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The effect of the Open Event on students' attitudes towards science in school across the transfer from primary to secondary education

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Abstract

Although the importance of students having a 'good transition' and the dangers of students' having a 'bad transition' in the transfer of schooling are well known within England there has been a lack of research on the effect that specific events have on students within that transition period. Therefore this study looks at a specific transition event, termed the Open Event, and how attending such an event might impact on students attitudes to science in school across the transfer from primary to secondary education. The study is based on cross sectional data collected from 23 English schools covering students aged between 9 years old (Year 5) to 14 years old(Year 8) which were deemed the 'transition years' as these two years cross the primary/secondary school divide. It involved using questionnaires as well as student and interviews with science staff in the secondary schools as well as focus groups. Field notes and audio-recordings were made throughout these visits to aid in analysis. The findings suggest that in trying to market itself and generate short term student interest at the Open Event, the science departments in these secondary schools inadvertently promoted a misconstrued image of secondary school science that can adversely affect not only students' attitudes towards science in primary school but also change some students' perception of the nature of school science. For some students attending an Open Event results in a decline in their attitude toward primary school science due to perceiving their primary school lessons, in contrast to what they have seen in the secondary school, as not being 'proper science'. Although, for the majority of students, this effect seems to last for only one academic term there is an embedded misconception, due to the misconstrued image of science observed at the Open Event, that secondary school science will be mainly practical in nature. The implication of this study is that the discordance between the realities of science in school and students' misconstrued expectations of science in school, developed from attending the Open Event, may play a role within the dip that has been reported in students' attitudes towards science following their transition from primary to secondary education. As such giving a more realistic image of what actually occurs in

secondary school science during Open Events may be more advantageous in the long term than focusing on developing a short term, unsustainable, image of science.

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Finally, for those that are closest to my heart, this thesis is dedicated to you. To Barry thank you for being an inspiration. To Billy thank you for waking me up at 5:30 every morning as you attempt to escape your bedroom.

Author's declaration

The author, Stuart Norris, declares that no part of this PhD thesis has been publicly published anywhere else.

Chapter 1

Introduction

I have always detested any departure from reality, an attitude which I relate to my mother's poor mental health.

Jean Piaget (1935) pp32

1.1 Preamble

Students, from my own experience as a secondary school science teacher, are generally either enthusiastic or apathetic about the subject of science. Teaching the core strands of Biology, Chemistry and Physics that make up this subject within secondary school lessons often interested, delighted, enthused and stimulated some students whilst, oxymoronically, at the same time caused indifference, displeasure and boredom for others within the same class. What was more it could also be observed that a noticeable decline in attitude towards the subject of science could clearly be seen when comparing a group of Year 7 students (aged 11-12 years), who had just transferred from primary school, against a group of Year 8 Students (12-13 years). This judgement was made in regards to the occurrence of low level disruptive behaviour, general body language and the general lack of willingness, in comparison to the Year 7s, to do and complete their class work I saw within lesson time.

My own interest of this phenomenon was stimulated further when I attended some local feeder primary schools, schools where the majority of our pupils transferred from after gaining their initial education from age 5-11, to help in bridging science across the transition. I had thought that a gradual disinclination towards science in school over time, which I had been observing, was due mainly to a shift in students' priorities/interests as they go through puberty and that, as such, I would find younger students in primary school more enthusiastic about science. This unfortunately was not what I noticed when I was introduced by their primary class teacher as a ‘science teacher’ coming to teach science which was frequently met with groans of dismay. It was not until they learned that I had come to teach a practical based lesson on designing, making and shooting an air powered rocket that the enthusiasm I had expected to find appeared.

Upon relating this story back to my physics colleague I ended up in a conversation on whether doing a practical based lesson, a lesson which, a colleague noted, was not really realistic to the everyday science we taught in secondary school, was the best approach to adopt. Their argument was that the subject of physics was not all ‘rockets and explosions’ and that it was no wonder students’ attitudes declined when they finally realised, after a few months in secondary school, that this was the case. This dialogue was ever present on my mind when later that week I attended and, as part of the science department, aided the my secondary school in showcasing what we could do in an Open Event, an evening put on for parents and children who had reached the age whereby they were finishing primary school and getting ready to transfer to their next stage of learning within secondary school. Not only was I directly involved with showcasing science tasks that I knew was not realistic to what I would normally do within science lessons (I had a stall set out whereby I was quite happily dissecting a rodent something that I would rarely do in teaching biology) but my science colleagues around me, including my physics colleague, where also quite happily enthusing these potential new students and their parents by making things explode, fizz, float and pop! As Piaget (1935) observed in the quote at the beginning of this chapter, this departure from reality, no matter what the object under scrutiny is, often causes a more negative attitude towards that object than is warranted. In fact I remember on one occasion when a practical experiment in class did not go to plan and produce a ‘pop’ and ‘explosion’ and my class went into uproar as I had ‘lied’ to them about the task at hand!

It was these three events:

1. Attending primary school for a bridging lesson;
2. ‘Lying’ to my class when they expected an outcome to a practical that did not occur;
3. Taking part in an Open Event for the school where my colleagues quite happily created an unrealistic image of science to enthuse perspective students;

that led me to wonder what affect the Open Event could have on students' attitudes and whether, in the case of science, the experience that the students had during attending an Open Event may be responsible, or at least partially responsible for, the decline that I had seen occurring, soon after transition, in students' attitudes towards science lessons.

1.2 The purpose of the research

Therefore the purpose of this research is to investigate the impact of the Open Event and how this may affect students' attitudes towards science within school. Breaking this down further this investigation has two broad aims. The first relates to identifying and constructing what actually occurs at an Open Event specifically with regards to the science department. It seems sensible that an event put on by the majority of secondary schools and that occurs at a time when students' attitude towards learning has been noted to begin to decline (Osbourne, Simon and Collins, 2003), should be researched thoroughly. Oplatka and Hemsley-Brown (2004) argued that dialogue between teachers, parents and students often had a greater impact on a student's schooling in comparison to parent-student or teacher-student conversations (or parent teacher – as at report Evenings?). Although they were referencing the importance of Parents' Evenings at school, the Open Event could be argued to have the potential to have a greater impact on the student as they visit this event in a state of transitional anxiety (Morgan, 1999) which is a factor that has been linked with reductions in attitude and fluctuating emotional states (Riglin et al., 2013). The second aim relates to the issue of whether the Open Event, and what the science department does at such an event, effects students' attitudes towards the subject of science in school. The potential is there that what occurs at the Open Event may aid in our understanding of why students' attitudes towards science in school have been observed to decline at this time. In relation to 'attitude' research one of the few clear themes that pervade this topic is that of its relationship to student attainment and subject retention (Osborne, Simons and Collins, 2003; Symonds and Hargreaves, 2016; Bennet and Hogarth, 2009). A clear correlation has been known since Dainton (1968) that a decline in students' attitudes towards a specific subject has led to a subsequent decline in the number of students choosing to pursue that subject in the post-compulsory phase of their education. Specifically in relation to the subject of science this has then led to a reduction in the uptake of science and a potential shortage of educated and skilled individuals for the science and engineering sectors (Osborne and Dillon, 2008). This relationship has led to numerous research papers investigating factors that could affect or trigger the formation of negative attitudes towards school science including gender, curriculum variables, teaching, personality and structural variables (Osborne, Simons and Collins, 2003). However the effect on student attitudes to school by attending specific transition events has only being analysed in relation to subject or tutor reporting with a priority on teacher/parent feedback for the next academic term (MaClure and Walker, 2010) and, as such, this thesis is attempting to fill the gap and conduct much needed research on the impact of the Open Event, a specific transition event, on students' attitudes towards science in school.

1.3 The structure of the education system in English schools

At the heart of this study is the data collected from 12 feeder primary schools and 8 secondary schools within England. It therefore may be useful to give a brief description of the English Educational system before proceeding to an overview of the thesis.

All institutions within the study where either state maintained or where attached to an academy trust. No matter the category however all schools followed the National curriculum and catered for a comprehensive intake of students. Within the English education system students complete four 'Key stages' over 11 years and are expected to take part in some form of post-16 education either within an academic institution or a work based apprenticeship for another two years after this. Students' initial education, termed junior and primary education, covers Key stage 1 and 2. This stage normally starts when a child is 5 years old and continues until the student is 11 covering Years 1-6. Students then often transfer to a secondary schools that covers Key stages 3 and 4. Key stage 3 is usually taught within the first three years of secondary school (termed Year 7, Year 8, and Year 9) whilst Key stage 4 is taught in the next two years (Years 10 and 11). At the end of Year 9 students often get to 'drop' subjects so that they can concentrate on more advanced learning of the subjects that they continue with. This is often called choosing your 'options'. Certain core subjects, such as English, Maths, Science, religious education and physical exercise (P.E.) are mandatory and cannot be dropped. The end of Year 11 often results in the student sitting their first public examinations (GCSEs) on the subjects that they chose to continue. Depending on these results students can then choose to take an assortment of post 16 courses.

In terms of science Key stages 1-3 is usually taught by non-specialist strand teachers and are designed to be done this way. That is that the mishmash of physics, chemistry and biology strands are taught in combination as the academic level is sufficiently undemanding as to enable a teacher of any specialism to teach it. In Key stage 4 strands of science are designed to be taught separately and by the subject specialist. This however is not a requirement and evidence would suggest that due to logistics, such as a shortage of physics and chemistry teachers, some schools science lessons at Key Stage 4 are being taught by science teachers with no formal qualification within that strand of science (Millar, 1998).

1.4 The overview of the thesis

This thesis consists of 8 chapters with the next two chapters, chapter 2 and chapter 3 being the literature review component of this research. Chapter 2 reviews what is meant by the term ‘attitude’ generally and how we use the term within science education. Having discussed this and other terms that are often used mistakenly to mean attitude this chapter concludes by making a distinction between a ‘scientific attitude’ and ‘attitudes towards science in school’. Chapter 3 starts by discussing when school transition occurs within England and the challenges that this brings to transitioning students. It highlights the phenomena of the decline in students’ attitudes towards school after transition and summarises the two main theories for this decline. The chapter then looks at specific transition events within this period and highlights what we know about the Open Event. Chapter 4 covers the methodology used in the thesis and starts by explaining the thought process behind how the approach used was chosen. A preliminary study and a pilot study is discussed with the findings used to inform the design of the main study. The theoretical framework is then discussed linking this to its usefulness in providing a structure to think about Open Events and their effects. Finally school selection for the study is discussed and reasons given for using a cross sectional sample that includes year 5 to year 8 students across the transition from primary to secondary school. Chapters 5, 6 and 7 each devote themselves to results collected to answer a specific research question. Although each chapter can be argued to be self-sufficient and, as such, can be read independently of each other it is the results combined that determines the overall impact of the Open Event on students. Chapter 5 focuses on identifying what is occurring at an Open Event through the lens of the science staff. Chapter 6 discusses changes in attitudes towards science in school before and after students have attend an Open Event whilst Chapter 7 assess whether the Open Event has effected the students' perception of what constitutes science in school. Chapter 8, the concluding chapter, provides a summary of the result chapters followed by a discussion in terms of what this means in regards to the impact the Open Event has on students. The chapter finishes by considering this study's contribution towards educational knowledge and its potential implications to stakeholders before offering suggestions on potential future research avenues and tentative recommendations on how Open Events should be run to maximise the positive impact on students.

Chapter 2: Students' Attitude Formation

2.1 Introduction

Within education and industry a trend of disengagement amongst students in subjects such as science, engineering and design technology has led to a gap in skills needed to fill British professions (Osborne and Dillon 2008). Due to the smaller pool of talent available this has had a net effect of decreasing the standards in STEM based industries resulting in a decline in standing in the international arena (AQA 2012). Research in the past decade has conducted investigations into this phenomena looking for a root cause of this trend and although a clearer picture is now known, a reasonable response to halt and negate this tendency has yet to be established.

What is known is that the decline in student attitude in relation to the STEM subjects begins to manifest itself from as early as year 6 (10-11 year olds) with the largest decrease in attitude towards science seen after transfer to secondary school (Rice et al., 2011). This decline continues until Year 9 (14-15 year old) with these attitudes, be they positive or negative, becoming embedded and unsusceptible to further change after this time (Riglin et al., 2013). This period occurs over a time of transition for most students as they leave childhood and is often linked with student social, emotional and cognitive upheaval and reassessment (Pratt and George, 2005). Although procedures focusing at the macro level have been put in place to ease student transfer with positive trends observed in regards to decreased levels of anxiety for students, the decline in the attitude of students within school have not changed (Pointon, 2010). What is of note is that students' attitudes towards lessons over pre- and post-transitional processes does alter and this change is often more extreme in relation to practical subjects than non-practical subjects (Osborne et al., 2003).

One explanation for this, suggested by Abrahams (2007), relates to the unrealistic image of science presented to pre-transfer students by secondary schools. Abrahams maintains that using practical work to market the school can lead to students having a unrealistic, and unsustainable, image about the nature of secondary school science and, in particular, the nature of practical lessons. This is supported by Oplatka (2007) who monitored 12 open house events, the equivalent of Open Events, in Canada and noted that parents and children often left with perceptions that did not reflect reality. In subjects such as science, schools often put on flashy practical demonstrations, which include stimulus and entertainment to aid in marketing the school. In transitional processes, such as ‘science days’, students often get to take part in practical such as lightening a Bunsen burner and testing acid-alkali solutions using universal indicator. In reality these examples of practical work are often the minority of lessons with the more flashy experiments unsafe for students to do in a class context. Instead focus is habitually given in lesson to repetition and writing tasks in relation to assessment (Sharpe, 2012). In comparison non-practical subjects such as English often focus on demonstrating students work during Open Events with English Open Events not dissimilar from ‘normal’ English lessons (Abrahams, 2011). This idea of the difference in students’ perceptions of a subject, in comparison, to the reality of the subject could be a contributing factor in the differences observed between the decline of student attitudes towards practical and non-practical subjects.

In this chapter an overview of what is meant by the term attitude is presented. Terms such as interest, value and motivation are highlighted with current research discussed before an appraisal of the importance of attitude in terms of science in school is considered. Finally what the students held concepts of science is argued before linking this to the potential effects of transitional processes on students’ attitudes towards the subject with an outline of what could be done to assess this.

2.2 Defining what we mean by ‘attitude’

As with all long-standing concepts the characterization of the term attitude has had many reincarnations over the years. In the original definition by Allport (1935) the concept of attitude was based on positive and negative perceptions of the individual. In 1975 Fishbien and Ajzen argued attitude was a learned disposition. Petty and Cacioppo (1986) expanded on this and applied positive or negative connotations whilst McGuire (1990) linked attitudes with emotion. Eagly and Chaiken (1993) widened the definition of attitude to include a psychological tendency with evaluative components whereas Scwarz (2007) disagree that attitudes are valued as stable constructs and argue that they are inheritably unstable representations. Finally the trend of implicit association methods has led to attitudes being sub-categorised as being formed of implicit and explicit components with definitions of attitude either being generalised or subcategorised to include this (Archer et al., 2013). In the next section of this thesis a more detailed breakdown of the different approaches and components of these arguments are referred to in order to provide a clear definition of the concept of attitude. These include the ideas of a functional definition for attitude, attitudes as object-evaluation associations, attitudes as unstable constructs and traditional connectionist models. Finally it must be noted at this time that although very little agreement can be observed within this domain the foundational principle of the importance of the concept of attitude is not in dispute (Gawronski, 2007). Attitude research is consistent with causal links to their use as a predictor and evaluator of behaviour (Sharpe, 2013) and is often used as a key measure in relation to student engagement (Fredericks et al., 2004) which has been linked to student achievement within education.

