nor were these characteristics of PA formally recorded. In retrospect, it would have been valuable to document the PA-based lessons in more detail. As in interview, some students mentioned examples of PA modes, including circuit training, playing football and fitness tests, and some students claimed that the intensity of PA was a potential variable in terms of subsequent on-task behaviour. If this data had been systematically recorded this would have enabled further illuminating analysis to be carried out regarding on-task behaviour outcomes.

It also proved impossible to convert with any accuracy the Technogym Moves® produced by accelerometers to other commonly reported intensity units such as Metabolic Equivalents (Wilson et al., 2016). This was mainly due to the manufacturer not divulging the algorithms within the software to enable the conversion of recorded Technogym Moves®, despite being requested by the author. Making direct comparisons with similar accelerometer studies was therefore not possible, a disappointing limitation given that intensity, duration and mode of PA have been highlighted as possibly important for future research by a number of authors (Bartholomew & Jowers, 2011; Herman et al., 2013; Wilson et al., 2016).

Furthermore, the thesis neglected to monitor PA outside of the educational environment, such as cycling and walking to college and extracurricular sports, that could have contributed to the PA on observation days and therefore, skewed outcomes; however, the failure to monitor discrete or naturally occurring PA outside the interventions or educational institutions being researched is a common weakness of almost all related studies (Mahar et al., 2006; Sullivan et al., 2017). The principal reason why these aspects were not recorded in this study was that the devices that would have made this possible were costly and not owned by the author. On reflection, a PA recall or diary (Booth et al., 2002) could also have been used to try and capture a more complete picture of student PA in and around the college. This data in itself would have been insightful and original, due to the lack of research in this area.

Despite the presence of a repeated-measures design and control condition to strengthen the internal validity, interview responses highlighted several other possible confounders not anticipated by the author so not recorded or controlled, that students perceived as affecting on-task behaviour. For example, students reported differences between lesson types and the placing of assignment deadlines. These confounders highlight the complexity of doing research in real-world settings, where multiple factors can influence outcomes. The researcher was not able to control the content of teaching and learning either, nor perhaps was this ethically or ecologically desirable. Furthermore, it is arguably impossible and unrealistic to expect to be able to control all factors in applied settings, yet it cannot be ignored when reflecting on the interpretation and implications of findings (Howie et al., 2014; Burns et al., 2016).

6.4 Recommendations for Future Research

Given the paucity of ‘high-quality’ studies addressing the effect of PA on students’ on-task behaviours in differing contexts, more research is clearly needed, as unless teachers can identify how PA impacts learning and academic standards, they may resist adopting PA initiatives (Sullivan et al., 2017; Maykel et al., 2018). While trying to address the ‘why’ of PA effects, the present investigation addresses some methodological gaps in previous research, yet multiple avenues for further inquiry remain. During the doctoral journey more elementary and fundamental questions irrespective of PA interactions became apparent such as: what is the common mean on-task behaviour level in college classrooms and across differing colleges? What are the time course interactions of on-task behaviour through continuous lesson learning activities without a break and when does on-task behaviour decline? What time(s) in the learning day are optimum for adolescent on-task behaviour? What are the most dominant effecting characteristics such as classroom environment and lesson design? In addressing these questions, a database of research would be invaluable since currently, there are some commonly held beliefs but little classroom-based research to support them (Bunce et al., 2010). Such a database could be helpful for researchers but also for teachers and college planners to optimise on-task behaviour in colleges.

It is hoped that this research will provide a platform for more mixed-method studies to further explore some of the more interesting outcomes, such as the interactions of fatigue. Such studies could include teacher perspectives to provide further insight and illumination as well as triangulation (Stylianou et al., 2016b; Snyder et al., 2017; Dinkel et al., 2017). The absence of the teacher perspective may be viewed as a missed opportunity of the current research; however, the inclusion of teacher participants was rejected purposefully as the volume of data generated would have been too large within the constraints of the thesis and use of a single researcher.

Although the present investigation utilised a within-subjects counter-balanced design, there was still considerable variability in individual-level effects of the effects of PA on on-task behaviour at an individual level, as reported in the RCI data. Thus, further research is also necessary to better understand this data and the extent to which individual confounders may moderate effects between PA and on-task behaviour (Pontifex et al., 2015). For example, research could explore the potential differential interactions between genders and socio-economic groups to on-task behaviour. This could help determine which findings are replicable and incorporate more nuanced, evidence-based PA in colleges across differing districts and individuals (Carlson et al., 2015; Goh et al., 2017; Ferrer & Laughlin, 2017).

Future studies could also assess the same students over multiple days, so as to improve the robustness of trends and patterns of on-task behaviour and assess if the potential benefits from the current thesis results are sustained over a longer time period (Carlson et al., 2015; Bublitz & Rhodes, 2017). To examine the trajectories of any residual effects of PA in subsequent lessons, more research is also needed on the acute time-course effects of PA (Stylianou et al., 2016a; Goh et al., 2016; Bublitz & Rhodes, 2017). Related to time considerations, students in this study also reported that the placing of PA and lessons in the school day may have influenced their on-task behaviour. Assessment of on-task behaviour in terms of different timetable structures and placement of PA could better inform the optimal implementation of PA and placement of sedentary lessons (Wiebelhaus & Fryer-Hanson, 2016).

The researcher did not have any control over the intensity or type of PA in this research. Yet, interview responses in this thesis and subsequent studies since the commencement of data collection, indicate this as one of the most foremost considerations for future studies. Included in the type of PA is how the PA is concluded before transitioning to a sedentary lesson, as several students commented a lack of cool-down or ability to recover with threats to homeostasis were debilitating to on-task behaviour. Such studies on these aspects are needed to explore the interactions of differing forms of PA and would extend the current understanding of the required amount of PA (Stylianou et al., 2016a; Peruyero et al., 2017). Linked to optimum dose considerations, acceptability from students and teachers is paramount. Thus, future research should perhaps focus on smaller durations of PA and PA in or close to the classroom, with minimal extra resource requirements (Carlson et al., 2017).

Another area in need of further investigation is the transferability of any benefits of PA on-task behaviour to other academic performance outcomes in FE colleges such as standardised tests and grade outcomes. Such accountable improvements in academic performance would be critical in persuading educators to invest in college PA incentives (Stylianou et al., 2016b; Wiebelhaus & Fryer-Hanson, 2016). In addition, studies could be carried out to help determine whether PA that featured deliberate, content-based learning material alongside PA, could also help students learn and retain course information. Furthermore, although not a major focus of the current thesis, any PA intervention implemented in a college for improved learning could also be assessed for the efficacy of various health benefits, particularly given that only a small percentage of the UK adolescent population meet government daily PA guidelines (Ma et al., 2014; Scholes, 2016).

Finally, future research may benefit from the collaboration between differing subdisciplines for example neuroscience, educational psychology, and exercise science, so as to combine expertise in the prescription and measurement of PA in colleges. This is particularly important as the specific psycho-biological processes responsible for the effect of PA on classroom behaviour have yet to be identified (Jensen, 2000; Klein, 2004; Braniff, 2011; Li et al., 2017). All the aforementioned possible future research recommendations warrant comprehensive examination in the pursuit of developing informed guidelines for practitioners and a clear case for or against PA.

6.5 Personal Reflections on the Process of Engaging with the Research

Embarking upon this journey in the Faculty of Social Sciences has been hugely beneficial to my practice as a researcher, teacher and coach. At the beginning of the doctoral journey, I arrived from a stringently quantitative exercise science background and consequently, my ideas for 'best quality' research were firmly cemented in positivism. At the start of the process, my mindset and ideas were naïve, focusing on 'proving' that PA either helped or hindered academic achievement. Through engagement with my supervisors and the initial learning tasks of the doctorate, I rapidly had to reassess my understanding for the world of qualitative research, it was almost like having to re-learn all my previous educational assumptions. This has been extremely liberating as I feel I have now gained another set of tools with which to analyse the world around me. Consequently, there are many things I have learned from this process that have led me to make different decisions. For example, when I initially started, the quantitative data drove the study too much and on reflection, the quality and usefulness of the data from the interview responses were underestimated. The richness of the interview data, involving asking college students their reflections on why they were more or less on-task in the two observed lessons, could have been the sole focus of the study, enabling extension and refinement of the data analysis. At the same time, the value of the quantitative data in this mixed-methods research is considerable and has allowed the comparison of student perceptions against observable behaviours, thereby offering a more complete analysis. Overall, the process has been truly the hardest and most beneficial journey I have undertaken to develop as a person and a professional.

6.6 Concluding Comments

Findings that suggest that PA can increase on-task behaviour are important as teachers commonly complain about deteriorating student concentration and behaviours (Caterino & Polak, 1999; Maykel et al., 2018). Off-task behaviour has the potential to limit learning time and opportunities, creating an unfavourable learning environment for others, all of which can negatively affect academic achievement measures such as grade outcomes, which are an increasingly important part of quality assessment in colleges (Ofsted, 2012; Dickinson et al., 2016; Maykel et al., 2018; Stoepker et al., 2018).

The evidence from this thesis adds to the growing body of literature that provides justification for policymakers, academic leaders and teachers to invest in of PA initiatives. Specifically in the pursuit of enhanced on-task behaviour in FE colleges and with adolescent populations that may also compliment the already acknowledge health and wellbeing benefits of PA. These findings contradict the regularly encountered staff room discussions that kick-started this research, namely that PA-based lessons inhibited subsequent lessons on-task behaviour. It may be that these teacher comments were in fact reflecting the initial transition problems students reported between lessons and once students are settled on-task behaviour may increase. Consequently, there may be added value in applying the current study's findings to teacher training and college CPD sessions to encourage reflection on practice and professional discussion.

At the same time, considering the benefits of PA only in relation to on-task behaviour is somewhat reductive and threatens to exclude the potential wider benefits of PA to classrooms and students (Benes et al., 2016). For example, others have found that students who participate in PA have an improved attitude towards education (Sadler et al., 1993; Basch, 2011) and incorporating PA in the college day has also been found to have a positive impact on students' overall health and wellbeing (Ma et al., 2014; Goh et al., 2017; Ferrer & Laughlin, 2017; Maykel et al., 2018). These supplementary factors should not be overlooked when considering the potential benefits of increasing PA in colleges.

Despite these and previous research findings regarding the benefits of PA, the amount of time available for PA is decreasing in educational settings (Blatchford & Sumpner, 1998; Kubesch et al., 2009). At the same time, government recommendations advocate the avoidance of extended periods of sitting (NHS, 2013; Finn & McInnis, 2014), a familiar occurrence in college classrooms, where students are expected to sit for long periods of time and be passive. Furthermore, world health organisations have advocated for increased PA opportunities through comprehensive whole-school approaches (Dinkel et al., 2017). Colleges should arguably also evolve and develop opportunities for PA, as a tool to enhance not only student learning but also their health and wellbeing, as part of meeting society's ever-changing priorities, demands and needs.

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Appendix 1 – Student Interview Questions

1. “Explain and read-aloud definition below:

“On-task behaviour includes verbal and motor behaviour that follows the rules of the classroom and is appropriate to the academic activity given by the teacher. Examples of on-task behaviour might include: actively working quietly at one’s desk, engaging in group learning activities, responding to teacher questions, and engaging in subject-relevant conversation when appropriate.” i.e are you following what the teacher would expect you to be doing?

2. “Considering the two lessons I came in and observed your class today, what percentage of time do you consider yourself on-task in the first/second lesson?”

3. “And the first/second lesson?”

4. “why is that?” (Explain reasoning for response to question 2 & 3)”

5. “In general, and not just including today’s lessons, does a physically active lesson affect your ability to be on-task in the following lesson after?”

6. “How/why is that? (Explain reasoning for response to question 5.)”

7. Do you have any other feelings, thoughts, comments or opinions around physical activity and on-task classroom performance?

8. Is there anything else like to add….

Appendix 2 – Consent Letters

Dear Potential Study Participant,

"Physical activity's effects on the classroom in UK Further Education Colleges".

I am writing to you about the research I am conducting as part of my Doctorate of Education (Ed. D) at the University of East Anglia (UEA).

I am interested in the effect physical activity may have on students and the classroom in UK Further Education Colleges. An emerging body of evidence appears to support increased physical activity (PA) positively effecting academic achievement/performance outcomes, quantified by factors such as attendance, standardised examinations and academic grade results However, only a limited number of investigations directly investigate PA's effect on the classroom environment. These limited number of studies appear to further support PA demonstrating positive outcomes in learning environment; however, typically feature primary school children, with no published studies focusing on adolescents. Through classroom observations and student and teacher interviews I aim to further examine the relationships between physical activity and classroom performance in UK Further Education Colleges.

It would be very helpful if you could take part in my research. Please read the information sheet attached to this letter and, if you are willing to take part in this study, please sign and return the consent form enclosed. There is no expectation or requirement for you to take part as participation is entirely voluntary.

If you have any further questions about the research, please contact me on: Jimmy.Hupton@uea.ac.uk. If you have any concerns about the research please contact my supervisor: Dr. Victoria Warburton, Victoria.Warburton@uea.ac.uk.

Yours sincerely,

J. Hupton

Jimmy Hupton

UEA Ed. D Research Student

INFORMATION SHEET

<u>"Perceptions and observations of physical activity's effects on the classroom in UK Further Education Colleges".</u>

Researcher: Jimmy Hupton
Supervisor: Dr. Victoria Warburton

I would like to invite you to take part in my research and I need your signed consent if you agree to participate. Before you decide, you need to know why I am doing this research and what it will involve. Please take time to read this information carefully to help you decide whether or not to take part. Please contact me if there is anything that is not clear or if you would like more information. Thank you for reading this.