2.21 Functional definition for attitude

As said previously the concepts of attitude can be categorised under different viewpoints within the research domain. In this approach the definition of Allport's original 1935 attitude concept is expanded and used as an umbrella term to aid in giving researchers a definition that can be used for *precision and generality*. Researchers have argued that a definition that is valid must be viable with current research but also be able to be universal enough that it can be applied to new findings in the future. Advocates of this approach are Eagly and Chaiken (1993) who suggest a definition of attitude should include three critical features: Evaluation, Attitude object and Tendency. Evaluation is in reference to all types of responding. Common features of this include the use of behavioural, affective and cognitive subcategories (Sharpe, 2013) or covert and overt subcategories (Hawkins and Ratliff 2015). An attitude object is in reference to an item that is under evaluation and forms an implicit or explicit behavioural response and is used to distinguish the concept of attitude in comparison to other concepts like mood (Eagly and Chaiken, 1996) whilst Tendency is the level in which a negative or positive response is predisposed within the individual. Overall the strength of this approach is its ability to set a template to aid in the comparison of data. Although the aim of having a definition of the attitude concept that is both general and precise is a worthy one it also must be pointed out that this balancing act may be at risk of being too holistic at times and could be argued to be difficult to maintain.

2.22 Attitudes as object-evaluation associations

Researchers that advocate the concept of attitude as object-evaluation associations focus on evaluative knowledge (Gawronski, 2007). First proposed by Fazio, Chen, McDonel and Sherman (1982) the concept of attitude was defined as levels of associations, based on availability from memory, between an object and its immediate or *summary evaluation*. The root of this is often argued and has been said to have been linked at one time or another with beliefs and affect or behavioural sources (Zanna and Rempel 1988), learning processes that are passive (Dehower et al., 2001), attitudinal diagnostic information, such as proprioceptive feedback (Strack et al., 1988), retrieval ease (Brinol et al., 2006) and perceptual fluency (Reber et al., 1998) as well as reasoning linked to active processes (Deutsch and Strack 2006). Although ideas on how attitudes are formed are still being appraised an essential ingredient of object-evaluation associations is that of its link with memory (Fazio 2007). This proposes that the concept of attitude is a simpler from of *evaluative knowledge* and is represented in memory just like any other piece of information. One of the strengths of this approach is its explanation in relation to differing powers in attitude on attitude objects (Pratkanis 2014). Within the literature a common theme in results collected is that of levels of association in which some individuals have different degrees of positive or negative attitudes. The object-evaluation association explains this result as an expected feature of both individual differences of the individuals in relation to evaluative aspects as well as a utility of individual interest (Gawronski 2007, Prokop et al., 2007, Pratkanis 2014).

2.23 Attitudes as unstable constructs

Within this approach the concept of attitude is seen as inherently unstable (Schwartz 2007). Researchers who support this view advocate an *attitude construal model* that portrays a capacity to report the variability across measures, situations and time. Attitude is therefore based on the idea that evaluative judgements are made automatically for the occasion when confronted with an attitude object (Schwartz 2007). Arguments against this idea are based on results that show similar attitudes at different times or in different contexts (Bless and Fiedler, 2003) with the dispute therefore based on an inherent stability needed for this to occur. In response to this criticism Strack, Schwartz and Wanke (2012) point out that these effects could be due to contextual influences being small and that observed changes therefore would not occur. More recently Cacioppo et al., (2014) have suggested that it could be due to the access of memory of previous information i.e. the memory of the previous attitudinal response. One facet of this approach that is often cited is that of its justification on attitude strength. Strands such as the object-evaluation association approach struggle to explain the oxymoronic phenomena whereby on the one hand strong attitudes are deemed difficult to change whilst on the other highlight the dangers inherent in question order effects on attitudinal research (Bennett and Hogarth 2009). As seen from an unstable construct viewpoint this phenomena is explained by the effect of implicit-explicit persuasion protocols in that awareness of influences weakens the impact of available information for evaluative judgements to be formed (Strack et al 1988).

2.23 Traditional connectionist models

The traditional connectionist models sponsor a localised and distributed representation of attitude. At its most basic a connectionist model, or network, is made up of simple processing nodes that are interconnected. Individual nodes can be defined in different ways: for example some can be more active whilst others can be associated with specific functions for memory, pattern assimilation or information-processing (Conrey and Smith 2007). The underlying principle is that streams of activation between nodes and the patterns that are associated with this dictate and control the formation and change of the attitude construct. This approach de-emphasises the intentional role of attitude formation instead focusing on past experiences as core influences on attitude formation (Cacioppo et al 2014). Specific models emphasise localised or distributed templates in the formation of attitudes (Conrey and Smith 2007). Localised connectionist models support object evaluation associations by suggesting evaluations on attitude objects are stored at nodes and, as such, can be retrieved when the individual comes into contact with the object again. Examples of this include the MODE model (Fazio 2007) and the Meta Cognitive Model (Petty et al 2007). Distributed connectionist models support a more unstable view of attitude formation with potential representations available but that must be reassessed again in association with the context the attitude object is observed within (Yeh and Barsalou 2006). These include such facsimiles as parallel distributed processing models (Conrey and Smith 2007) and the Interactive processing model (Cunningham et al 2007). The challenge with this approach is that the majority of connectionist models are generally designed for concepts such as stereotyping and perception research and have only been applied to attitude at a later date. One connectionist model specifically designed for attitude research that needs to be mentioned is that of Bassili and Brown (2005). The authors present the idea of activation of *microconcepts* by nodal function when an attitude object is observed, which are then assembled with other microconcepts to form an evaluation. Context therefore plays a fundamental role as differentiated microconcepts are activated dependent on environmental stimulus resulting in the model having activation fluidity (Gawronski 2007). This potential recruitment model advocates four pillars of latent triggers including recent experience, associated concepts, working memory and eliciting conditions of the attitude object. An advantage of this is an explanation in regards to explicit-implicit processes in which implicit expression of attitude is the result of unconscious speeded responses whilst explicit attitude expression is the result of a greater activation of reflective memory processes.

2.24 ABC model

Within Education research the common structure of an attitude is often framed within a tripartite model also known as the ABC model of attitude. This structures an attitude into three components consisting of afferent (Emotions), behavioural (actions) and cognitive aspects (beliefs and knowledge). One of the recent criticisms of this model is that of the underlying assumption that the behaviour of a person will be consistent with the afferent and cognitive components that are held by that person. This principle of consistency predicts that people are logical and attempt to behave rationally always. There is however evidence that the cognitive and affective components of attitude do not always match with behaviour (LaPiere, 1934). One rebuttal of this is that of Azjen (1978) who states that afferent and cognitive aspects of attitude are good predictors of behaviour as long as a specific attitude towards a specific object is measured. As such the use of a duel model of attitude in that afferent and cognitive aspects of attitude are measured and behaviour is predicted is also common within educational research (Sharpe, 2013; Osborne et al, 2003)

2.3 Summary

In review functionalists advocate a generalised and precise definition of attitude based on the three variables of evaluation, attitude object and tendency. Object-evaluative associations indicate an attitude concept as a piece of evaluative knowledge embedded in memory. The attitude construal model suggests an automatic system of evaluative judgments on attitude objects whilst traditional connectionist models support a local or distributed cognitive network with Bassili and Brown (2005) advocating the idea of attitude formation being dependent on an accumulation of microconcepts to form context based evaluations. What is clearly apparent is themes of ideas of an attitude object and evaluation that permeate throughout all of the approaches summarised. Therefore the attitude concept that will be used within this thesis will that in which an attitude is defined as ***learned evaluative associations to an attitude object.*** In relation to the concept of attitude research, in this thesis the concept of attitude will follow the traditional ABC model of attitude with the behavioural component being able to be inferred from the afferent and cognitive components of attitude measured.

It must also be noted that, in general, research involving both the attitudes concept and science have been eclectic in the concepts used to define attitude (Barmby *et al* 2008). The challenge that these researchers have encountered due to this have been the use of a range of components that individuals have used as a measure on *attitudes towards science* including the use of the terminology motivation, interest, attitude, anxiety, value and enjoyment (Osborne et al 2003) which make comparisons difficult (Sharpe 2013). As such the next section looks in detail at some of these eclectic concepts which may be revealing in regards to attitude research within education.

2.3 Interest

At its most simplistic the concept of interest is the idea of an individual's *fascination* with something (Bandura 1986). Confusion with the use of this term originally stems from the literature that classifies the idea of individual tendency and interest as the same concept (Archer *et al.* 2010). Interest can generally be categorised into two distinct domains that focus on either situational or personal characteristics. This suggests that interest is associated with the increased tendency to behave towards an attitude object with a *specific emotive response* (Logan and Skamp 2010). Studies by Krapp (2010) support this idea and have shown that individuals who have measured high on interest gauges on a variety of subjects demonstrate a higher percentage of attentive behaviour and higher scores on happiness scales. This is also supported by Hidi and Harackiewicz (2000) who looked at the effect of interest on cognitive performance with those individuals that were deemed interested doing better in comparison to those that were less interested within an examination task.

In relation to the attitude concept interest is an important latent trigger in the formation of microconcepts. Interest collects and accrues both individual and situational constitutes that potentially aids in the formation of the emotional engagement of the person (Jidesjo et al 2015). Individual interest is often characterised as stable and often increases with an accumulative effect at a young age (Archer and Dewitt 2010). Individual interest has been linked with benefits in cognition, behaviour and self-esteem for students within a school environment (Krapp and Prenzel 2011). In contrast situational interest is often characterised as unstable and temporary due to contextual influences (Swarat *et al.*2012). What is important to call attention to however is that situational interest can influence the development of individual interest (Sharpe 2013) by storing information that can be accessed by the person in support of a cognitive assessment to decide on an emotive response at a later time. This viewpoint is supported by Hidi (1990) who advocate a four phase process that includes triggered situational interest, maintenance of this interest in accessible memory stores, increased tendency towards an individual interest and finally the formation of an individual interest leading to an emotive association. This formulated interest, in tangent with other concepts such as attitude formation and motivation, add together to inform implicit and explicit student engagement properties (Fredericks *et al*. 2004).

2.4 Motivation

Motivation is the foremost denominator in indicating how invested an individual is with their own personal learning (Lai 2011). Research is often categorised under three sub-headings termed intrinsic and extrinsic motivation and amotivation (Sharpe 2013). Intrinsic motivation is loosely defined as an internal attribute that drives the individual to perform or not perform a specific behaviour whilst extrinsic motivation is loosely defined as external attributes that drives the individual to perform or not perform a specific behaviour (Osborne et al 2003). Amotivation will be defined later in this section.

Within the framework of student attitudes, focus is governed towards intrinsic motivation as a cognitive principle (Fredericks et al 2004) whilst extrinsic motivation is linked as a behavioural variable allied with external manipulations in attributed values held (Symonds and Galton 2014). Present approaches within education studies in the learning of motivation concept is often characterised as being connected to cognitive variables with focus on empirical evidence on traits of motivation. These include links between increased motivation and reading ability (Galton 2009) as well as increased motivation for maths and maths ability (Galton 2011) in which students with higher levels of ability in reading and maths have been noted to have higher levels of motivation. This has been argued to be due to intrinsic motivation in conjunction with emotive concepts providing data flow that supports attributed value towards specific tasks. The collaborative nature suggests that intrinsic motivation should be an unstable concept and this has been supported with factors such as context, domain and emotive engagement all being linked with fluctuating levels of motivation capacity (Mujaba *et al.*2012). It also must be pointed out that on top of this are challenges with directly observing intrinsic motivation at the cognitive level with researchers often relying on behavioural aspects such as levels of task attention, personal planning and self-regulation to learn to measure this concept (Lai 2013). In contrast extrinsic motivation is easy to measure (Sharpe 2013). Variables such as competition and positive or negative rewards have all being linked with changes to student extrinsic motivation although their effect is dictated by context, type, peer relations, teacher competency, individual intrinsic motivation and attributed values (Bennett and Hogarth 2009). Unlike intrinsic motivation extrinsic motivation is linked with lower levels of self-determinism in that external influences are needed for goal orientation to take place.

Amotivation is where very little or no self-determinism is observed and this concept has often been highlighted in the literature in reference to student disengagement and learned helplessness (Sharpe 2013). Based on these principles amotivation is loosely defined as lacking drive that causes the individual to perform or not perform a specific behaviour. This lack of self-determinism is often based on feelings of inadequacy as well as perceptions of learning being of low value to the individual and is often associated with psychological conditions such as depression (Christdou et al 2011).

One important phenomenon in motivation research that should be mentioned is that of motivation across different subject domains. Pre transfer students have been noted to have high levels of intrinsic motivation (Galton 2009) and this has been observed to decrease at different levels across specific domains when transfer has occurred.

2.5 Task Value

Value is best seen as an entwining notion that is a form of catalyst in the development of the other constructs within students' attitude towards an object. Perspectives on the idea of this concept such as the expectancy-value model focus on the level individuals performance, tenacity and choice being dictated by the individual beliefs held about their self-efficacy (Bong 2004).Generally the idea of value can be conceptualised as groups of beliefs that are stable (Feather 1992) which can be framed within four keystone markers that consist of attainment value, intrinsic value, utility value and cost (Eccles and Wigfield 2002). Attainment value catalyses the formation of positive attitude and the intrinsic motivation to do well in support of their personal self-schema (Bong 2004) and has been linked with personal ideas on achieving competency in various domains including ideas on masculinity or femininity (Reiss and Mujaba 2012). Intrinsic value is a catalyst for ideas of personal interest. This is often context driven and triggers personal benefits of feelings of enjoyment (Gillan et al 2015). Utility value has been linked with the idea of personal goal formation (Meeusen et al 2015). This is often linked with more extrinsic motivational goals in that a person values a task more highly when they know that achieving well within the task will mean that they gain a monetary award. Finally the idea of cost is in relation to the idea of associated negative connotations towards a choice behaviour. For example in the scenario in which a student is considering to do a physics A level the positive aspects could be that the student is personally interested, intrinsically motivated with extrinsic monetary reward on offer by their parents if they do well. However negative aspects that decrease this choices value of choosing physics could be due to costs of perceived level of difficulty, low competency rating of the teacher and personal effort and time needed to do well as well (Reiss and Mujaba 2012). Interestingly cost-value associations have been observed to differ across humanity and scientific subjects with negative **task** value associations being linked to the decline in the re-uptake of subjects such as maths and physics whilst negative **ability** self-concept associations have been linked with the decline of the re-uptake of subjects such as English (Parker et al 2015).

Overall the concept of value can be argued to be a micro-concept component that aids in the triggering of behavioural responses due to the catalysed increase in flow formation (Bassili and Brown 2005). Components such as interest, motivation, attitude and subjective value collaborate at the emotional, cognitive and behavioural level to formulate students' held attitudes towards school and individual subjects such as science. Of note also is that this formation and collaboration results in different net effects on different domains based on personalised beliefs and ideals held by the individual student which in turn change over time as micro-concept formation is accumulated from experiences. This is supported within the literature by Galton (2011) who observed that motivational and attributed value held by students where more general across subjects and only became differentiated as they increased in age. In relation to attitude Sharpe (2013) demonstrated differences within biology, chemistry and physics whilst Archer et al (2013) demonstrated that students' interest differed. This would suggest therefore that studies analysing student attitudes need to specialise in subject areas and not generalise in relation to whole school judgements (Parker et al 2015).

Due to this ideal the next section focuses on the specific domain of secondary school science. As this subject has been linked with decreased levels, in comparison to other subjects, in students' held attitudes after transfer which have resulted in a skills gap for the British economy (Osborne and

Dillon 2008) the level of research has been robust and gives the best chance to observe a clear picture as possible within this area. Therefore the next section will highlight the subject of secondary school science and students' concepts of this with the aim of summarising the research in relation to students' held attitudes' towards this subject.