What is this study about?

I am trying to find out more about the ways in which physical activity (PA) may affect learning performance during the college day. Currently, it is unknown whether PA has any effect on learning in UK College Students

How will you be involved?

(Delete as appropriate dependent on RQ's the student/teacher may be participating).

RQ1: You will have your height, body weight, age and sex on initial consultation recorded. You will be observed in a natural classroom environment recording time spent on- and off-task behaviours. I will also be recording the number of verbal teacher directions in your class. There will be a minimum of four separate classroom observations in which you may be observed. You will also be asked to wear a HR monitor, pedometer or accelerometer device during part of a college day to record physical activity.

RQ2: You may be asked to attend a one-to-one interview with questioning focusing on your perceptions of how physical activity may or may not affect your learning and the classroom environment. This will require approximately 10minutes on one occasion only, at a time and location on the college campus that is agreeable to you. The interview will be audio recorded and the contents analysed for themes across a number of participant interviews. All interviews will be anonymous.

Who will have the access to the research information (data)?

Data management will follow the 1998 Data Protection Act. I will not keep information about you that could identify you to someone else. All the names of individuals taking part in the research and the college(s) will be anonymised to preserve confidentiality. Any data linking individuals will be stored safely and will be fully destroyed when my project is completed 01/12/2016. Data will only be seen by myself, my supervisor, and those who mark my work.

The fully anonymised data will be used for my work towards Ed.D thesis and maybe published in an academic journal.

Who has reviewed the study?

The research study has been approved under the regulations of the University of East Anglia's School of Education and Lifelong Learning Research Ethics Committee.

Who do I speak to if problems arise?

If there is a problem please let me know. You can contact me via the University at the following address:

Jimmy Hupton
School of Education and Lifelong Learning
University of East Anglia
NORWICH NR4 7TJ
Jimmy.Hupton@uea.co.uk

If you would like to speak to someone else you can contact my supervisor:
Dr. Victoria Warburton, Victoria.Warburton@uea.ac.uk.

If you have any complaints about the research, please contact the Head of the School of Education and Lifelong Learning, Dr Nalini Boodhoo, at N.Boodhoo@uea.ac.uk.

OK, I want to take part – what do I do next?

You need to fill in one copy of the consent form and return by hand to Jimmy Hupton. Please keep the letter, information sheet and the 2nd copy of the consent form for your information.

Can you change your mind?

Yes. You have the right to withdraw from the research at any time, without the need to supply a reason. This entitlement will cease once data synthesis and analysis is complete on 01/05/2017.

Thank you very much for your time.

CONSENT FORM

(1ST COPY FOR RETURN TO RESEARCHER)

“Perceptions and observations of physical activity’s effects on the classroom in UK Further Education Colleges”.

I have read the information about the study and been offered the opportunity to ask any pertaining questions.

Please tick the relevant box.

I am willing to take part in the study. ☐

I am not willing to take part in the study. ☐

I am willing to be audio recorded as part of the study. ☐

Your Name: ……………………………………

Your Signature: ………………………………………………………….

Date: ……………………………………………..

CONSENT FORM

(2ND COPY FOR YOUR RECORDS)

“Perceptions and observations of physical activity’s effects on the classroom in UK Further Education Colleges”.

I have read the information about the study and been offered the opportunity to ask any pertaining questions.

Please tick the relevant box.

I am willing to take part in the study. ☐

I am not willing to take part in the study. ☐

I am willing to be audio recorded as part of the study. ☐

Your Name: ……………………………………

Your Signature: ………………………………………………………….

Date: ……………………………………………..

Dear Parent/Guardian,

<u>"Physical activity's effects on the classroom in UK Further Education Colleges".</u>

I am writing to you about the research I am conducting as part of my Doctorate of Education (Ed.D) at the University of East Anglia (UEA).

I am interested in the effect physical activity may have on students and the classroom in UK Further Education Colleges. An emerging body of evidence appears to support increased physical activity (PA) positively effecting academic achievement/performance outcomes, quantified by factors such as attendance, standardised examinations and academic grade results However, only a limited number of investigations directly investigate PA's effect on the classroom environment. These limited number of studies appear to further support PA demonstrating positive outcomes in learning environment; however, typically feature primary school children, with no published studies focusing on adolescents. Through classroom observations and student and teacher interviews I aim to further examine the relationships between physical activity and classroom performance in UK Further Education Colleges.

I have approached the College your child attends and explained the purpose of the study, and the College has kindly agreed to distribute these letters to you.

Please read the information sheet attached to this letter. You will see that my research involves observation of pupils during normal lessons and there will be no direct contact with any of the children during lessons. For anthropometric measurements students will be invited to attend an allocated session away from the class outside of timetabled lessons, in small groups of up to 5 to help preserve anonymity of those who do not opt-in, the class teacher/tutor will also be in attendance in these sessions. This session is expected to take approximately 5minutes where height will be recorded with shoes only removed using a wall mounted stadiometer, body weight will also be monitored fully clothed with shoes removed standing on a set of scales. Body Composition (lean body mass versus fat percentage) will be measured using industry standard bioelectrical-impedance devices. Some students will be asked to attend a short 10minute interview in an open environment at the college asking questions on PA and learning. I hope therefore that you will agree to your child being involved in my research.

If you have any further questions about the research, please contact me on: Jimmy.Hupton@uea.ac.uk. If you have any concerns about the research please contact my supervisor: Dr. Victoria Warburton, Victoria.Warburton@uea.ac.uk.

If you would prefer that your child does not take part, please sign and return the form enclosed.

Yours sincerely,

J. Hupton

Jimmy Hupton

UEA Ed. D Research Student

Appendix 2 – Consent Letters

INFORMATION SHEET

<u>"Perceptions and observations of physical activity's effects on the classroom in UK Further Education Colleges".</u>

Researcher: Jimmy Hupton

Supervisor: Dr. Victoria Warburton

I would like to invite you to take part in my research and I need your signed consent if you agree along with your son/daughter to participate. Before you decide, you need to know why I am doing this research and what it will involve. Please take time to read this information carefully to help you decide whether or not to take part. Please contact me if there is anything that is not clear or if you would like more information. Thank you for reading this.

What is this study about?

I am trying to find out more about the ways in which physical activity (PA) may affect learning performance during the college day. Currently, it is unknown whether PA has any effect on learning in UK College Students

How will my child be involved?

RQ1: I will record student height, body weight, age and self-reported sex on initial consultation. Your child will be working in a normal lesson and your child's learning will not be modified or affected in any way. I will be observing the class and taking written notes recording when students in the lesson are on or off-task. I will also be recording the number of teacher directions to the class. There will be a minimum of three separate classroom observations in which observation may occur. Students may be required to wear a HR monitor, pedometer or accelerometer device during part-of a college day.

RQ2: I will interview participant's one-to-one questioning perceptions of physical activity and learning. This will require approximately 10minutes on one occasion only, at a time and location on college campus that is agreeable to the participant. The interview will be audio recorded and the contents analysed for themes across a number of participant interviews. All interviews will be anonymous.

Who will have the access to the research information (data)?

Data management will follow the 1998 Data Protection Act. I will not keep information about your child that could identify them. All the names of individuals taking part in the research and the college(s) will be anonymised to preserve confidentiality. Any data linking individuals will be stored safely and will be fully destroyed when my project is completed 01/12/2016. Data will only be seen by myself, my supervisor, and those who mark my work.

The fully anonymised data will be used for my work towards Ed.D thesis and maybe published in an academic journal.

Who has reviewed the study?

The research study has been approved under the regulations of the University of East Anglia's School of Education and Lifelong Learning Research Ethics Committee.

Who do I speak to if I have questions about this research?

If there is any questions please let me know. You can contact me via the University at the following address:

Jimmy Hupton

School of Education and Lifelong Learning

University of East Anglia

NORWICH NR4 7TJ

Jimmy.Hupton@uea.co.uk

If you would like to speak to someone else you can contact my supervisor:

Dr. Victoria Warburton, Victoria.Warburton@uea.ac.uk.

If you have any complaints about the research, please contact the Head of the School of Education and Lifelong Learning, Dr Nalini Boodhoo, at N.Boodhoo@uea.ac.uk.

What do I do next?

If you are happy for your child to be involved in my research please complete one copy of the attached form and return the form to college and ask your child to hand to their tutor in an envelope marked F.A.O Jimmy Hupton. Please keep the letter, information sheet and the 2nd copy of the form for your information.

Can you change your mind?

You and your child have the right to withdraw from the research at any time without need to supply a reason. This entitlement will cease once data synthesis and analysis is complete on 01/05/2016.

Thank you very much for your time.

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PARENT OPT-OUT FORM

(1ST COPY FOR RETURN TO RESEARCHER)

<u>"Physical activity's effects on the classroom in UK Further Education Colleges".</u>

I have read the information about the study and talked about this with my child.

Please tick the box below.

I am willing for my child to take part in the study. ☐

I am not willing for my child to take part in the study. ☐

Name of child: ……………………………………

School: …………………………………………….

Class: ……………………………………………..

Signature of parent/guardian: ………………………………………………………….

Date: ……………………………………………..

PARENT CONSENT FORM

(2ND COPY FOR PARENT/GUARDIAN RECORDS)

<u>“Physical activity’s effects on the classroom in UK Further Education Colleges”.</u>

I have read the information about the study and talked about this with my child.

Please tick the relevant box.

I am willing for my child to take part in the study. ☐

I am not willing for my child to take part in the study. ☐

Appendix 2 – Consent Letters

Name of child: …………………………………

School: …………………………………………….

Class: ……………………………………………..

Signature of parent/guardian: ………………………………………………………….

Date: ……………………………………………..

Appendix 3 – Ethics Application

UNIVERSITY OF EAST ANGLIA
SCHOOL OF EDUCATION AND LIFELONG LEARNING RESEARCH ETHICS COMMITTEE

APPLICATION FOR ETHICAL APPROVAL OF A RESEARCH PROJECT

This form is for all staff and students in the School of Education who are planning research. Applicants are advised to consult the school and university guidelines before preparing their application by visiting http://www.uea.ac.uk/rbs/rso/research_ethics/index.htm and reading the EDU Research Ethics Handbook. Staff and Postgraduate (PGR) student applications (including the required attachments) must be submitted electronically to Dawn Corby d.corby@uea.ac.uk, two weeks before a scheduled committee meeting. Undergraduate students and other students must follow the procedures determined by their course of study.

The Research Ethics page of the EDU website provides links to the University Research Ethics Committee, the UEA ethics policy guidelines, ethics guidelines from BERA and the ESRC, and resources from the academic literature, as well as relevant policy updates: www.uea.ac.uk/edu/research/researchethics. If you are involved in counselling research you should consult the BACP Guidelines for Research Ethics: www.bacp.co.uk/research/ethical_guidelines.php.

Applications must be approved by the Research Ethics Committee before beginning data generation or approaching potential research participants.

1. APPLICANT DETAILS	
Name:	Jimmy (James) Hupton
School:	Edu
Current Status:	PGR Student
If PGR Student, name of primary supervisor and programme of study: Victoria Warburton and Ed.D	
If UG student or other student, name of Course and Module:	
UEA Email address:	Jimmy.Hupton@ccn.ac.uk

2. PROPOSED RESEARCH PROJECT DETAILS:

Title:	"Physical activity's effects on the classroom in UK Further Education Colleges".
Start/End Dates:	May 2014 – December 2016

3. FUNDER DETAILS (IF APPLICABLE):	
Funder:	XXXXX – Part Tuition Fees
	Has funding been applied for? NO Application Date:
	Has funding been awarded? N/A
Will ethical approval also be sought for this project from another source? NO	
	If "yes" what is this source?

4. APPLICATION FORM FOR RESEARCH INVOLVING HUMAN PARTICIPANTS:

4.1 Briefly outline your research focus and questions or aims (no more than 300 words).

An emerging body of evidence appears to support increased physical activity (PA) positively effecting academic achievement/performance outcomes, quantified by factors such as attendance, standardised examinations and academic grade results(Telford et al., 2012; Lambourne et al., 2013; Donnelly et al., 2013). Psychosocial improvements are also found in the literature (DeBate et al., 2009; Biddle & Asare, 2011), including an increased level of self-esteem and connectedness in schools, purportedly encouraging retention (Melnick et al., 1992; Stead & Nevill, 2010; Rasberry et al., 2011). However, conclusive inference between cognition, PA, classroom behaviour and AA has not been fully derived (Howie & Pate, 2012), and results from the few available prospective studies on this topic are inconsistent (Stead & Nevill, 2010; Donnelly et al., 2013). Many of the published studies involve large-scale cross-sectional correlation analysis, with only a limited number of investigations directly investigating PA's effect on the classroom environment(Mahar et al., 2006; Morgan & Hansen, 2008; Mahar, 2011; Herman et al., 2013). These studies appear to further support PA demonstrating positive outcomes in learning environment (Maeda & Randall 2003; Verret et al. 2012); however, typically feature primary school children, with no published studies focusing on adolescent classroom behaviour and PA. The relationship between PA and classroom behaviour and performance currently requires further scrutiny after some promising initial findings.