2.6 Importance of the concept of Science

Students' concepts of science are dictated by an amalgamation of students' *attitudes towards science* and *scientific attitudes* (Gardner 1975). The former is based on evaluations of an attitude object associated with a science context whilst the latter is linked with scientific processes (Osborne et al 2003). This would suggest therefore that student's attitudes towards science within the context of the classroom could be potentially different in comparison to their attitudes of science outside the classroom and this has been supported within the literature. Bennet and Hogarth (2009) collected baseline attitudinal data from 280 students aged 11,14 and 16 using *the Attitudes to School Science and Science* instrument that demonstrated that students attitudes towards science outside of school are often more positive in comparison to measured attitudes within school. Barmby, Kind and Jones (2008) used an attitude construct that measured different aspects of students views of science noting that the biggest decline in attitude was related to learning science in school with only small reductions observed in regards to attitudes towards practical's within science and the importance of science in society measures. These findings were also supported by George (2006) who observed stable attitudes in relation to attitudes on the usefulness of science. What is of importance to note is that a clear distinction must be made within the design of a research method on what aspect of students concepts of science is going to be measured. Although a more detailed analysis will be eluded too within the method section of this thesis it should be pointed out that common methods that assess students views within science lessons have often consisted of components that measure different categories of what is deemed 'science'. Klofer (1971) was the first to attempt such a categorisation whilst more recently the use of Attitudes to School Science and Science instrument (Bennett and Hogarth 2009) and the Views On Science Technology Society (VOSTS) questionnaire (Sharpe 2009) have had some success. In the next section a more indepth look at what the common trends are within research into student engagement towards science within lesson will be alluded too. The majority of studies conducted within this niche domain have been focused on attitudinal measures of student engagement within science. Although the importance of using attitude as a measure will be alluded to in the next section it must be pointed out that although a clearer picture is now known comparisons within this area is difficult due to lack of standardised methods and as indicated previously a lack of clear definition in regards to key terminology within this genre (Barmby, Kind and Jones 2008). As such the research summarised next are only meant to be broad brushstrokes of the literature with trends within the data highlighted in relation to transfer years and specifically in regards to science within lesson unless otherwise stated.

2.7 Research in relation to Science Lessons

Students' attitudes towards science at first glance can seem to be oxymoronic in its nature in that individual students either like it and rate it comparatively high in relation to other subjects or dislike it (Hendley etal 1995) and rate it comparatively low in relation to other subjects. Differences within attitudes towards science have been observed between gender (Colley et al 1994), race (Smith 2014), age (Osborne et al 2003) year group (Barmby, Kind and Jones 2008), and within the breakdown of science in relation to biology physics and chemistry (Sharpe 2013). The common trends seem to indicate a picture of a decline in student attitudes towards *science lessons* starting from year 6 to year 9 with this seen to be more severe in relation to girls, ethnic minorities and more abstract science lessons such as chemistry and physics. After year 9 a shift in focus of the students seems to halt and in some case improve their attitudes towards science lessons. As yet no clear justification has been made for this overall effect. Galton (2009) associates transfer and transition effects to the decline in attitude. Abrahams (2011) suggests that attitude decline could be due to the overselling of science to students in primary school whilst developmental psychologists such as Weiss et al (2015) link attitude decline as a by-product of students becoming more focused on peer pursuits with school being perceived to be getting in the way of this. More research needs to be produced in this area to clarify the effect.

Students' motivation towards science within school has similar trends as that of attitude (Sharpe 2013). The common trends seem to indicate a picture of a decline in student motivation towards *science lessons* starting from year 6 to year 9. In relation to science however girls motivation has been observed to be lower in comparison to boys and does not decline as severe as boys motivation towards school is observed to do (Reiss and Mujaba 2012). Very few studies have looked at the motivation towards practical's within science although Abrahams (2009) makes note that the term motivation was often used by students to indicate short-term interest in regards to practical's within science which had little if any effect of post 16 science choices. Generally the motivation of students with regards to science lessons has been noted to be more unstable than the attitude construct although this could be due to extrinsic motivation and not intrinsic motivation being measured (Symonds and Galton 2014). What is of note is that trends of an increase in motivation have been observed at the start of transfer or transition years suggesting that students often have at least short term plans of performing to the best of their ability although this is often not followed through. More research is needed in what constitutes are needed for students to be able to keep their motivation towards science lessons high and what processes have an effect on this.

In regards to the concept of interest, *personal* interest is linked with increased scores on emotional engagement measures (Logan and Skamp 2010). Although personal interest is specific to the individual, the variable of teacher effects on tailoring students' individual interest has been linked with increased attainment scores within science (Archer and DeWitt 2010). In another study Abrahams (2009) focused on science practicals and associated them with situational interest. As such practical lessons were observed to have short term benefits observed only and interest was soon forgotten after the lesson. In regards to trends students that were deemed to have higher personal interest within science where often observed to have more motivation and a more positive attitude although declines still occurred over time (Galton 2011). One feature of the research of note is that of Uitto and Saloranta (2010) who studied the relationships between motivation, interest, attitudes and what they categorised as human values. The study highlighted that interest was often influenced by many cognitive and affective factors including potential mechanisms that aid in the formation of intrinsic motivational and value valences. Specifically they observed a trend in which students aged

14 were ranked higher in motivation and value scales on a specific paradigm, where also more interested with the task given.

Finally in relation to task value its catalytic nature has made it difficult for studies to assess this concept individually. The majority of the studies published relate value in relation to its extrinsic nature in that students are seen to value their science teacher (Reiss and Mujaba 2012) or that students are seen to value the worth of a science revision lesson (Degner and Wentura 2010). Like interest the concept of value is supportive in nature in that it is often an important influence on cognitive and affective factors. Unlike interest however value has been strongly linked with extrinsic motivational and attitudinal concepts. For example Schwartz (2007) argued that the formation of student attitudes was often a process triggered by external stimuli which then accessed benefit-cost processes to formulate a response. In regards to science lessons this would suggest that when students are placed into a situation in which a difficult task must be completed value is part of the micro concept process that enables an implicit procedure to take place. In support of this is that of Eccles and Wigfield (2007) who linked value with more extrinsic motivational goals in that a person such as a student values a task more highly when they know that achieving well within that task will mean that their parents will give them a monetary award.

In summary student's attitudes and motivation towards science lessons can be seen to decline from age 11 to age 14 with differences in decline rate observed dependant on race, gender, interest, value and level of abstractness in the science covered. Motivation has been observed to be more unstable in relation to student attitude and as such has been difficult to measure accurately within the research domain. The concepts of interest and value seem to be linked in the research as catalytic microconcepts that aid in the formation of motivational and attitude levels. This would suggest that studies within this area should focus on attitude as the most stable construct to measure levels of student engagement within science with a supportive role in measures to motivation and potential interest and values as a triangulation methodology to increase reliability within the results.

2.8 The Potential Impact of Transitional Processes on Students' Attitudes towards Science Lessons

Transfer is often a time of great anxiety for most students (Demetriou, Goalen, and Rudduck 2000). Students are often nervous about leaving a place which has been consistent in both macro and micro processes for the majority of their lives. Students habitually associate primary school with positive feelings of safety, peer relationships, autonomy and fun (Carroll-Lind, 2009). At the same time secondary school can have connotations as a place full of mystery and the potential risk in relation to older peers (Wolke et al, 2015). This is in parallel however to research that demonstrates that students have optimistic expectations with secondary school being seen as a right of status passage in that students are now leaving childhood and entering adolescence (Garpelin, 2014). Although older peers are seen as a risk, meeting peers their own age are often an aspect students' look forward to when attending secondary school.

One way in which secondary schools attempt to minimise negative feelings such as anxiety is through the focus of macro processes in relation to curriculum and logistical variables. An important transitional tool for the senior leadership managing this process is through the implementation of Open Events in which parents and children are given a tour of their perspective school. The majority of Open Events run on a similar format in which the head teacher gives a general talk about the aspirations and ethos of their establishment before summarising the attainment and extra curricula opportunities that are available for prospective students. This is then followed by a tour of individual departments which are set up to demonstrate what they do within lesson. Specifically within science the department is often laid out to demonstrate practical's with a wow factor (Abrahams 2011) and this potentially could leave both parents and students with a misconstrued perception on what actually occurs in normal science lessons. This misconstrued notion in turn could affect emotional, cognitive and behavioural processes in relation to students' held attitudes towards science. Sharpe (2013) demonstrated that positive attitude formation declines when students have to revaluate an attitude object that is different from what they perceived to be the case. This is supported by Cameron, Banko, Pierce (2001) who found that explicit motivation measures decreased in value when not followed through with positive rewards. This sequentially was also seen to reduce implicit motivational behaviour. It has also been observed that situational interest was seen to decline when tasks where over marketed (Parker 2000).

2.9 Implications of the Literature

In summary a decline in students choosing to carry on STEM related subjects has led to an assessment looking for a root cause for this trend. The impact of both transfer between primary and secondary school and a decline in students' held attitudes towards science has been highlighted as key denominators for affecting student engagement within secondary education (Galton et al 2007). However the literature on 'transition' or 'transfer' is ripe with ambiguity on not only the factors that affect student attitudes and successful transfer from primary to secondary school but also the basic meaning of the terms under consideration (Osborne et al 2003). This minefield has led to over 800 articles being published since 1990 (Web of Science search criteria 'attitude' or 'transfer' or 'transition' limited by 'education' tab) with varying degrees of citation and criticisms being observed examining factors such as attitude, motivation, interest, value, and anxiety. An analysis of year 6 Open Events and the impact they have on students' held attitude towards science is conspicuous however by its absence.

In relation to 'attitude' research one of the few clear themes that pervade this topic is that of its relationship to student attainment and subject retention (Osborne et al 2003, Garret 2010, Eagly and Chaiken 2007, Bennet and Hogarth 2009). A clear correlation has been known since Dainton (1968) that a decline in attitude of a specific subject has led to a decline in the student choosing the subject within further education. Specifically in relation to the subject of science this has then led to a reduction in the uptake of science and a potential shortage of educated and skilled individuals for the science and engineering sectors (Nottingham Skills and Enterprise 1994 and 2004). This relationship has led to numerous research papers investigating factors that could affect or trigger the formation of negative attitudes for science including gender, curriculum variables, teaching, personality and structural variables (Osborne et al 2003). However the effect on student attitudes to school by attending Open Events has only being analysed in relation to subject or tutor reporting with a priority on teacher/parent feedback for the next academic term (MaClure and Walker 2010).

Therefore the aim of this research is to discuss the level of impact that Open Events may have on students' student's attitudes towards science in school across the transfer from primary to secondary school. In the next chapter a more detail assessment of the idea of transition will be alluded too. Only with a more detailed analysis will a more comprehensive picture of the consequences for the way in which school marketing for students during transfer between primary and secondary schools using Open Events be eluded too. It is then not too big a leap that this could potentially inform researchers and institutions alike in filling in much needed detail on the phenomena of the reduction in students' held attitudes within subjects like science after transfer and retention within science in choosing further education options.

Chapter 3: Transition

3.1 Introduction

The area of transition has been under constant review even before the introduction of the National Curriculum (Braund 2009). The main reason that transition has had funds driven into research within this domain is the causal link associated between a bad transition and a reduction in attainment, a decline in positive attitude towards lessons and the potential for lasting damage to students cognitive and social development (Bailey and Baines 2012).

This area was deemed so important for its key function in the potential to affect the health and wellbeing of British children that the introduction of the National Curriculum had a focus on transition processes as one of its fundamental concepts (GOV.UK). The idea was that a progressively levelled and therefore consistent step by step approach to learning would eradicate or at least minimise what was deemed the main challenge between the transitions from primary to secondary school: That of consistency in standards of education and the improved generalization of ability of students when they left primary to attend secondary school.

Within the past decade a shift from public local educational authority run schools to a system of *acadamisation* has occurred in which schools are no longer made to use the National Curriculum as there framework for student learning. This change has been advocated due in part to the findings that the National Curriculum did not improve transitional issues (Galton 2007) with current evidence suggesting that in subjects like the STEM group this decline has actually progressed (Torres and Mouraz 2015).

Today focus has slowly shifted from macro level problem solving initiatives on transition such as timetabling and continuity of curriculum (Bicknell and Riley 2013) to more micro level intervention processes although work in this area still needs to be done. This involves focus on student's wellbeing and cognitive development although this is often only applied to minority groups in student bodies such as SEN children instead of a holistic focus on the majority of students. Macro level initiatives such as bridging units (Braund 2009) and student induction days have had some success in limiting the risk of students going through a 'bad' transition by minimising anxiety (Coffey 2013), developing networking opportunities (Weetman 2013), academic self-concept (Maguire and Yu 2014) and raising self-esteem (Symonds and Galton 2014). Micro level initiatives like 'buddying up' systems (Bicknell and Riley 2013), peer support networks (Weetman 2013) and parent/teacher networks have benefitted SEN students when macro-level processes by themselves had not worked and qualitative gains have be observed for all students when micro level procedures are used in tangent with macro-level procedures (Pointon 2010). However the dip observed in student attitude to learning still to this day persists with multiple studies showing a pattern of decline that consists of

- A decline at the start of year 6,
- An increase at the end of year 6
- A sharp decline at the start of year 7
- A decline at end of year 7 which continues until year 9 before levelling off.

This is especially more pronounced in the STEM subjects (Osborne et al 2003).

In this chapter an overview of the area of 'transition' or 'transfer' will be focused on. A discussion of what is meant by the term will be eluded too with reasons given for the breaking down of the dialogue of transition in terms of micro and macro levels. This will then be used as a foundation to highlight the importance of transition linking this to the effect of transition on students' attitude towards school subjects and the conceptual views held by individuals who play a key role during transition. Finally the link between transition and the formation of student attitudes in relation to science will be discussed with a summary on what the current literature says about the reason behind the decline/increase/decline of student's attitudes.

3.2 Definition of Transition or Transfer

The literature is ripe with opposing or confused definitions for the meaning of the term transition with some local education authorities using the term 'transfer' and 'transition' interchangeably. The umbrella term 'transition', as in the word used to describe the domain, relates to the process of which people must leave one area in which the person has invested there energy and time and move to another (GOV.UK). This means that at its most wide interpretation 'transition' can be used to describe a person moving home, a person changing from one job to another or a person ending a relationship before embarking on another. It is the process of moving on that is fundamentally the same whilst the time it can take and the start and end points of what a person is changing can differ substantially. In areas of educational research, which is what this thesis is based upon, transition is a term often used to describe the process of a child moving from and adapting too either a new year within school or making the larger process of leaving one school for another (Gorwood 1991). This in itself is not a clear enough definition for researchers in this area to use as this often causes miscommunication within the domain about the process of which researchers are studying. Galton (1999) clarified the issue within his work entitled 'Changes in Patterns of Teacher Interaction in Primary Classrooms: 1976-96' and it will be his definitions that we will be using throughout this thesis. Therefore 'transition' will be used to talk about students moving from one year group to another *within the same school.* This means that micro level changes may have taken place (Different teaching style) but the macro level has not altered or altered very little (Structure of timetable for school). The term 'transfer' will be used to talk about when a student moves *from one school to another.* This therefore translates as changes at the macro and micro level that the student must face when attending their new location. Finally the term *'transition processes'* will be used to indicate the domain of research involved within transfer or transition of students. Within this thesis it is the impact of students transferring from one school to another, of transfer and the processes of transition, which is the main focus of this work.

3.3 Types of transfer in Wales and England's education system

Within the Welsh and English education system compulsory schooling lasts until the students are 18. As such *typical* transfer occurs three times within a student's education. These include:

1. From nursery to primary school (age 4-5)
2. From primary to secondary school (age 10-11)
3. From secondary school to college or an apprenticeship (16-18)

Atypical, (a term used loosely in this case due to the prevalence of this three tier system) transfer however can also include a ‘middle school’ element in which primary school children transfer at age 9 until age 13 or age 8 to age 12 before secondary or high school transfer takes place. Some secondary schools have also taken advantage of neoliberal processes (Braund 2009) and now also have an attached sixth from teaching element in which the secondary school student will stay until they are 18 instead of attending a separate institution (See table 1).

The reason behind this difference is embedded in a battle within the transition research domain between two schools of thought and this argument will be expanded on within the next section.

It must be noted here that Scotland also differs within its structure for schooling within the UK. According to General Teaching Council of Scotland although Scotland has differences in macro level policies these variances do not lead to fundamental discrepancies between the three key regions. As this thesis is not attempting a comparative study based on these differences within the UK or collecting data from this region this in itself is not of importance for this PhD however a more detailed account can be found in Donaldson (2011) for those that are investigating the area.

Transfer points	Nursery Student age	Primary School Student age	Middle School Student age	Secondary School Student age	College or Apprenticeship Student age
Typical transfer points	3-5	5-11	N/A	11-16 or 11-18	Option: 16-18
Atypical transfer points (1)	3-5	5-9	9-13	13-16 or 13-18	Option: 16-18

Atypical transfer points (2)	3-5	5-8	8-12	12-16 or 12-18	Option: 16-18

Table 3.1 demonstrating an outline of typical and atypical student's ages of transfer within England and Wales

3.31 Stage-Environment Fit vs Status Passage

As school budgets are governed by student numbers it is unsurprising that within the 1970's and 80's a push for 'middle schools' occurred (Braund 2009) in which primary schools used existing building capacity to cater for their students for an extended 1 to 2 years. The underpinning of this three tier system was supported by ideas that 'matching' or facilitating a 'stage environment fit' was key to a good transition process (Galton 2009). Within this idea was the assumption that students emotional and cognitive development occurred within increments and as such an educational transfer policy that catered for this and also occurred in increments would be best to limit dips in attainment, attitude and behaviour (Zeedyk et al 2003). The notion was that students 'goal aspirations' in tandem with the students expectations of gaining more rights of choice and freedom often had difficulty in adapting to a different pedagogy approach within secondary school in which competition and teacher led activities where the rule (Galton 2009). This idea of *best fit*, with an emphasis on continuity at transfer, was designed to limit immediate macro and micro level changes and then gradually filter these across the middle school years to reduce the impact of educational adjustment. However this idea is not supported in part by research findings that suggest that 75% of students in typical secondary schools have adjusted to transfer by the middle of the first half term (Symonds and Galton 2014 and Holmstrom 2014) with the first ORACLE study claiming as much as 88% adjustment which is in contrast to what you would expect to find if the Stage Environment Fit held true: A gradual adaptation based on the rate of student development over time.

The idea of person-environment fit theories contrasted sharply with the ideas of school transfer as a student's right of *status passage*. Whilst the idea of Stage-Environment Fit had schools focusing on continuity between primary and secondary the idea of transfer between schools as a social rite of passage advocated an element of discontinuity (West et al 2010). Without discontinuity, the ending of primary and the start of secondary schooling, students may find it difficult to see outward signs that they have left behind being children and are now an adolescent (Weller 2007). Looking at this viewpoint the argument would therefore be that a decline in attainment, attitude and behaviour during transition processes would be due to the student's expectations before transfer not being met by the reality after transfer at the micro/macro level. This is supported by studies such as the ORACLE project (2005) and by the National Foundation for Education Research's study on the use of bridging units. Powell et al (2006) found that when student note books were used for bridging it was often only when a student finished the book or finished the 'primary school' topic those students believed that they had become a secondary school student. In fact throughout the literature challenges with continuity of micro-level processes have shown a pattern of reduction in anxiety, aiding the wellbeing of a student during transfer, whilst also showing a decline in attitude towards the work as it was viewed by the students as 'primary' (Powell et al 2006).

Either way quality transfer from primary to secondary school is significant for the continuation of the child's social, emotional and physical development (Braund 2009). A positive start to school is often associated with a student's healthy perception of themselves as a person and as a learner (Barmby et al 2008). The risks of the student not engaging with their academic experiences are reduced whilst social interactions are refined to give students the ability to respond appropriately to their environment. The school's preparation for the learner is fundamental as strong communication between parents, the student and teachers is needed to enhance the development of the child. Although the process of transition can be stressful it is important that continuity of curriculum, progression and what occurs within the classroom be bridged as closely as possible to cushion the negative impact of change whilst also balancing this with a need to make the student perceive that they have left childhood to enter adolescence (Galton 2011).

In relation to school structure it must be noted that there is no evidence to suggest that the introduction of a 'middle school' element or the lack of this aids in improvements in student's attainment, development of a positive attitude or a reduction in negative behaviour (Riglin et al 2013).

Although decline's in transition process anxiety differs within studies the reduction in attitude and attainment is consistent across both typical and atypical types of educational journey (Symonds and Galton 2014). Potentially this could be due to the changes that occur, no matter at what rate, to micro and macro processes for student education. It is these processes that we focus on in the next section.

3.4 Macro-transition processes

Within transitional process research a common theme that runs through the literature is what this author is terming *macro processing challenges*. It is these challenges that have been a focus by some researchers as a key component of the dip within attainment, attitude and behaviour after transfer (Rice et al 2011). At its most basic macro-transitional processes include the effective management of physical changes to schooling that the student must adhere too. Students experience logistical changes during transfer that often include a change in timetabling, the timings in relation to the school day, rooming's, the use of planners or diary's, and curriculum continuity (Galton et al 2000). It is this logistical upheaval that some researchers have argued limit and causes regression within students (Holmstrom et al 2014). The majority of published research focuses on individual variables under the macro-transition umbrella and these will be discussed in the next section especially in the area of curriculum continuity. What is important to note at this time however is that school focus during transitional processes is primarily in relation to embedding students and parents into their own management procedures (Bailey and Baines 2012) and as a by-product of this micro transitional processes are often ignored or an add on to an already existing macro level system.

3.41 Structural Variables

Schools have improved with supplying both parents and students with enough information about the structure of the school day, rooming's and school procedures for an assortment of miscellaneous events that stress has been limited and the majority of students and parents now look with anticipation towards starting a new institution (Bicknell and Riley 2013). Correspondence by email, post and the use of Open Events and induction days are prime tools that smooth the path of transfer. More recently the implementation of direct school contacts for teachers and middle managers in the majority of schools with England and Wales (GOV.UK) has led to a greater transparency between parents, carers and the senior Leadership Teams within education. This open access has led to a reduction in anxiety for students at transfer although it must be noted that this more tailored approach has also caused a workload increase to already at capacity staff (NASWUT). According to Galton et al (2001) improvements to structural variables has led to a reduction in student categories of anxiousness especially for students with special educational needs. However the authors do make the distinction that just because students have less objects to worry about does not in turn mean they are less anxious about transfer, instead that their worrying is just shared across fewer variables. Bicknell and Riley (2013) focused their research on a different category of student: The gifted and talented. They found that clear communication of timetabling, rooming's and the structure of the school day reduced the time needed for the students to adapt to the changes in school and that it was curriculum continuity that was the limiting factor in this area. As said earlier the majority of research in this area has been conducted on the challenges with curriculum over transfer and it is this area that we expand on next.

3.42 Curriculum Variables

Research conducted on the curriculum pre and post transfers have uncovered a range of challenges that students encounter including its organisation and its delivery (Symonds and Galton 2014). In this section we focus on the macro-transitional process of organisation including continuity. The delivery or teaching style will be discussed in detail under the micro-transitional processes section.

One of the key changes that transfer students go through is that of losing one or at worst two teaching generalists and gaining as many as 10-20 subject specialists. Apart from the logistical problems students encounter with this including more lessons and reduced time to complete tasks (Coffey 2013) the continuity of the curriculum is often a challenge as often different students have ended the primary schools subjects at different points and as such need to start at different points within secondary school. One way in which schools have tried to combat this is by using *bridging units* as a means to combat this differentiation (Powell et al 2006). These bridging units or bridging projects are often schemes run by feeder primary schools in association with a secondary school in which a topic is started at the end of year 6 and finished at the start of year 7. The assumption is that they can be used as a foundation of stability for core subjects and as such be a conduit between maintaining progress across transfer (Galton 2011). Although these bridging units have met with some success in relation to subject attainment within the short-term, they have been found to be ineffective if the secondary school in question has too many feeder schools (Powell et al 2006). It also must be noted that student attitudes and behaviour within lessons towards the subject material actually decline during this process as students often perceive the work as beneath them now that they have moved up from primary school. Another method that has been used to promote continuity whilst also providing students with the perception of a rite of passage is that of subject induction days (Abrahams 2011). These days are often done just before the summer holidays in which year 6 students attend a day at their transfer school taking part in taster lessons of specialised subjects such as science and design technology. For the primary school this provides the students with specialised equipment that they have little or no experience with whilst for the secondary school this provides the opportunity to create a starting point that can be used when they attend lessons for the first time as students in September. There is however an associative danger of overselling the subject to students on induction events which in the long term may have detrimental effect of the attitudes towards that specific subject.

3.5 Micro-transition Processes

It should be pointed out at this juncture that the outcome of improved macro-transitional management has been the reduction in anxiety of students during transfer (Coffey 2013). This however has had very limited impact on student’s reduction in attainment, a decline in positive attitude towards lessons and the potential for lasting damage to student’s cognitive and social development. The answer to this may lie with a shift in focus towards micro-transitional processes during transfer (Symonds and Galton 2014). Although the transitional process in relation to macro transition has improved within the past decade a by-product of this has been the neglect of micro transition processes. At its most simplistic this term encompasses the differences experienced in the classroom setting that the students will experience on a day to day basis although it can also encompass in a broader sense what also occurs within *student time* for example the lunch break. Micro-transitional processes include such variables as teaching style (Barmby et al 2008), student dynamics (Galton 2011) and the expectations of the teacher and students (Osborne et al 2003). Although just as important to parents and more important to teachers micro-transitional variables are often seen by the school to be the remit of the individual teacher (Oplaka 2003). The exception to this rule is that of the group of students under the label special educational needs (SEN) in which a more holistic school approach to micro-transitional process management is observed (Galton 2011).

3.51 Teaching style

It is not part of this thesis to asses in detail the different teaching styles but it is important to give a broad brush stroke of this area in relation to transitional processes. The myth of a style of teaching that suits the student for outstanding learning to take place has prevailed within the literature since the 1950's . Depending on the decade and subject in which a teacher was trained individuals will advocate different preferences for different styles. A study by Cazden was conducted in 2001 looking at common themes found in outstanding lessons. The findings suggested that lessons with three separate parts: a clear starter, a main and a plenary, where best to promote learning within students of all ages. The recommendation at the time was that this framework be used across schooling to support lesson constancy and as such would aid in student transition between transfer. Although this has helped with student's anxiety by having similarities in lessons there are still pedagogical differences and fundamental preferences of teachers between transfer (Jordan et al 2010).

In primary school, independence, group work and social skills are heavily focused on. This can be seen in the design of the room with 'group tabling' (Harris et al 2012), the displays on the wall (Morgan 1999) and the relationship between student-teacher (Capel et al 2005). In comparison at secondary school discipline is promoted (Logan and Skamp), independence is often limited (Riglin et al 2013) with focus more on specialised subject content and skills associated with this (Abrahams 2011). This has led in part to students perceiving that they have a stronger relationship with their primary school teacher in comparison to their secondary counterparts which in turn has resulted in lowered attitude towards learning (Sharpe 2013). Research by Bailey and Baines (2012) has demonstrated that this lack of attachment development is especially difficult for SEN students who struggle in this area however this is in counterpoint to Symonds and Galton (2014) who looked at studies covering over 200 students within six different secondary schools over a ten year period. They showed that a good teacher can minimise the formation of negative attitudes towards the school as a whole and promote positive attachments to their specific subject especially for SEN students. Another method that has been linked with student attitudes towards science lessons is that by Sharpe (2013). Sharpe looked at the effect of science practical's on students attitudes and found that the use of a more hands on approach made the students perceive science in a more positive light and reflect on the teacher as a 'good' professional. Although this differed depending on the type of science and attitudes still declined over time this may be due to an over marketing of the type of practical's students would get to attempt (Abrahams 2013).

In relation to transfer this would suggest that a key component in transfer policy should be placing teachers who are 'inspiring' in their subject to teach year 7. A comparison between features of a teacher that promotes positive attitudes and one that does not has as of yet been adequately assessed. However a root cause of these teachers not being used more often on transfer years could be the focus of secondary schools on exam results (NASWUT). This often means that the school timetable is planned around the older years and as such year 7's are often given non-specialist teachers or a mix of three separate teachers for three lessons (Toole et al 2013). The introduction of Progress 8 and Attainment 8 policies (GOV.UK) should cause schools to shift their focus away from prioritising exam groups and this will potentially aid in the teaching of transfer groups however a clear policy during transitional procedures has yet to be seen on this aspect (GOV.UK).

3.52 Student Dynamics

Research indicates that the micro-process of group dynamics is often what students are most positive or negative towards during transfer (See table 2 and 3 taken from Zeedyk et al 2003). The worry about bullying and the long term effect it can have is prevalent in the literature although it must be noted that the majority of schools have macro procedures in place and often have a ‘zero tolerance’ policy in regards to this issue (Mellore and Delamont 2011). Another variable that Zeedyk et al highlights is that of the making of new friends. Although the focus of most secondary schools over transfer is to embed the students into a new routine, students themselves are more focused on making new friends than learning (Bailey and Baines 2012). This lack of focus on academia has often been cited as a key cause for the dip seen within attainment however when high proportions of friends within the same primary school transfer together to the same school this attainment dip still occurs (Bicknell and Riley 2013). One argument for this dip still occurring is the impact of their older peers and the change of their social status as the ‘bigger students’ to the ‘little year 7’s’ (Weetman 2013). Just as the students are earning more autonomy and becoming more self-sufficient they then move to a place in which less autonomy is given and opportunities to be self-sufficient or take leadership roles are limited (Bicknell and Riley 2013). Potentially it is this perception of being the archetypal little fish in a big pond after going through a rite of passage of transfer that often causes upheaval during transitional processes as students attempt to map out where they fit in their new environment. The use of buddying up systems within transitional policies for schools could aid in this area. Research by Evangelou et al (2008) demonstrated that students with an older peer buddy before transfer showed less negative trends in anxiety and emotional wellbeing measures. Symonds and Galton (2104) also found that students with older siblings already at the school found transfer easier in comparison to their peers who did not have that network already in place.

3.53 Expectations of Teachers and Students

Finally it must be mentioned that the change of ethos can have an impact at the micro-transitional level. Often primary schools focus on equality and collaboration with strong links with parents and individuals within the community. Although primary school students perceive themselves to be more independent in actuality a

Themes	*Primary Pupils* N = *192* %	*Secondary Pupils* N = *128* %	*Primary Parents* N = *119* %
New friends	57	40	43
Academic subjects	37	44	45
New teachers	17	15	17
New routine	6	17	11
Extra curricular activities	8	2	15
Learning challenges	8	2	22
Being grown up	2	2	5
Miscellaneous	14	9	11
Everything	1	–	3
Nothing	2	1	1
No answer	1	4	4
Unclear	2	4	–

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Table 3.2: Taken from Zeedyk et al 2003. Entitled 'What aspects of secondary school do children look forward too?'