Aim: "To examine the relationships between physical activity and classroom performance in UK Further Education Colleges".

From the aim and analysis of the current literature two principle research questions are to be addressed:

RQ1. How does PA affect subsequent student on-task behaviour?
RQ2. What are teacher and student perceptions of PA on the classroom and learning?

4.2 Briefly outline your proposed research methods, including who will be your research participants and where you will be working (no more than 300 words).

A mixed-methods case study design.

Method 1: RQ1. How does PA affect subsequent student on-task behaviour?

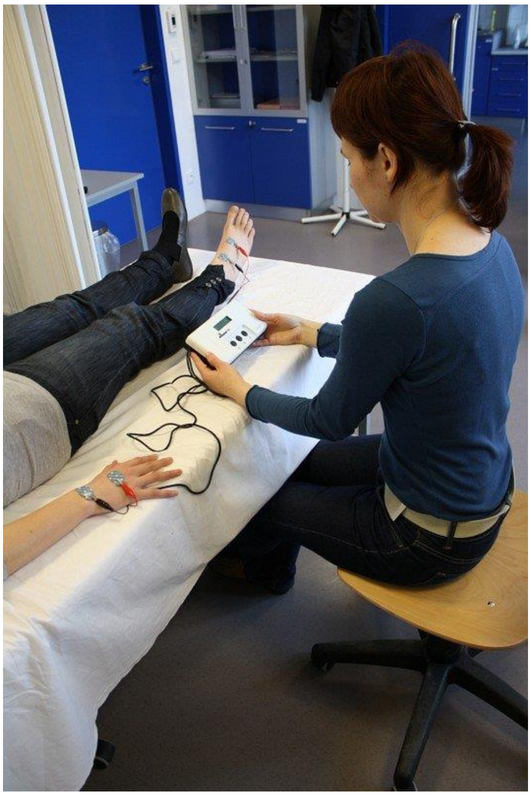
Participants
>90 Further Education (FE) college students aged 16-19 will be observed for a minimum of four separate occasions: prior, immediately after, a 60minutes occurring lesson involving physical activity (PA) of ≥3 metabolic equivalents and on a control day. Activity levels will be monitored using heart rate monitoring straps, pedometers and/or accelerometers. Anthropometric measurements of Height (Cm), weight (Kg), body composition (using industry standard bioelectrical-impedance devices) sex, and age will be recorded after completion of informed consent and Physical Activity Readiness Health-Screening Questionnaire (PAR-Q). This data will allow comparisons to similar studies.

For the anthropometric measurements students will be invited to attend an allocated session away from the class outside of timetabled lessons, in small groups of up to 5 to help preserve anonymity of those who did not opt-in, the class teacher/tutor will also be in attendance in these sessions. This session is expected to take approximately 5minutes where height will be recorded with shoes only removed using a wall mounted stadiometer, body weight will also be monitored fully clothed with shoes removed standing on a set of scales. Body Composition will be measured using only one of the following methods:

Omron body fat monitor bf306 (Omron, NL) holding it out in front of the student for 90seconds as per instructions see example diagram below:

http://www.omron-healthcare.com/eu/en/our-products/weight-management/bf306

Or using a body stat 1500 (Bodystat, UK) as per instructions where the participant lays on a treatment table and has an electrode attached to their right hand and there right foot, see image below. http://www.bodystat.com/Corporate/Corporate/home.aspx



Body stat is deemed more accurate but is marginally more time consuming.

All methods are non-invasive, standard procedures, using equipment endorsed by British Association Of Exercise Scientists (BASES) laboratory equipment and performed fully clothed with only footwear removed. This data is consistent with similar investigations and is required to allow direct comparisons to other studies as these measurements are a key indirect measure of long-term energy balance of participants.

Classroom performance through on-task behaviour will be measured using a concurrent amalgamation of methods from Mahar et al. (2006) and Herman et al. (2013). Pilot observations on 12 students will occur to check the validity of the combined approach.

The method will involve a 30minute observation period; the observer assesses on- and off-task behaviour of six students (equating to 5minute per student). The observer, will also record frequency of disciplinary corrective words (DCW) from the teacher that were directed at individual students or the class as a whole.

Score for on-task behaviour is a percentage of 15second intervals in which on-task behaviour occurred during the 5-min observation period (Mahar et al., 2006). Total DCW instances will be quantified. Data will be analysed using SPSS.

Method 2: RQ2. What are teacher and student perceptions of PA on the classroom and learning?

Semi-structured interviews of ~25 FE College students and ~25 FE College teachers on a one-to-one basis. An interview framework will guide questioning. Each interview is expected to take a maximum of 10 minutes to conduct. All interviews will be audio-voice recorded, transcribed and analysed through a thematic analysis inductive approach and the use of coding.

A voluntary debrief will be included at the end of the process to explain some of the findings to participants.

4.3 Briefly explain how you plan to gain access to prospective research participants. (no more than 300 words).

- **If children/young people (or other vulnerable people, such as people with mental illness) are to be involved, give details of how gatekeeper permission will be obtained.**
- **Is there any sense in which participants might be 'obliged' to participate – as in the case of students, prisoners or patients – or are volunteers being recruited? Entitlement to withdraw consent must be indicated and when that entitlement lapses.**

Letters/emails will be sent to the principles, head teachers and/or senior manager of local colleges. Access will be gained after combined signed consent of college principle/senior management, line manager and finally teaching staff. The researcher will then offer a short presentation of the project outline to student groups and invite opportunity for consenting student volunteers.

Students' feelings of obligation to take part will be minimised by fully explaining to each group they have the right not to take part and no expectation exists for them to take part. All participation will be through opt-in consent and informed consent will be sought by every participant with a signature.

No vulnerable individual's, for example those under-16 or with a diagnosed intellectual disability will take part. It will be deemed acceptable for participants to give full-informed consent commensurate with their age, maturity and extremely low level of risk or severity of negative consequence from these procedures even though some will be under-18 (BERA, 2005; Watson & Boodhoo, 2013). This will also be agreed with consent from college senior management. If senior management require parental consent, this too will be pre-requisite for participation (opt-in).

It will also be highlighted to participants that volunteers are entitled to withdraw from the study at any stage, without need to supply reason; they will also be informed that this entitlement will cease once compete data synthesis and analysis is finalised on 01/05/2016.

4.4 Please state who will have access to the data and what measures will be adopted to maintain the confidentiality of the research subject and to comply with data protection requirements e.g. will the data be anonymised? (No more than 300 words.)

All data will be anonymised. Only the researcher and supervisor will have access to the data. All data will be stored on computers or portable drives that will be password encrypted. All data will be stored under lock and key. Quantitative data will feature means with standard deviations and pseudonyms used with protected names and locations. All data will be handled according to the Data Protection Act (1998).