Themes	*Primary pupils* N=*192* %	*Secondary pupils* N=*128* %	*Primary parents* N=*119* %	*Primary teachers* N=*11* %	*Secondary teachers* N=*19* %
Bullying	31	48	27	64	90
Getting lost	13	23	13	46	47
Peer relations	12	14	19	46	63
Workload	12	10	13	46	26
New academic subjects	4	–	4	18	11
New environment	4	2	18	18	32
New teachers	6	9	7	27	37
Being the youngest again	1	5	4	9	11
New routine	1	1	–	18	–
Academic performance	6	4	5	–	5
Miscellaneous	7	6	8	–	–
Everything	1	1	–	–	–
Nothing	33	8	19	–	–
No answer	1	2	5	–	–
Unclear	1	1	2	–	–

Table 3.3: Taken from Zeedyk et al 2003. Entitled 'What aspects of secondary school do children worry about?'

support network controls, nurtures and guides their behaviour. In affect student behaviour and self-autonomy is closely monitored and controlled by teachers and parents (Galton et al 2011). When students leave primary school they have expectations that the work will be harder (Galton 2009) but that they will be given more responsibility and autonomy in their learning (Braund 2009). The reality however does not meet these expectations. At secondary school this focus of collaboration and group activities with parents and teachers explicitly supporting students shifts. Secondary school teachers have the expectation that the student can and will take responsibility for their own learning. This is indicated by the introduction of 'diary's' that most schools give out (Symonds and Galton 2014). Parents have very few opportunities to monitor their children at this level apart from homework (Barmby et al 2008). The student is expected to self-monitor their own behaviour (Bennett and Hogarth 2009) and contribute across school. Teachers often take a more authoritarian approach with the attitude that it is easier to let the students have some slack later then it is to take up the slack if they are too easy on them (Galton et al 2000). Due to this expectations of students behaviour and attitude towards work is high (Coffey 2013) although oxymoronically the level at which they are working at is often underestimated by the secondary school teacher (Huggins and Knight 2006). This perfect storm of factors that students must transpire to map their way through is exasperated by different expectations of teachers within different subjects or even different teachers expectations within the same subject.

One way in which students can be aided at this time is through teacher/parent networks (Kwalsund 2000). Research clearly demonstrates that parents often have a clear idea of what is worrying their child (Symonds and Galton 2014). At the same time research clearly demonstrates that when teachers and parents collaborate more effective tailored learning can take place that aids the students during the process of transfer (Braund 2009). As transitional processes at the macro level are well established it may be advisable for schools to look at tailoring micro-transitional processes. A good place to start would surely be transferring the strong links with parents and primary school teachers to the secondary school equivalents. When this has occurred in relation to SEN students (Pratt and George 2005) the process of transition for those students has had high success.

One aspect of transitional processing that schools are improving on is that of transparency and ease of communication for the parent (Grey et al 2011). This is important as often the parent has a better insight into what affects their child and their viewpoint is worth listening too (West et al 2010). The challenge still exists however between communications of different groups focusing on different aspects of transition. In the next section these conceptual differences will be evaluated in more detail. Only through understanding the participants within the transitional processes will a more holistic view be gleaned from the research within this area.

3.6 Conceptual view on transfer

During transfer from primary to secondary school the key components that govern the process of transition include the student, the parents or carers, the teachers and the school itself. Each classification group however is focused on different urgencies during transfer (Speering and Rennie 1996). This is clearly reflected with the school focusing on more macro-transitional problems whilst the teacher and student are often more focused on micro-transitional problems (Coffey 2013). However even within this students and teachers are different. For the student this focus is often on more short term gains whilst the teacher often reflects on more long term issues (Torres and Mouraz 2015).One of the underlying themes within education in England within the last decade has been the introduction of polices that directly link to fostering ideas of ‘market forces’ and competition between schools (Finn, 2015). Legislation such as the Academies Act (2010) the Wolf Report (2011) and the revised Education Act (2011) have changed the educational landscape within England causing education to move away from a nationalistic based system, in which education was monopolised by the state, to one that was based on ideas of privatisation (Inglis, 2014). During this process ideas of parental power have been one of the key selling points of moving away from a public market of education and moving towards an education system that promotes individual choice. As an example Academisation, a policy that embeds privatisation within English schools, has been seen as a mechanism to increase competition between educational institutions that would in turn increase standards in schools (Education Act, 2011). This change from Local Educational Authority controlled schools to the formation of independently run academy chains is therefore meant to reinvigorate the standards seen within schooling (Department of Education, 2010) and halt the slide in standards observed in ranking in National Educational league tables by such measures as the Programme for International Student Assessment (PISA) tests (The White paper, 2011).

One implicit area within this ideological change of education and schooling within England was promotion of the importance of communication between educational stakeholders (McNamara et al., 2010). Research suggests that maintaining strong communication links with parents, their child, the teacher and the educational establishment results in better student outcomes in regards to students' general wellbeing (Rice, 2006) and their academic achievement within school (Education and Adoption Act, 2016). The introduction of market values within education is seen as an aid in highlighting this theme including achieving key aims such as improving legislation regarding the responsibility and accountability of parents and teachers in relation to their child's educational welfare (Maclure and Walker, 2000), focusing more on children's academic performance within school as an indicator of the school itself (Coughlan, 2009) and the promotion of the choice of parents in regards to controlling where their child attends school (Ofsted, 2014).

According to the rhetoric of these educational changes parents should therefore have an increased choice of a range of schools within their local area in which they are free to pick and choose from (Education Act, 2011). In turn the introduction of legislation to support parental choice has led to changes in school recruitment strategy in that they there now seems to be a need for schools to offer to their perspective customers (the parents) a history of strong academic performance (MaClure and Walker, 2010) and show 'value for money' (Palmer and Koenig-Lewis, 2009) in regards to a child's all round education including extracurricular activities on offer. As with any free market a product not judged as highly as another product will have lower clientele numbers. In a school context the theory is that less students will therefore attend the less well regarded school which will result in a lower available budget due to lower student numbers. If this continues with standards being seen as not good enough in comparison to their competitors the risk is there that the school will eventually close. It is with this control, that of parents choosing their children's school, that market values are seen as an important determinant in increasing educational standards (Finn, 2015).

Due to these developments it is not unsurprising that it is now more common for schools to employ public relations officer (Ball, 2003) to aid in and develop the image that the school gives to their local community and to communicate with perspective and current parents. There is however an accumulation of evidence that is beginning to suggest that although parents how increased opportunity to communicate with the educational establishment it is only during the process of transfer, when a child must choose what secondary school to attend, that their viewpoints are listen too (Bosetti, 2004). After transfer has occurred maintenance of their communication links is minimal (Clark and Power, 1998) and is exasperated by the lack of genuine discourse and the personal agendas of the main stakeholders within secondary education (Oplatka and Hemsley-Brown, 2004). In this section the standpoints of the different groups are summarised in aid to give an outline of the priorities involved during transition.

3.61 The Student

Students are forced to evaluate their *identify* during transfer and this leads to the reassemble of their *self-concept* (Maguire and Yu 2014). Students are often focused on short-term goals during the process of transition. This holds true for gifted and talented (GT) and special educational needs students (Bicknell and Riley 2013). On the one hand students are looking forward to wider subject *choice* and have an unrealistic ideal on what these subjects will be like (Demetriou et al 2000). On the other hand they are often focused on making new friends and worried about being bullied (Galton et al 2000). After transfer students often report problems with lesson delivery (Maguire and Yu 2014) with GT students reporting challenges with pace of lessons as well as going over similar content from primary school (Reiss and Mujaba 2012). This theme is a common one within the research literature with students often *comparing* their new school to an amalgamation of what they are used to from primary school and what they expected secondary school to be like. Problems of transitional processes for the student are often based on this process when the student perception of school differs drastically from actuality of school post transfer.

3.62 The Parent

Parents have been noted to be a strong reflection of the student's worries during transition (Jordan et al 2010). In a study analysing the views and influence of different groups involved within school within Scotland over 70% of mothers were able to accurately match their child on what their concerns where. Interestingly although focused on short-term variables at transfer such as the risk of bullying parents did differ in that they were concerned with a balance between their child's emotional wellbeing as well as the child being pushed to fulfil their potential (Gorwood 1999). This could be in part due to the mothers understanding that some emotional upheaval may have to occur at transition for the long-term benefit of their child (Galton 2011) although father's opinions differed in that they viewed transfer as just a procedure their child had to go through to meet new peers (Symonds and Galton 2014).

3.63 The Teacher

The teacher is tasked with fulfilling two roles at transfer: That of a subject teacher dealing with student attainment and then as a tutor dealing with the emotional welfare of their new charges (Reiss and Mujaba 2012). The literature suggests that teachers take a long term few on these two roles and often prioritise their time on attainment to older year groups and do the minimum in regards to their pastoral role with the expectation that the pastoral system employed by the school will deal with any major challenges. In relation to year 7 an assessment of content and skills associated with their subject is often taken early on arrival and then reassessed at times set out by the school policy. A focus on data and students *improving* within lesson is a key priority (Ofsted 2012). This focus has been highlighted recently with the governments shake up of the current systems of data collection secondary schools must make public. The introduction of attainment 8 and progress 8 policies will have an impact in this area with the schools now being monitored on the attainment and progress in the transfer years and not just examination groups (GOV.UK). At this time however it is too early to tell what the effect will be.

Overall themes of safety, student wellbeing, attainment and developing peer relations embed the views of the individuals involved within transitional processes. Although as said earlier within this thesis that there are differences at the procedural level as to the focus of transfer be it macro or micro there are also differences that occur in relation to the short or long term view of the individuals that are part of this process. Students are more focused on the immediacy of change. Parents support this view but understand that effective transfer may take time for their child to settle down into a routine. The teacher often has a more long term view in that they have five years to make sure that the student attains their potential especially within the examinations that they need to take. All of these different perceptions on transfer inform the idea that students have needs that not only have to be met but also must be perceived to be met by the individual for a successful transfer to have taken place. In this next section we evaluate current transitional research to sift out what student needs during transfer are.

3.7 Students' needs during transfer

Student's needs during transfer are underpinned by the dual idioms of safety and enjoyment. This underpinning is important for attainment, positive attitude towards lessons and students cognitive and social development (Riglin et al 2013). Above all else the majority of students *enjoy* primary school. They often have fundamental ideas formed that going to school will help them later in life (Rice et al 2011). They understand that school is important (Galton et al 2011) and they often want to do well. For some school is the safest place they know (Barmby et al 2008) and the process of transition disrupts this routine at both an environmental, cognitive and social level (Bennett and Hogarth 2009). At the same time transfer occurs as developmental change is triggered (Osborne et al 2003). These new adolescence often have different needs from the children they were and these needs can be typified into categories. It is these categories that are discussed next.

3.71 Individual self-development

Student's when asked often perceive that they have become an adult once they start secondary school (Holmstrom et al 2014). As such they have optimistic expectations for themselves that include more autonomy then they are used to and worry about self-regulation and organisation (Sharpe 2014). A common theme highlighted by (Osborne et al 2003) is that of the fear of getting lost and this is prevalent throughout transitional research. Students also show a need for opportunities to display how mature they are and are often resigned when these leadership opportunities pass them by for their older peers (Barmby et al 2008). In fact in some schools opportunities do not exist for younger years due to the number of roles available dependant on the structure the school is geared towards (Rice et al 2011). This is further exasperated by reduced opportunities to choose their work mate or where they even sit within lesson time (Riglin et al 2013). Although on the whole these seem like small setbacks the period of transfer is a time of heightened emotional state and any negative or positive experience is magnified by the student (Galton 2011). In the case of individuals self-development the lack of leadership opportunities limits a mechanism in which the student judges their own worth against others (Symonds and Galton 2014). The consequences of this could potentially be seen within symptoms of anxiety in which students during the transitional process often go through emotional states that include sadness, nervousness, worry and feeling of being afraid. The emotional wellbeing of the student is often at risk if the student perceives their interaction with the environment to not be safe or if they do not know where they fit. Feelings of anxiety are a common symptom during transfer and often are embedded within student self-assessment of doubts about if they are ready for the leap to *big school* (Braund 2009). Although this transitional anxiety is often reported to dissipate quickly after transfer some students develop a more generalised anxiety disorder during this process which can take longer to overcome (Holstrom et al 2014). This generalised anxiety, in which the student activates their fight or flight response mechanism, has been argued to be responsible for more disruptive behaviour seen at transfer and is linked with students increased risk of developing depression or the formation of fallacies on school realities. Depression itself can lead to student formation of negative thoughts as well as disinterest in the world around them. This lack of enjoyment is often a clear indication of the students need for self-development not being met and a sign of a good transitional policy should attempt to eradicate this from occurring and have both macro and micro procedures in place to deal with this if it happens to occur.

3.72 Peer developments

Whilst opportunities to demonstrate self-determinism as an individual are sporadic the student often evaluates themselves in valuation to their peers (Attard 2003). The attendance of secondary school often results in the student attending a larger school in which more opportunity exists to choose friends from a larger cohort. The need for the student to develop or reassess their peer group is often their main focus throughout the first term post transfer (Holcomb-McCoy 2011). The outcome of this is larger friendship groups of often better quality friendships based on the self-awareness of likes and dislikes of objects. At the more advances stage of friendship building this also includes the acceptance into school cliques in which the group bases its identity in comparison to others (Graham and Hill 2003). This dynamic also has the added benefit of protection against the older peers and often reduces the student's anxiety towards the many myths and legends about what occurs to new school students when they arrive post-transfer (Chmielewki et al 2013). Within these peer groups students form new academic self-concepts (Duchesne et al 2009) or confirm old beliefs (Galton 2012). Studies show inconsistencies on the increase or decrease of student beliefs about their academic potential possibly based on the schools focus on academia in which they attend. Symonds and Galton looked at year 6 and 7 across ten schools and found an increase-decrease pattern. In comparison Weetman (2014) observed the opposite with a decrease-increase pattern. What can be argued however is that there is strong evidence of an effect on the students 'perception on their academic competencies which is unrelated to the research method used.

3.73 Need for teacher support

One of the few stabilising roles between pre and post transfer is that of the teacher. Although the individual teacher has changed the students often need to be valued by their teachers (Barmby et al 2008). This is exasperated however by the teaching mentality of *'don't smile until Christmas'* (Galton 2012). The different pedagogic styles and the strictness of the teacher have been highlighted as one of the key factors in negative attitude formation (Sharpe 2013). Studies by Bennett and Hogarth (2009) have shown that teacher attitudes of their students are more negative than their primary school counter-parts and have been linked with unrealistic expectations of their students. Students in turn are often used to evaluating where they fit in the social scheme in relation to their peers using teacher feedback (Rice et al 2003). This *perfect storm* of minimised positive feedback from teacher as well as student disassociation in regards to their place in the social schemata of school life potentially results in an environment in which psychological development may struggle to progress. One potential consequence of this is that of the potential of the formation of student low self-esteem. Research has been conducted to test the link between self-esteem and transitional effects with mixed success. Studies conducted over transition by Newman et al (2011) suggest that self-esteem formation occurs with no effect by transfer apparent. However findings by Hirsch and Rapkin (1987) and Cantin and Boivin (2004) observed the opposite with evidence of both declines and increases in measured results on student self-esteem. Symonds and Galton (2014) reviewed the available quantitative data on self-esteem studies based round transition and indicated that the effect size for the deadline/incline of self-esteem was very low (-0.17) suggesting that any significant differences within results could be due to the effect of small numbers of students on either side and that on a whole self-esteem was deemed consistent on average.