4.5 Will you require access to data on participants held by a third party? In cases where participants will be identified from information held by another party (for example, a doctor or school) describe the arrangements you intend to make to gain access to this information (no more than 300 words).

No.

4.6 Please give details of how consent is to be obtained (no more than 300 words).

Copies of proposed information sheets and consent forms, written in simple, non-technical language, MUST accompany this proposal form. You may need more than one information sheet and consent form for different types of participants. (Do not include the text of these documents in this space).

Consent for RQ1 and 2 will be via informed consent letter attached. See also 4.3.

4.7 If any payment or incentive will be made to any participant, please explain what it is and provide the justification (no more than 300 words).

None

4.8 What is the anticipated use of the data, forms of publication and dissemination of findings etc.? (No more than 300 words.)

For Ed.D thesis and intention of publishing at least one peer-reviewed journal article.

4.9 Will the data or findings of this research/project be made available to participants? If so, specify the form and timescale for feedback. What commitments will be made to participants regarding feedback? How will these obligations be verified? (No more than 300 words.)

Yes, if published, participants who opt-in to be notified, will be emailed a link to the journal.

4.10 Please add here any other ethical considerations the ethics committee may need to be made aware of (no more than 300 words).

N/A

PLEASE NOTE THAT THE FOLLOWING QUESTIONS SHOULD BE COMPLETED ONLY IF THEY APPLY TO THIS RESEARCH. THEY MAY NOT BE APPLICABLE.

4.11 What risks or costs to the participants are entailed in involvement in the research/project? Are there any potential physical, psychological or disclosure dangers that can be anticipated? What is the possible benefit or harm to the subject or society from their participation or from the project as a whole? What procedures have been established for the care and protection of participants (e.g. insurance, medical cover) and the control of any information gained from them or about them?

No significant risks or cost have been identified.

RQ1 will be overt observation in a natural setting so no costs will be incurred to participants. During observations the observer will position themselves in an inconspicuous place to minimise any interference with the classroom.

In RQ2 cost to participants is only time (~10minutes), travel cost will not feature as the process will take place at the subjects' place of work/study at a time convenient to them.

No identifiable potential for harm to subjects is expected to arise from this project. There is potential for psychological anxiety in participants who are observed, but this will be limited by requesting volunteers, supplying informed consent, allowing participants the right to withdraw without having to supply a reason and observer working in an open and professional manner.

Adolescence is a vulnerable development period for life-long sedentary habits and associated negative consequences of physical inactivity. If PA influences academic attainment this has implications for stronger rationale for college policy changes to offer physical activity opportunities to students, which could improve elements of student health, wellbeing, enjoyment and academic statistics. Conversely, potential for harm could arise that PA shows detrimental effect on classroom performance; however, almost all studies-to-date indicate improvement or no change. Colleges are potentially an opportunistic and worthy environment to maximise PA health behaviours in adolescents, this may lead to increased lifelong adoption of positive PA habits.

Procedures that have been established for the care and protection of participants include:

Informed consent
Right to withdrawal

Research adhering to ethical codes (BERA and UEA)
Contact details of researcher and supervisor to raise private concerns
Information and contact details for complaints to UEA
xxxxxxx Public Liability Insurance
UEA Research Liability Insurance

All information will be held in strictest confidence and in accordance with the Data Protection Act (1998).

4.12 Comment on any cultural, social or gender-based characteristics of the participants which have affected the design of the project or which may affect its conduct.

N/A

4.13 Identify any significant environmental impacts arising from your research/project and the measures you will take to minimise risk of impact.

N/A

4.14 Please state any precautions being taken to protect your health and safety. Have you taken out travel and health insurance for the full period of the research? If not, why not. Have you read and acted upon FCO travel advice (website)? If acted upon, how?

Risk assessments have already been complied by institutions for the PA and College environments. Copies of these will be sought.

4.15 Please state any precautions being taken to protect the health and safety of other researchers and others associated with the project (as distinct from the participants or the applicant).

Secondary observers will be involved to pilot and verify the method validity of combining two methods only. All data will be the researchers own in the final analysis for Ed. D thesis submission.
No distinct H&S concerns require reporting around these associated persons who will also be DBS checked. All observers will be passive and not influence the class (other than the presence of body).

4.16 The UEA's staff and students will seek to comply with travel and research guidance provided by the British Government and the Governments (and Embassies) of host countries. This pertains to research permission, in-country ethical clearance, visas, health and safety information, and other travel advisory notices where applicable. If this research project is being undertaken outside the UK, has formal permission/a research permit been sought to conduct this research? Please describe the action you have taken and if a formal permit has not been sought please explain why this is not necessary/appropriate (for very short studies it is not always appropriate to apply for formal clearance, for example).

N/A

4.17 Are there any procedures in place for external monitoring of the research, for instance by a funding agency?

N/A

5. DECLARATION:

Please complete the following boxes with YES, NO, or NOT APPLICABLE:

I have read (and discussed with my supervisor if student) the University's Research Ethics Policy, Principle and Procedures, and consulted the British Educational Research Association's Revised Ethical Guidelines for Educational Research and other available documentation on the EDU Research Ethics webpage and, when appropriate, the BACP Guidelines for Research Ethics.	Yes
I am aware of the relevant sections of the Data Protection Act (1998): http://www.hmso.gov.uk/acts/acts1998/19980029.htm and Freedom of Information Act (2005).	Yes
Data gathering activities involving schools and other organizations will be carried out only with the agreement of the head of school/organization, or an authorised representative, and after adequate notice has been given.	Yes
The purpose and procedures of the research, and the potential benefits and costs of participating (e.g. the amount of their time involved), will be fully explained to prospective research participants at the outset.	Yes
My full identity will be revealed to potential participants.	Yes
Prospective participants will be informed that data collected will be treated in the strictest confidence and will only be reported in anonymised form	Yes
All potential participants will be asked to give their explicit, written consent to participating in the research, and, where consent is given, separate copies of this will be retained by both researcher and participant.	Yes
In addition to the consent of the individuals concerned, the signed consent of a parent/carer will be required to sanction the participation of minors (i.e. persons under 16 years of age).	Yes
Undue pressure will not be placed on individuals or institutions to participate in research activities.	Yes
The treatment of potential research participants will in no way be prejudiced if they choose not to participate in the project.	Yes
I will provide participants with my UEA contact details (*not* my personal contact details) and those of my supervisor, in order that they are able to make contact in relation to any aspect of the research, should they wish to do so. I will notify participants that complaints can be made to the Head of School.	Yes
Participants will be made aware that they may freely withdraw from the project at any time without risk or prejudice.	Yes
Research will be carried out with regard for mutually convenient times and negotiated in a way that seeks to minimise disruption to schedules and burdens on participants	Yes

At all times during the conduct of the research I will behave in an appropriate, professional manner and take steps to ensure that neither myself nor research participants are placed at risk.	Yes
The dignity and interests of research participants will be respected at all times, and steps will be taken to ensure that no harm will result from participating in the research	Yes
The views of all participants in the research will be respected.	Yes
Special efforts will be made to be sensitive to differences relating to age, culture, disability, race, sex, religion and sexual orientation, amongst research participants, when planning, conducting and reporting on the research.	N/A
Data generated by the research (e.g. transcripts of research interviews) will be kept in a safe and secure location and will be used purely for the purposes of the research project (including dissemination of findings). No-one other than research colleagues, professional transcribers and supervisors will have access to any identifiable raw data collected, unless written permission has been explicitly given by the identified research participant.	Yes
Research participants will have the right of access to any data pertaining to them.	Yes
All necessary steps will be taken to protect the privacy and ensure the anonymity and non-traceability of participants – e.g. by the use of pseudonyms, for both individual and institutional participants, in any written reports of the research and other forms of dissemination.	Yes

I am satisfied that all ethical issues have been identified and that satisfactory procedures are in place to deal with those issues in this research project. I will abide by the procedures described in this form.

Name of Applicant:	Jimmy Hupton
Date:	20/03/2014

PGR Supervisor declaration (for PGR student research only)

I have discussed the ethics of the proposed research with the student and am satisfied that all ethical issues have been identified and that satisfactory procedures are in place to deal with those issues in this research project.

Name of PGR Supervisor:	**Victoria Warburton**
Date:	**29/04/2014**

6. ATTACHMENTS:

The following should be attached to your application as necessary – please indicate if attached and list any additional materials:

X Project Information Sheet (for participants)
X Participant Consent Forms
Other Supporting Documents

Appendix 4 – Ethics Approval

Jacqueline Watson (EDU) XXXXX@uea.ac.uk

Wed 04/06/2014 17:34

Dear Jimmy,

Thank you for your carefully amended ethics application. This was discussed at the EDU research ethics committee today and it was approved. You can now begin your research.

With best wishes, Jackie

Dr Jacqueline Watson
Chair EDU Ethics Committee
School of Education and Lifelong Learning
University of East Anglia Norwich Research Park
Norwich NR4 7TJ, UK

Email XXXXX@uea.ac.uk
Telephone: +44 (0)XXXXXXXXX
http://www.uea.ac.uk/education/research/research-ethics

Appendix 5 – Example Transcripts

All student interview coding analysis was conducted within NVivo11 software package (QSR International, 2016). Thus, the below transcripts are illustrative examples due to the complexities of the software structure and conversion to print.

Example 1

Thematic code	**Content**	**Speaker**
	Ok I am going to read to you a definition of on-task behaviour that we are investigating in this study. On-task behaviour includes verbal and motor behaviour that follows the rules of the classroom and is appropriate to the academic activity given by the teacher. Examples of on-task behaviour might include: actively working quietly at one's desk, engaging in group learning activities, responding to teacher questions, and engaging in subject-relevant conversation when appropriate." i.e are you following what the teacher would expect you to be doing? So, Considering the two lessons I came in and observed your class today, what percentage of time do you consider yourself on-task in the first lesson?	RESEARCHER
	Thirty percent.	PARTICIPANT
	Okay. What about the second lesson?	RESEARCHER
	after X teachers?	RESEARCHER
	Yes.	PARTICIPANT
	So, well, X teachers lesson, yeah.	RESEARCHER

	I would say about 95% to 100%.	PARTICIPANT
	Engaged?	RESEARCHER
	Yeah, I've done the whole work.	PARTICIPANT
	So why is you more on-task in the second lesson?	RESEARCHER
Fatigue and Energisation – concentration and focus	I don't know. Probably 'cause, like, hormones had risen and stuff like that	PARTICIPANT
	Yeah? How?	RESEARCHER
Fatigue and Energisation – concentration and focus	Well, I've been quite ill today, as it was, in an afternoon. And then I felt like it flushed out my system.	PARTICIPANT
	Yeah.	RESEARCHER
Fatigue and Energisation – concentration and focus	And it just made it a little easier for me to concentrate.	PARTICIPANT
	Because I was like, "And that's it."	PARTICIPANT
	Yeah.	RESEARCHER
	Okay.	RESEARCHER

	because I just felt better.	PARTICIPANT
	Yeah. So, why did you feel better?	RESEARCHER
Enjoyment	I just enjoy physical activity, no matter what it is. And if I do that, I can then sit down and do whatever I want.	PARTICIPANT
	Yeah.	RESEARCHER
	Like with my exams--	PARTICIPANT
	Yeah.	RESEARCHER
Fatigue and Energisation – concentration and focus	I used to go out, go for a run in the morning, and then sit down for, like-- I'd sit down for up to five hours just doing, like, revisions, stuff like that.	PARTICIPANT
	Okay. So that's interesting. So how does that help you?	RESEARCHER
Fatigue and Energisation – concentration and focus	I just find it as a good release.	PARTICIPANT
	Mm-hm.	RESEARCHER
	And I found that as soon as I stepped over that line going into the pitch--	PARTICIPANT
	Yeah.	RESEARCHER

Fatigue and Energisation – concentration and focus Enjoyment	--everything just disappeared, and I could just concentrate on what I loved, and what I wanted to do.	PARTICIPANT
	Yeah. Okay. So that's when you're doing it. And then afterwards, how does that help your exams	RESEARCHER
Fatigue and Energisation – concentration and focus	Just- I just feel more concentrated and in the zone.	PARTICIPANT
	Yeah? Okay. You feel more concentrated. And when you say in the zone, obviously that relates to concentration? but what particularly does it relate to when you say in the zone?	RESEARCHER
Fatigue and Energisation – concentration and focus	I listen more, feel more attentive.	PARTICIPANT
	Yeah.	RESEARCHER
Fatigue and Energisation – concentration and focus	Uh, I find it easier to interpret things, but, like, it just comes across a lot more clearer--	PARTICIPANT
	Yeah?	RESEARCHER
	--after I've done it (PA)	PARTICIPANT
	Okay.	RESEARCHER

Fatigue and Energisation – recovery	I think it's mainly because I'm knackered, and I just--	PARTICIPANT
	Yeah.	RESEARCHER
Fatigue and Energisation – recovery	want to concentrate and just recover.	PARTICIPANT
	So you want to recover.	RESEARCHER
	Yeah.	PARTICIPANT
	So you kinda calm down?	RESEARCHER
	Yeah.	PARTICIPANT
	So it's quite an interesting thing, isn't it? You said that you feel tired - so almost perverse in some ways, isn't it?	RESEARCHER
	Yeah.	PARTICIPANT
	That being tired makes you able to focus more, doesn't it?	RESEARCHER
	Yeah.	PARTICIPANT
	Can you explain that ?	RESEARCHER