3.74 Need for school emotional engagement

Students often need to feel appreciated and in turn their perception of the school is based implicitly and explicitly on this ideal (Gorwood 1991). According to Osborne et al (2003) a summary of the literature shows a pattern of decline of student enjoyment in school. Although this differs in severity based on subject, with least severity seen in English and most severity seen within science, enjoyment declined until the age of 14 before becoming stable. The cause of this decline can be fit into three subcategories: *carer orientation, academic achievement and classroom management.*

In relation to carer orientation students often suffer with their perception of not seeing the relevance of the reason why they are doing a specific task especially within STEM subjects (Barmby et al 2008). Students struggle to understand how they can make a contribution to subjects heavy on content such as the sciences and technology and often have low aspirations on how well they will do in these subjects in comparison to others (Bennett and Hogarth 2009). When tasks have been explained to the student in relation to developing their career positive emotional engagement is activated (Sjoberg 2012). This is supported by Holmstrom et al 2014 who interviewed students on the usefulness of careers guidance with students demonstrating increased levels of motivation with subjects that where linked to careers they were interested in pursuing. The results indicated that if the student could not see the point in the context of why they needed to know it they often were not positively emotionally engaged towards the topic.

In relation to academic achievement students often need to feel they are doing well to engage with a subject. In a study by Barmby et al (2009) students had to rate their class subjects in order of what they found the most difficult. The subjects rated the hardest are often the subjects most cited as those where emotional engagement declines the steepest. In a study by Symonds and Hargreaves (2014) who considered reasons behind declines in overall engagement they established that views on competency and autonomy where important for subject enjoyment.

This links with the idea of classroom management in which the student often chaffed and lost enjoyment when their individual autonomy was affected by their peers or by the teacher (Abrahams 2012). Research by Galton et al (2003) demonstrated engagement when peer relations were supportive and lessons where deemed to have relatedness to the individual. Overall emotional engagement was limited by micro level processes not fulfilling the student's personal criteria. As this is fundamentally based on an individual to individual basis research should demonstrate differences between findings on autonomy and emotional engagement. This was found to be true with MacIver et al (1986) demonstrating 'clusters of children' with differences in desire of levels of autonomy within lessons.

3.75 Need for parental support

As stated previously the role of the parent on influencing positively their child's emotional, social and cognitive wellbeing during the process of transition is vital. The mediating effect of good parenting has been linked with the decreased risk of a child adjusting negatively during transfer (Symonds and Galton 2014). Maintaining a stable and loving environment provides the child with opportunities to be praised and to self-express which is important for both identity formation and self-esteem (Rice et al 2003). Parents have also been associated with providing their child with *soft skills* supplementary with dealing with situations in which social upheaval may occur. This can include coping mechanisms such as the ability to communicate their thoughts and feelings (Symonds et al 2014), emotional management (Symonds et al 2014), social management (Symonds et al 2015) and problem solving (Attard 2003). These soft skills enable the student to be both resilient and confident in their ability to manage the process of transition with lower incidences of anxiety reported . At the same time parents that reflect their worries and anti-social values to their child can also impact the process of transition negatively . According to research by Bicknell and Riley (2013) parents who *mother* their children often as a by-product deskill their child from coping independently with change. This is often seen with parents of SEN students who are very protective of any change for their child. To overcome this problem some secondary schools put in place parent workshops and induction programmes actively encouraging parents to take a more considered role during the process of transfer . This enables the parents to be actively engaged in the nursing of and intervention of their child from one school to another whilst providing a network of support for the parent to deal with their child's decrease in dependency on them (Galton 2012). Networking has also been linked with a child experiencing good transfer as parents can evaluate and share ideas that helped them with a specific problem. Parents can also provide more covert support pre-transfer by placing their child into situations in which they must meet a larger cohort of peers then they are used to from primary school. This is often done in the form of joining different social clubs such as karate as well as more communal based operations such as the local football team or dance studio (Symonds et al 2014). This covert parental operation often provides the child with a framework to make new friends with similar interests that they may join with at secondary school making the process of transition easier for them.

3.76 Few opportunities for parent-teacher discourse

A common criticism of the relationship between parents and their children's secondary institution is that of the lack of available information for parents on what happens on a day to day basis (Hughes, Wikely and Nash, 1994). The challenge however is finding clear opportunities for parent-teacher discussion. This feature of the communication between schools and parents is not new and is not just an academy challenge. Hughes, Wikely and Nash (1994) questioned parents and asked them what different forms of communication the school used to communicate with them. The most common answer was that of the school newsletter (100% of sample received at least one) with parents evenings also highlighted (84% had attended). The use of the PTFA was also noted as a potential avenue of communication but only covered a small percentage of parents (10% of sample). In a separate study Varlaam et al. (1985) observed that 90% of parents attended the yearly parents evening but only 15% had volunteered in any capacity to help within the classroom. They also observed clear differences between schools in regards to parent's opinions in so far as that parents from one sample school felt that they were wanted to be involved by their Childs' school whilst within another sample school this was the complete opposite. What these earlier studies highlight is two key themes in regards to parent-teacher communication: That of dialogue between the parent and teacher about their child's education and that of dialogue between the parent and teacher about what is occurring in their child's school. It is within this context that the next section gives an overview of current research in regards to opportunities for parents of secondary school children to communicate with their teachers.

3.77 Parents and their child's education

A key difference between secondary school and primary school seems to be the expectation that parents are not needed for support in regards to classroom learning (Ofsted, 2014). As such much of the parental communication between school and their child's education seems to takes place in regards to what the parent can do to support their child's education outside of school (Epstein, Herrick and Coates, 1996). This discursive shift from parents helping schools educate their child from without instead of within is generally accepted by parents (Brighouse, 2002) with this idea based on the assertion that parental support within class will cause their child embarrassment with their peers (Walker, 1998) and that parents being in attendance would go against the premise that students have begun to mature and become independent when they have reached secondary education (West et al., 1998).

As such communication between parents and their child's education is primarily done through websites and printed information on subjects such as expected attendance (Quade, 2005) punctuality (Power and Clark, 2000) and general guidance on how they can aid in the learning taking place at home for example the completion of homework (West et al. 1998). A common feature of most schools is the access they grant parents to 'Moodle' school databases or virtual learning campus's (Vincent, 1993). This means that the dialogue between school and the parent takes the shape of the school providing resources to enable the parent to better understand what their child is learning at school (MaClure and Walker, 2010) and at what target they expect their child to achieve (Inglis, 2014). A criticism of this however is the lack of parental involvement (McNamara et al. 2000) The communication between the stakeholders seems to be one way in that the parent receives information about their child's education but has very little opportunity to communicate back (Walker, 1998). Unlike in pre-school in which targets are jointly set by teachers and parents, student targets are often told to the parent (West et al., 1998). In a survey of Ofsted's Parents Panel (2010) it was found that 84% of schools were good at informing parents what grade their child should be aiming for and what grade they were currently working at but only 49% involved parents in setting these targets suggesting that an unequal collaboration exists between teachers and parents in regards to who knows what is best for their child.

The attendance of the yearly parents evening seems to be the event that the majority of parents make sure that they are present at (Bastiani 1988). Although such events as the newsletter, parent governors and the PTFA seem to lack the opportunity for parents to communicate with the school about their child's needs (MaClure and Walker, 2010) the annual parents evening is often seen as the opening to get answers to questions that they want to ask about their child's education (West et al., 1998) Within England the secondary school parents evening is often set within the schools main assembly hall or other big room with individual desks set out of which teachers in subject clusters sit and wait for parent consultations (Walker, 1998) Often parents are given time slots to see individual subject specialist teachers and as such move from desk to desk at the appropriate time reviewing how their child is doing in each subject. There is evidence to suggest however that the parents evening is a missed opportunity for parents to communicate effectively with their child's teachers (Quade, 2005). MaClure and Walker (2010) observed that at these parents' evenings teachers seem to hold the power and that very little collaborative communication occurred. This was demonstrated by parents-teacher consultations often beginning with what they termed a ‘teacher diagnosis’ , an uninterrupted monologue where the parent often sits silent and listens as the teacher uses specialist terminology to explain how their child is doing within their subject, and as such setting the relationship of the meeting along the lines of expert-novice interactions (Oplatka, 2007). Although opportunity exists for parents to have their say this is often not seen within parents’ evenings (Inglis, 2014) as parents regulate their own behaviour in the face of expert opinion about their child (West et al., 1998). When disagreement or off the topic questions are asked teachers often struggle to give coherent answers (Bastiani, 1988) and are seen to resort to stock answers or expert terminology (Ball, 2003) which is rarely understood by the parent and often not questioned at the time (Inglis, 2014). As such it could be argued that parental conformity to social norms seems to cause a missed opportunity at this event.

3.78 Parents and their child’s school

As said previously the use of monthly or termly newsletters is often one of the few incidences of how a parent finds out what has been happening within their child’s secondary school (Gerwitz, Ball and Bowe, 1995). Just like the use of virtual learning campuses however this is often one directional in that the parent is communicated to by the school but the parent has very little opportunity to communicate back. A potential better vehicle for parental-teacher dialogue is that of the parent joining the PTFA or parent teacher associations (Ofsted, 2014). These groups often are designed to provide fundraising opportunities for the school and the community and also give the opportunity for parents to communicate their ideas as well as sharing information about thier community. The challenge with this mode of communication however is the small proportion of parents involved which gives limited opportunity of dialogue with the majority of parents as well as a focus on what the PTFA can offer to the school and not what the school can offer to the parents (MaClure and Walker, 2010).

There is also some evidence that the specialist skills set of parents could be used to facilitate learning within the school and that these opportunities are sorely missed (Ofsted, 2014). As an example a parent who is a talented musician has skills to offer the music department within the school community. The government have tried to foster this mentality by giving schools the power to hire non-qualified teachers to teaching posts (Education Act, 2011) however few incidences of skilled parents offering their services have been recorded (Ofsted, 2014).

It must also be mentioned about the role of parents as school governors. In the past parents of children that attended the secondary school had a chance to be voted in as a school governor. This gave a direct link, for some parents, in communicating their opinions and feelings in regards to how the school was run (Taylor and Wollard, 2003). However the Schools and Parents Ofsted review (2013) noted that it was rare for parent governors to be able to name specific polices that they had effected suggesting again a superficial dialogue between the school and the role the parent played.

Overall the communication between parent and teacher and the dialogue that takes place between these stake holders seems to highlight a skewered system that favours the secondary institution (Inglis, 2014). Information is available to parents about the school and what occurs within the school but the time periods when this information is given and what is said is controlled by the secondary institution. Information to aid their child's learning at home is often available but very few actual opportunities seem to exist in which parents get a chance to communicate effectively with the school (West et al, 1998). One of the few incidences in which they have the opportunity to do so, the yearly parents evening, seems to be structured so that parents are the receivers of controlled information about the child from the expert, the teacher, but social norms as well as a lack of time or opportunity is available to communicate their own feelings or ask their own questions (MaClure and Walker, 2010).

3.79 Parents and transition

There is however an occasion for parents to voice their opinions which seems to be more socially acceptable through communication about potential schools during Transition Events. Sometimes termed the year 6 open evening or rising year 6 open events and not to be confused with parent evenings, year 6 open evenings are duel purposed in that they advertise potential secondary schools which parents have the choice to send their child after they have reached the end of their primary education whilst also giving the opportunity for parents to pursue the school and actively look for answers to questions regarding the criteria they would like their ideal school to meet in relation to their child's education (Nottingham City Council, 2015).

The year 6 open evening is an event placed on by the secondary school in which the secondary institution opens its doors for perspective parents to peruse what the school can offer in relation to student transfer. Within England this typically occurs between the months of September to October, the first half term of the school year (Department of Education, 2016), as parents and their Year 6 children (10-11 year olds) must hand in their secondary school choices in regards to which institution they would prefer to attend. Although different counties have different hand in dates and different forms for parents to complete in regards to secondary school choices all systems must have a completion date of no later than the 31st October with the results of which secondary school a student has been placed sent to the parents and school on the 1st of March, or if this lands on a weekend, the next working day (Department of Education, 2014). The majority of counties request parents to place between 4-6 school choice preferences down in rank order (Department of Education, 2016). Where possible the 1st preferred choice is chosen with 84.2% achieving this in 2015 (Weale, 2016) whilst 95% of parents receive an offer of a school place for their child in their top three preferred secondary schools (Weale, 2016).

Anecdotal evidence would suggest that the year 6 open evening first originated in the 1950's and was the purview of the independent and grammar school system. As such the concept of this event was for the school to 'show off' what they had to offer in regards to a focused academic curriculum. It was not until the 1960's and the tripartite model of schooling was subsumed by the comprehensive system (Fenwick, 1976) that this event was taken on by the majority of schools to differentiate themselves from each other within similar catchment areas (Hargreaves, 1982). This was especially important as unlike the tripartite system in that grammar schools where associated with academic learning, technical schools where associated with specific trades and modern schools were for everyone else (Shaw, 1983) the comprehensive school catered for all (Bellaby, 1977) and used the year 6 open day to showcase what they could offer for everyone's individual needs. Throughout the late 1970's this event became embedded within transitional processes of schools (Shaw, 1983). Secondary comprehensives engaged local primary schools and facilitated the move of their students from their basic general education to the more advanced level of general education. With the advent of the GCSE certificate in 1988 the year 6 open event seems to have then become implicitly linked with transition and aiding in the successful transfer of students between schools (Hargreaves, 1983). Although what occurred in this event seems to have stayed the same the rhetoric of comprehensive schools around the event seems to have changed. This adjustment from the sole focus on the well-rounded education that the school could offer (Finn, 2015) to including minimising the disruption of transfer and enabling progress to take place was an automatic reflex to the advent of league tabling introduced by John Major in 1992 (Norris 2016). The year 6 event therefore became an amalgamation of highlighting what a school could offer whilst at the same time showing off the resources they had (Abrahams, 2007) whilst balancing this with reducing parental and student anxiety during the move from primary to secondary school (Morgan, 1999).

Within the present landscape of education within England direct competition between schools and the Education Department’s focus on academic achievement has led to an increased focus of schools attempting to gain high achieving students so that league table positions are improved or maintained (Temple et al., 2014). Although historically parents sent their child to their local secondary school this changed when the 1993 Education Act was introduced. This educational modification led to parents having more power to make choices on where they could send their child in relation to them completing their statutory period of education. To differentiate themselves from rival’s competing for the same specific typology of student within similar catchment areas secondary schools therefore have to use marketing processes to inform parents what they can offer for their child in relation to their future development (Norris, 2016). With the introduction of league tabling as an academic comparison tool and the creation of the Office for Standards in Education, Children's Services and Skills (OfSTED) the challenge that the senior leadership team had is that of balancing the promise of what the school could offer against the reality of the day to day running of the school (Oplatka and Hemsley-Brown, 2003).

It is in this context that parents with children in the last year of primary school must go through this process of transition and look for their child's next school. (Department of Education, 2015). The introduction of public access school league tables have been available since the early 1990's highlighting different statistical measures, including the percentage of students gaining 5 GCSES C or above including English and Maths, which is seen as a key measure in indicating the competency of a school (Department of Education, 2015). With the outline of the Progress 8 and Attainment 8 measures informing the picture of the journey that students have been on from the start of their secondary education to when they take their General Certificate of Education exams at the end of their secondary education it could be argued that parents have access to more information about potential schools than ever before (Finn, 2015). However local education authorities' advice is still for parents, who are going through the process of choosing the next stage of schooling for their child, to visit a year 6 open event placed on by potential candidate schools (Lincoln City Council, 2016). This advice seems to be based on the understanding that statistics may not be able to tell a potential parent everything about the institution under consideration and as such gives the parent the opportunity to personally peruse the school, to hear what the establishment have to say and to make a more informed judgement based on the individual needs of the child.