Fatigue and Energisation – recovery	I don't-- I don't-- I don't know. It just-- it just happens, really.	PARTICIPANT
	Yeah.	RESEARCHER
Fatigue and Energisation – recovery	It's just because I can't-- I guess it's 'cause I can't be bothered to talk [laughter], so I don't-- I don't talk to my friends.	PARTICIPANT
	Yeah.	RESEARCHER
Fatigue and Energisation – recovery	I focus more on the task at hand than what I would if I wasn't knackered, and I was, like, messing around with mates or whatever, having a chat with them.	PARTICIPANT
	So, basically, that you're tired so you can't be bothered to mess around, so that you just get on with-- you just get on with it?	RESEARCHER
Fatigue and Energisation – recovery - concentration and focus	So I think knackering me out's the best thing to do.	PARTICIPANT
	Yeah.	RESEARCHER
Fatigue and Energisation – recovery - concentration and focus	It helps me wind down.	PARTICIPANT
	Okay. Brilliant. Um, so, in general - I mean, we've covered some of this ground already - but, in general, not including today, um, does the physically active lesson affect your ability to be on task in the preceding lesson, which you were saying is, yes, it does?	RESEARCHER

	Yeah.	PARTICIPANT
	Okay. So it's mainly-- you-- in your eyes, mainly positive?	RESEARCHER
	Yeah.	PARTICIPANT
	Yeah?	RESEARCHER
	Definitely positive, yeah.	PARTICIPANT
	Okay. Definitely positive. Okay. Could you explain further or is there anything else you want to add to that? You know, reasons why or-	RESEARCHER
	I think I pretty much said it already.	PARTICIPANT
	Like, so you go for a run first thing in the morning?	RESEARCHER
Morning comments	I go for a run every morning, yeah, about 4:00.	PARTICIPANT
	Yeah. And does that help your on-task behaviour?	RESEARCHER
Fatigue and Energisation - concentration and focus	Helps me wake-up but -the main reason I do it and also to keep fit. So I play football.	PARTICIPANT

	Do you have any other feelings, thoughts, comments or opinions around physical activity and on-task classroom performance?	RESEARCHER
	No, I think I have said it all	PARTICIPANT
	Interview ends with participant thanked for there participation in the interview and research	

Example 2

Thematic code	Content	Speaker
	Ok I am going to read to you a definition of on-task behaviour that we are investigating in this study. On-task behaviour includes verbal and motor behaviour that follows the rules of the classroom and is appropriate to the academic activity given by the teacher. Examples of on-task behaviour might include: actively working quietly at one's desk, engaging in group learning activities, responding to teacher questions, and engaging in subject-relevant conversation when appropriate." i.e are you following what the teacher would expect you to be doing? So, Considering the two lessons I came in and observed your class today, what percentage of time do you consider yourself on-task in the first lesson?	RESEARCHER
	Well, I done all the tasks she asked me to--	PARTICIPANT
	Yeah.	RESEARCHER
	--but because I finished all my assignments, it's more of just sitting there and listening to her. But overall, I did do-- she gave us a few sheets--	PARTICIPANT
	Yeah.	RESEARCHER
	--and I finished them, so I don't know.	PARTICIPANT

	So as a guestimate, what would you say it would be out of 100%?	RESEARCHER
	85%.	PARTICIPANT
	Yeah? Great. And the second lesson with Y teacher?	RESEARCHER
	What lesson was that?	PARTICIPANT
	The one you've just had.	RESEARCHER
	Oh, the one we just had. I'd say it was more. About 50% because--	PARTICIPANT
	Yeah.	RESEARCHER
Assignment completition status	--I had no assignment to do, but I did finish one assignment, but other than that I had nothing to do.	PARTICIPANT
Assignment completition status	So have you finished all your assignments, have you?	RESEARCHER
Assignment completition status	Yeah, apart from one at home.	PARTICIPANT
Assignment completition status	Okay. There's one at home?	RESEARCHER
	Yeah.	PARTICIPANT
	any other reasons why there might have been a difference in--?	RESEARCHER

	What, the two classes?	PARTICIPANT
	Yeah, the answers you've given.	RESEARCHER
Fatigue and Energisation - Recovery	Uh, well, obviously in Teacher Y's lesson, I was like really hot 'cause I just did PE.	PARTICIPANT
	Yeah.	RESEARCHER
Fatigue and Energisation - Recovery	So it's-- I-I find it harder to focus when I'm quite hot.	PARTICIPANT
	Yeah.	RESEARCHER
Fatigue and Energisation - Recovery	I wanna cool down and have some like water and stuff before I actually start working.	PARTICIPANT
Fatigue and Energisation - Recovery	Okay. So you had a lack of water?	RESEARCHER
Fatigue and Energisation - Recovery	No, I was just really hot, that's why I didn't concentrate as much.	PARTICIPANT
	Yeah. Okay.	RESEARCHER
Assignment completition status	But, I didn't have as much to do in that lesson as I did in the first one.	PARTICIPANT

	Yeah. So you say you didn't have much to do. Do you think there was any other difference?	RESEARCHER
Lesson Variations – Format	Well, the less-- the first lesson, it was led--	PARTICIPANT
	Yeah.	RESEARCHER
Lesson Variations – format	--whereas the second lesson, we could almost do what we want.	PARTICIPANT
	Yeah, it was more of a free-for-all?	RESEARCHER
	Yeah.	PARTICIPANT
	Yeah. Okay. Um, excellent. Thanks for that. Um, generally speaking, not just today, but does PE lessons or physically active lessons in the college day, does that affect your ability to be on task in the next lesson?	RESEARCHER
	Yeah, I would say it does--	PARTICIPANT
	Yeah?	RESEARCHER
	--in all honesty.	PARTICIPANT
	In what ways?	RESEARCHER
Fatigue and Energisation - Recovery	Um, well just after lesson, because obviously us boys get really hot and sweaty and that.	PARTICIPANT

	Yeah.	RESEARCHER
Fatigue and Energisation - Recovery	I find it hard to con-- like sit down at a desk when I'm like really hot--	PARTICIPANT
	Yeah.	RESEARCHER
Fatigue and Energisation - Recovery	It's just hard to do.	PARTICIPANT
Fatigue and Energisation - Recovery	Do you not get a chance to have a shower and change? Or are they like literally straight--?	RESEARCHER
Fatigue and Energisation - Recovery	No, it's literally straight away.	PARTICIPANT
	No gap. Okay. And any other ways in might affect you?	RESEARCHER
	No. No, I wouldn't say so.	PARTICIPANT
	Okay. Um, do you have any other thoughts, feelings, comments, or opinions around how physical activity might effect classroom and performance?	RESEARCHER
	Interview ends with participant thanked for there participation in the interview and research	PARTICIPANT

Appendix 6 - Bibliography

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