3.79 Summary

In summary students going through the process of transition have a perception of themselves that often clashes with the reality of transfer change (Abrahams 2011). Their unrealistic assumptions of what they thought secondary school would be like often clashes with the reality of what secondary school actually is and their needs are based on an emulsification of self-identity, friendship formation, teacher and parent support as well as emotional engagement. The process of transition can often begin to separate and in some cases disintegrate these variables as the student is forced to evaluate the environment and where they fit within the social hierarchy of the school. This in turn can cause anxiety and in some cases depression and a strong transition policy is needed to minimise and monitor this from occurring. One of the interesting points of note is that of the decline in student's held attitude to school especially within the STEM subjects like science. Although changes have occurred at the macro and micro level in transitional processes over the years the dip in student's held attitude is still apparent within the literature with a potential correlation in relation to student achievement (Symonds and Galton 2014). In this next section a summary of the key findings in relation to the dip in student's held attitude pre and post transfer will be analysed with suggestions on potential policies that could be affecting this.

3.8 Transfer and the effect on students' held attitude

Within the English and Welsh educational system students choose their secondary school options at the start of year 6 within primary school. Often parents and their child must place three options down, a first, second and third choice, before the local education authority assemble all the choices and places students in relevant secondary spaces. Some schools, due to location or reputation are often oversubscribed (GOV.UK) whilst others have to compete with schools within the same area for the best students. Undersubscribed years have a lasting effect on secondary schools as funding is supplied on school numbers with a higher portion being awarded for students with special educational needs.

In addition to this context at the start of their year 6 school life students must focus on upcoming examinations in core subjects in English and Maths with primary schools often focusing 90% of their teaching time in regards to this (Braund 2009). Around this time students attitudes towards science in lesson has been noted to begin to decline with this continuing for 4 years (Galton et al 2011). Although the rate of decline is different dependent on individual differences such as race, sex, and ability the effect of this decline is the potential decrease in attainment in science subjects as well as a reduction in science subject continuation post 16 (Galton et al 2013). In the next section the journey of attitude decline is sign posted with potential processes used by secondary schools to aid in transfer highlighted.

3.81 Attitude towards science in year 5

Year 5 can be argued to be the start of the process of transfer for most young children. Often primary schools use links with the secondary schools within their catchment area to share their resources in relation to specialised subjects such as science and design technology. This in turn gives the secondary schools the chance to advertise themselves to potential students before students are inundated with information regarding secondary school placement (Oplaka 2009). These specialised subject induction days are often very exciting for primary school students as they get to leave their normal classroom environment and go on a trip to ‘big school’ in which hand on practical lessons are often the norm (Galton 2009). It is also during this year that attitude towards learning begins to decline (Osborne et al 2003). This has been observed across science, maths , and English lessons although no study is available to judge the attitude of students in relation to the humanities and language subjects within this age group (Barmby et al 2008). Explanations within this area seem to focus on ideas of the students beginning to outgrow their primary school environment and that attitude decline could be due to perceiving that as one of the older year groups they should be given more autonomy within their learning within the classroom (Galton et al 2012). Another explanation is that of Attard (2003) who argues that students begin to develop a big fish, little pond mentality in which the student wants to be perceived as being grown up and attending primary school still is holding that ideal back.

3.82 Attitude towards science in year 6

Year 6 is often a time of great anxiety and stress for most students (Reiss and Mujaba 2012). At the start of the academic year students, with parents, visit on average three secondary school open evenings (GOV.UK). Although it has been noted that parents often focus on the long term needs being met of their child (Riglin et al 2013) students are often interested in more short term goals such as where their peers are going (Rice et al 2003), what the teachers are like (Braund 2009) and what the older students are like (Braund 2009). Within this context students attitudes to school science lessons have been noted to decline (Osborne et al 2003). Explanations for this have been linked with the primary schools focus on end of key stage assessments of English and Maths that devalue all other subjects (Galton et al 2009). Another potential explanation is that of students misconstrued perceptions in which science within primary school is seen as ‘childish’ and not being done well and that only attending secondary school will ‘proper science’ be attempted . This is supported somewhat by findings within bridging strategies within maths in that students often devalued the work brought over from primary school as they associated the tasks as too primary (Powell 2006). Within this year students often attend again specialist's induction days for their secondary schools. This is especially true of key feeder secondary schools in which the majority of students from primary attend. Although very similar in scope to year 5 specialised subject induction days more macro level processes are focused on here with opportunities for bridging or setting a foundation to start year 7 lessons the focus. In science this often takes the form of learning the structure and function of a Bunsen Burner an important piece of equipment which the majority of students would have no experience of. Although the literature indicates that students at the end of year 6 begin to perceive their leaving of primary school with *optimistic apprehension*, which is linked with some studies showing an increase in attitude at the end of year 6 (Bennett and Hogarth 2009), no study to date have questioned the effect of open days as an effector in this process and much more research needs to be completed in this area.

3.83 Attitude towards science year 7

At the start of year 7 attitudes towards subjects have been noted to start to decline by the end of the first half term (Symonds and Galton 2014). Although in year 7 this decline is very gradual this effect does not halt until year 9 and has been linked with a decline and a reversal in attainment (GOV.UK). Although as noted earlier within this chapter students habitably place more focus into peer pursuits than to academic learning (Barmby et al 2008) this does not justify that the decline in practical subjects like science is greater than in non-practical subjects (Bennett and Hogarth 2009). One explanation for this within the literature is that of the structure of the subject in which science content in comparison to others subjects is high and skill acquisition is low (Abrahams 2013). As focus within science previously has been with the idea of students' skill acquisition as the primary objective with content talking a supportive role this reversal in emphasis may cause some students to respond more negatively. Another explanation is the idea that primary schools often do not spend time on science within lessons as the primary focus is on literacy and mathematical principles. As this is often a foundation principle in Ofsted and LEA judgments none- essential subjects are often pushed to the wayside with a condensed syllabus attempted when time permits leading to unstable foundations within science that inform the students' perception that science is difficult. Ideas of students valuation of the quantity of effort needed to do well is a common denominator in a feature linked with declines in positivity in attitude, motivation, and interest ratings (Sharpe 2013).

3.84 A potential theory

One potential theory put forward is that of Abrahams (2011) who argued that the use of Open Events gave students an unrealistic view of science lessons within secondary school. This could explain in part the changes in students' attitude towards science. The overselling of science lessons for marketing purposes by the secondary school to year 5 students potentially could cause students to perceive primary school science lessons more negatively which affects their attitudes towards these lessons. This perception of secondary science supported by Open Events in year 6 could cause unrealistic expectations contributing to their optimistic apprehension towards transfer. When they finally attend secondary school and their expectations are not met by the reality of science lessons these perceptions could contribute to a decline within attitude towards this subject. Further investigation of the effects of Open Events however has yet to be completed.

In summary a decline in attitudes towards science has been observed as early as year 5 in primary school. Although this decline seems to halt and actually increase just before transfer due to optimistic apprehension mechanisms when students attend secondary school this decline has been observed at the end of the first half term and is seen to continue at an accelerated rate until the end of year 9. Macro processes such as open days and open evenings may have an important role in the formation of these attitudes towards science lessons however as of yet further investigation within this are need to be completed. Therefore, the aim of this research is to investigate what effects, if any, that Open Events could have on students' attitudes towards science in school across the transfer from primary to secondary school with England.

Only with a more detailed analysis of the above will a more comprehensive picture of the consequences for the way in which school marketing for students during transfer between primary and secondary schools using Open Events be eluded too. As such in the next chapter, chapter 4, the methodological approach and the methods used to investigate this research question will be discussed.

Chapter 4: Research Methodology

4.1 Introduction

This study is a critical exploration of the effect that the Open Event has on students' attitudes towards science lessons across the transfer from primary to secondary school. Data will be collected from 6 counties within England. It employs a mixed methods strategy using cross-sectional sampling from observational field notes as well as a multiple choice questionnaire which will then inform the semi-structured questioning used in tape-recorded focus groups and interviews.

4.2 Background

Despite the numerous variables that are mentioned that effect students' progress in learning teachers' themselves, those individuals who are at the frontline of educating the next generation, often reiterate how increasing or maintaining their students' positive attitudes towards their subject is a key variable in student engagement within lesson time and the precursor to effective knowledge acquisition (Germann, 1986, Sherbet, 2010). In fact Ofsted, in regards to judgements on teaching, make a distinction between 'good' and 'outstanding' teachers as those that can 'facilitate engagement throughout the lesson of all students to enable outstanding learning to take place' (Ofsted 2010). There is however a worrying phenomenon in that students' attitudes towards subjects, such as science, show a decline after they go through the process of transition and transfer school. This decline has been observed within the final year of students' primary education and continues throughout the transition period.

Whilst previous large scale studies, the most current of which are over 5 years old, have provided an awareness of the challenges that students' face across the transition between primary and secondary schooling (Galton 2014), they do not focus on specific transition events, such as the Open Event, and how this could have an effect on students attitudes towards specific subjects such as science.

With the new academic measures coming into force such as 'progress 8' whereby schools are now monitored on the level of progression made by students' after transfer from primary to secondary school the need for a study that investigates variables that could effect student progression, such as students' held attitudes towards subjects such as science, seems all the more warranted.

4.3 Research Focus

The overall aim within this thesis is to explore the impact that the Open Event, a transition event placed on by secondary schools for potential student candidates from primary school, may have on students' attitudes towards science in school. As there has been very little if any research conducted on the Open Event this dissertation aims to answer two broad research questions:

1) What occurs at an Open Event in relation to science in school?
2) Do Open Event's effect students' attitudes towards science lessons in school?

To answer these research questions it was thought best to use a constructionist paradigm and collect data from the viewpoint of the individuals directly involved. At this point only these two research questions where decided upon as it was thought that the literature review by itself did not provide enough information on students' experiences at transition events to make clear any other potential research questions without support from a pilot study in this area.

In regards to research question one the use of focus groups made up of science technicians and science teachers was thought best to employ as these are the key participants during transition between primary and secondary school. It was also thought best to conduct some of these focus groups before the transition event to give a more detailed view of the event and how it was planned. In regards to research question 2 a semi-quantitative questionnaire was employed to students so that patterns in relation to their attitudes towards science lessons could be identified. It was deemed best that data should be collected both before and after the transition event enabling a larger picture of what was occurring to be formed and highlight potential trends during this time. As such the questionnaire was decided to be administered at least once in every academic term to both year 5 (Pre transition year), year 6, year 7 (Transition years) and year 8 (post transition year).These results then informed potential areas for questioning that where expanded on using semi-structured student interviews and focus groups conducted at the end of the school year with all sampled year groups with the aim of enabling a deeper understanding of the effect of the year 6 open event to be developed.

4.4 Initial strategy for research question one

One of the underlying assumptions made within this thesis was that not only were transition events a common occurrence in the majority of schools within England but that what actually occurs at these events at different schools could be generalizable. Although, as stated in the literature review, the analysis of council websites clearly supports the idea that the year 6 Open Event is embedded in transition events across England it is less well known if these events are standardised especially in relation to what occurs in regards to science in school. As such it seemed relevant that a pilot study should focus on answering this question.

4.41 Phase one confirming Open Evening activities for research question one

In phase one it was decided that the use of focus groups involving secondary science teachers and lab technicians (The science department) would be the best method to use to give a naturalistic view of what occurs at the Open Event in regards to how science is represented during transitions events. The advantage of this would be the get the ‘participant’s view of the situation under study’ (MacKenzie and Knipe, 2006) and enable both a *broader* range of information as well as *detailed* information on science teachers and science technicians perspective of the transition event under study. To encourage discussion it was thought best that stimulator questions should be used for the main study and as such this was also trailed within the pilot. The purpose of this semi-structure was to enable some form of control for the researcher and aid in the comparability of focus groups from different schools. A literature review was conducted to find papers within education that had used a focus group as a method of data collection. The aim of this was to compare what number of stimulator questions where commonly employed. Using ERIC, as this is the most comprehensive source for research within education, the database was advanced searched using the criteria 2005-2015 (as a decade was considered a reasonable range), and the search terms ‘Education’, and ‘Focus Group’. This revealed 24 results. Careful evaluation of these resources quickly determined that a range from 3-4 stimulator questions was common. To decide on what questions should be asked the researcher convened a research group with his peers to 1) Collect potential stimulator questions and 2) Evaluate the best questions to be applied in the context of the research. It soon became apparent that the stimulator questions discussed fit into three main categories including:

1) Questions on identifying what actually occurs at the transition event
2) Identifying what actually occurs in the science department at these transition events
3) Identifying what the purpose of the Open Event for the science department was

Using this peer review process it was decided that three questions, was the best number to stimulate discussion. With discussion with academic supervisors these three questions to be trialled within the pilot study was decided to include:

1. What normally occurs in a year 6 school Open Event?
2. What does the science department do in a year 6 Open Event?
3. What is the purpose of a science year 6 Open Event?

4.42 The pilot study for research question one

An opportunistic sampling technique was used to gather data on what the features of a ‘typical’ year 6 Open Event in science where. This involved attending a ‘teach meet’ conference in which schools from 6 different counties in England were represented. In total this gave the researcher an opportunity to get the viewpoint of 24 science teachers and 5 science technicians all representing a different secondary school and who had personally been involved in planning and attending an Open Event for the subject of science. As this was an opportunistic sample the number of years that these teachers and technicians had been involved in a year 6 Open Event differed based on years of teaching experience ranging from 1-28 years of service. What is of note however is that all schools represented had run an Open Event for transition purposes in every year of every persons teaching career giving anecdotal support that the Open Event is a mainstay of British schools.

All teachers and technicians were used in a large focus group to discuss common features of a science Open Event using the stimulator questions decided upon by peer review with the recorded statements transcribed with common elements highlighted.

4.43 Analysis of the Pilot study for research question one

The general discussions held spent the majority of the time on question 2 (What does the science department do in a year 6 Open Event?). Discussion on question 1 and 3 was brief (72 lines of transcribed text) and it soon became apparent that although a general knowledge of what the school did during transition was known a compartmentalised mentality existed in that the science teachers and technicians focused more on the science departments role in the transition event than looking at it holistically with very little or no evaluation on a subject level of how well the event actually went. In regards to question 2 over 500 lines of text was analysed line by line with any patterns highlighted within the margin. Due to the richness of data it soon became apparent that what the science department did during the transition event could be categorised into three sub-groups that included *tasks related to student input, tasks relating to teacher input and tasks relating to self-sufficiency* (See table 1).

Agreed by all	**Agreed by 27 of 29**	**Agreed by less than 14. Actual number of agreement in brackets**
Use of the Van der Graff	Dissections	Use of prisms (13)
Skeleton props		Elephant Toothpaste (9)
Peppers Ghost		Agar plates (8)
Advertisement of subject results for past academic year		Screaming Jelly baby (7)

An assortment of text books		
Samples of pupils assessments		
Make onion cell slides		
Acid and alkali testing using universal indicator		
Use of microscopes		
Flame testing		
Student representatives		

Table 4.1 demonstrating common features of a science Open Event

4.431 Tasks relating to student input

This involved the use of older students as ambassadors or role models to aid in demonstrating a practical component or answering questions from parents and prospective students at the Open Event. Common uses of students seemed to be in relation to guiding parents around the science area, demonstrating the work they have done or the practical skills they have acquired in science lessons such as making an onion cell slide.

4.432 Tasks relating to teacher input

This involved the use of teachers in practical demonstrations. Another point that was noted was that the practical’s used were chosen with the aim of representing the three different components of science in either biology, chemistry or physics. Possibly due to this criteria, agreement was reached in that biology was often represented by the use of microscopes and preparing cells to be seen, chemistry was represented by acid and alkali testing and the use of Bunsen burners in relation to flame testing and physics was represented by the use of the Van Der Graff and the uses of light such as Peppers Ghost or common diffraction experiments.

4.433 Tasks relating to self-sufficiency

This involved what one teacher termed ‘the bumf’ of science that ‘parents expected to see’. Represented by the use of stereotypical props such as the use of a model skeleton and displays of science text books and science work these elements were self-sufficient in that they could be placed out and parents could choose to look or not look at them with little or no explanation needed.

The focus group transcripts highlighted 12 features that were agreed upon by all present, 1 that was agreed upon by all but 2 individuals and 4 items that where agreed upon by less than 14 of the focus group. What is of interest is that the disagreement within the focus group was generally about the *specific* practical that was to be used to represent a component of science (Biology, Chemistry or Physics). It was however *still a practical component.* In fact the general debate that occurred in the focus group was not about inserting a non-practical activity instead of a practical activity but was in terms of what resources or skill set the individual departments had to showcase Biology, Chemistry and Physics in a practical manner.

4.44 Emergent issues for research question one

Overall the pilot study indicated that what occurred in the science department at transition events could be generalizable. As the use of a focus group in the pilot study seemed to be effective in constructing what actually occurred within the science department at these transition events it was thought best to use the same format for the actual data collection. What also emerged however was lack of data in regards to generally what occurred in transition outside the department and ideas on evaluating its purpose and how well the event actually went. It was also felt that a general weakness with this method was the risk that departments were telling the researcher what they would *like* to do but due to other demands such as time commitments may not actually do on the day. As such it was decided that it made sense to include an observational component and that the researcher attend these events so that a comparison could be made between the individual department’s rhetoric and the reality of what actually occurred during the year 6 Open Event as well as giving the opportunity to be able to see a more holistic picture of the Open Event.

4.5 Initial Strategy for research question two

The common approaches in measuring a person's attitude have historically involved scaling methods such as Thurston-type scales, semantic scales or Likert-type scales (Ajzen, 2001). The challenge within the science educational literature has therefore been in regards to the reliability and validity of these measures in their application in measuring a construct that is innate and can only be measured by inference. As argued by Ajzen and Fishbien (1980) a common mistake made within attitudinal studies was the application of questionnaire measuring a general attitude to predict a specific behaviour or vice versa resulting in data that very rarely correlated. Taking this into account it was decided that the instrument development would include some pre-pilot investigation. Similar in approach to that of Sharpe (2013) who based her research methodology on Bennett and Hogarth (2009) this phase used interviews of students as well as teachers to identify areas that represented the concept of science at an Open Event. The purpose of this approach was to develop what Carr (2000) termed composition validation in that questionnaire statements were developed and tested for face validity in regards to were the statements actually asking what the participants thought they were asking and were the answers given understood correctly by the researcher. The development stages of the instrument went through three rounds of refinement before being trailed within the pilot study. The rationale behind this process was based on what Noll (1935) termed the lack of *'thinking scientifically about scientific attitudes'* in that a common weakness of the use of scaling questionnaires is the apparent lack of rigor in their design.

4.51 Instrument Development stage one

Following Ajzen and Fishbien's suggestion that the best way to measure a persons' attitude towards an object is to ask them the researcher asked students two questions:

1. Write three things that you liked about the year 6 Open Event
2. Write three things that you did not like about the year 6 Open Event

The word 'thing' was inserted after peer review as it was thought that the participants age may affect there understand of the original word 'statement' and it was important that the initial questions developed an open dialogue that could be applied and inform the production of attitudinal statements later. As time was a factor due to the year 6 Open Event occurring in a school only once within a year an opportunistic approach was applied to gain permission from school X, an urban academy primary school, and school W, an urban secondary school academy in which the head teachers had worked with the researcher previously. As the main research project required data across the transition years, 25 year 6 students from school W and 31 year 7 students from school X were chosen to take part in the open questionnaire. In both school W and school X this was administered within their science lesson. It was made clear to the students the context of the questionnaire and research project as well as that students should not write their names on the questionnaire as they should be anonymous.

Evaluation of the results determined that year 6 students seemed to remember and have retained what occurred at the Open Event in more detail than that of the year 7 cohort. On average year 6 students completed the task within 15 minutes with year 7 students only taking 5 minutes to complete it. Year 6 students used terms such as ‘grown-up’, ‘big’ and ‘stricter’ in their responses often describing how they liked or disliked the Open Event object based on how they made them feel. For example:

Year 6 student response: I liked the big rooms. I always feel like a giant but I didn’t feel like a giant there.

In contrast the year 7 cohort had trouble remembering the event at all with the class teacher having to describe the event to trigger their memory. Potentially due to this year 7 responses used simplified statements and seemed to be more negative generally about school:

Year 7 student response: The head teacher talked for ages

Year 7 student response: It was really long and we got lost and ended up in the carpark instead of music.

Most comments given by year 6 or 7 cohorts were not specifically related to the subject of science at the Open Event however 60% of year 6 students and 65% of year 7 students included at least one science related comment. These included two common strands; that of practical ‘doing’ comments in that students liked taking part in a science activity and that of ‘comparison’ in that what occurred in the science labs in the year 6 Open Event was different from the rest of the subjects on display.

4.52 Instrument development stage 2

Using the information collected from the first round of pre testing in regards to students views the next step was applying this to a method to collect attitudinal data. To aid in this a literature review on attitudinal measures used within science education research was conducted. This involved the use of database ERIC as this is the most comprehensive source for research within education. As a starting point the database was advanced searched using the criteria 2005-2015 (as a decade was considered a reasonable range), search terms ‘attitudinal measures’, AND ‘science’ OR biology/chemistry/physics with peer reviewed articles searched only. Although this had the potential to cut out interesting contributions in text books and from other sources it was thought that attitudinal measures that had been peer reviewed was the best source for reliable examples. This resulted in 19 articles. From then perusing the abstracts this was then minimised to 6 potential articles two of which were review articles themselves. These where then analysed and any resulting references of interest were followed. This literature review revealed some thought-provoking exploratory research. Aikenhead and Ryan (1992) developed the views on science technology-society (VOSTS) tool. This consisted of statements based on science content in which a student must agree or disagree before writing a reason WHY they agree/disagree. Common arguments from the students were then used to form the multiple choice component for later administration to measure attitudes. This was in turn supported by semi-structure interviews to confirm students multiple choice answers represented what the student actually thought on an item. This process was itself updated by Bennett and Hogarth in 2009. Pell and Jarvis (2001) developed their attitudinal tool for primary school students based on West, A; Hailes, J and Sammons, P (1997) smiley face 5 point Likert scale format. These included measurements of *being in school* placing attitude into a school context, *science experiments* measuring feelings towards science practical’s and *what I really think of science* measuring feelings of science in and out of school. Kind, Jones and Barmby (2007) used Pell and Jarvis (2001) attitudinal measure in combination with a Likert scale questionnaire based on the PISA attitude questionnaire making 8 scales that included *learning* *science in school, self-concept in science, practical work in science, science outside school, future participation in science, importance of science, general attitude towards school and combined interest in science.* Finally Blalock et al (2008) did a comprehensive review of science attitudinal measures from 1935-2005 arguing that an attitudinal measure without a clear theoretical framework, methodological structure and clearly defined constructs limited their use. They devised a matrix that scored papers on their theoretical background, reliability, validity, dimensionality, and development/usage with Germann (1988) achieving the highest aggregated score in relation to attitude towards science measures.

It was decided that Germann (1988) may be the best place to start as a template. This was decided on the basis that both Pell and Jarvis (2001) and Kind, Jones and Barmby (2007) were designed based on questions used for younger students whilst Aikenhead and Ryan (1992) and Bennet and Hogarth (2009) methodological approach was based on the three separate sciences which is not separated in teaching until the start of secondary school and in some cases not until GCSE teaching commences. This is not to say that components of their studies where not useful but more that it was deemed best to use as a guide a study based on students of a similar age, which clearly highlighted its theoretical framework, methodological structure and constructs used within its research.

What became apparent during this process was the lack of agreement on how to measure an attitude in regards to students' attitudes towards the subject of science. Measures used had suffered from construct definition problems as well as weak design, reliability, validity, and repeatability as researchers keep making new ones making standardisation and comparisons difficult (Ramsden, 1998). Also highlighted within the literature was the inherent risk of *immaculate perception* (Munby 1983) in that it's assumed that responder and researcher share the same view on the meaning of an item on the questionnaire.

Overall from this process as well as from the pre pilot findings, it was decided to adapt Germann's (1988) 12 statements that identified a students' general attitude to school and refine this in an attempt to measure a students' attitude towards the *subject of science in school*. Using Germann's (1988) original statements as a template a meeting of peers consisting of 10 academics decided on 12 adapted statements which then progressed to round two to be piloted (See table 3). In round two school Y, a primary school in a rural setting, and school Z, a secondary school in a rural setting, were administered the draft of the main study questionnaire with an open response phase. This included 19 year 6 students from school Y and 23 year 8 students from school Z. In round three of phase two samples of 10 students from each school were group interviewed to collaborate and probe findings for any further development. Analysis of the disposition statements indicated that all but one question demonstrated face validity in that what the researcher thought the statement was inferring was also seen in this way by the students. One question however showed some variation. . In giving a reason why a student agreed with the statement ‘I would like to learn more about science’ answers included:

Student 1: I like knowing about how the body works and I think that will be useful as biology is US.

Student 2: Without science you can’t make chemicals to help people so it’s important to know

Evaluation of the reasons given for the responses indicated that students’ concepts of ‘science’ may differ. When the concept of science was probed further within interview it became apparent from this process that some students from both school Y and school Z viewed the concept of science as mainly *‘biological’* in nature, others mainly *‘chemical’* and others focused on *‘physics’* aspects. As the concepts held by the student on what they perceive science in school is about will be a key determinant of their attitude towards science in school it was decided to start the questionnaire with a section that asked the student to agree with one of 4 statements describing what science in school was all about.

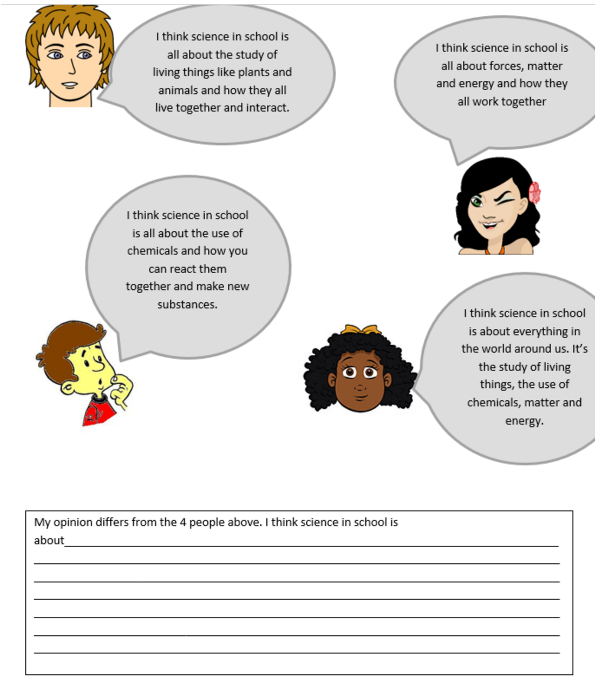


Figure4.1 demonstrating section 1 of the questionnaire confirming the students held concept of science in school.

These 4 statements consisted of either a biological, chemical, physical or general descriptor of science (See diagram 4.1). Initial definitions where sent and collaborated with the Institute of Physics, Biology and Chemistry before being trialled by the researchers peers in a task that asked the 22 individuals to place the definition under the terms Biology, Chemistry, Physics, General Science. All respondents placed the definitions on the correct terms. Finally after this peer review process it was also thought best that an additional text box was also added for the student to write their own definition of science in school if the student disagreed with all four statements. The main purpose of this section therefore was to define students' construct of the subject of science and also monitor if this construct changes before and after the year 6 Open Event as well as after transfer from primary to secondary school.

4.53 The pilot study for research question 2

After the initial phases within the pre-pilot study a draft questionnaire was ready to be trailed. It was decided that the pilot study would be within a secondary school academy with an attached primary school on a separate site termed for this study school 0. As this thesis is primarily collecting data from students across the age of transference from a primary phase of learning to a secondary phase of learning it made logistical sense to use school 0 to cover a range of both primary students that had gone through the Open Event that academic year and secondary students who had transferred school less than 2 years previously. This school had so far not been used previously so that the questionnaire could be applied to a new cohort of students and due to this be a good indicator on the time needed by the researcher for students to complete the questionnaire, interview process and taking part in a focus groups. Another reason for using a new school was that it aided in validation of the items within the questionnaire as well as testing the clarity and readability of the methodological tool in regards to illuminating if students over the transition age understand the task set in front of them.

The pre-pilot questionnaire had developed the instrument so that it contained two parts: The first section that asked the student to define their held construct of science in school, the second section that measured the students' attitude held towards science lessons using 12 statements (See appendix NUM for complete questionnaire). The questionnaire was handed to four classes, one in year 5 containing 33 students (14 boys and 19 girls), one in year 6 containing 31 students (17 boys and 14 girls), one in year 7 containing 34 students (18 boys and 16 girls) and one in year 8 containing 30 students (13 boys and 17 girls). All questionnaires were administered on the same day to the students in their normal science lessons. It was made clear by the researcher that they should not indicate who they are and that they could stop at any time.

4.54 Analysis of the Pilot Study for research question 2

Generally it was observed early on that some students struggled with how to fill out the questionnaire in section 2. A common complaint was that they did not know where to place their answer in relation to the Likert scale item. In the year 5 and 6 groups a common request was for the researcher or teacher to demonstrate how to fill section 2 in whilst the year 7 and 8 groups did not request this supporting the idea that the more mature cohort of students seemed to be more independent than that of their younger peers. In relation to time the majority of students completed the questionnaire between 15-20 minutes which was deemed as an appropriate time for effective administration and collection within the main study.

Alongside administering the questionnaire instrument a trail of using focus groups were conducted with school 0 just after the Easter break to triangulate the findings. The aim was to use the results from the semi-quantitative questionnaire to inform the choice of questions to ask during the focus groups and interviews. As such an unstructured process was applied at this stage. Although this potentially made this method more unreliable as comparisons between groups and individual interviews would become more difficult it was felt that richness of data gathered on the pilot study and how they answered the questionnaire would provide more valid data and give scope for more probing questions.

This involved 10 students from year 6 (3 boys and 7 girls), year 7 (6 boys and 4 girls) and year 8 (5 boys and 5 girls). The main purpose of this was to trial the method for use in the main study later whilst examining students' responses. This process revealed challenges in regards to timing and logistical issues. It soon became apparent that the use of 10 students per year group was too large a cohort to be practical. Due to their size the focus group was often dominated by 3 or 4 individuals with a biased proportion of time been divided between this subset group and the rest of the individuals within the main group. This was also exasperated by conversations that could drift off topic or conversations that struggled to start and as such this meant that the focus group occurred for a longer time then was necessary. Improvement points for the main study were discussed with peers with a plan of action dictating that reduced numbers of students involved in the focus group a recommendation that was followed. As such a decision was made so that only 4 students would be involved within the focus group within the main study including were possible the demographic of 2 boys and 2 girls of mixed ability. This therefore should mean that time management can be better upheld and that individuals can have a better proportion of the time available to discuss their thoughts. The use of the same percentage of sex as well as a mixed ability range would enable as generalizable a sample as can be controlled.

In tangent with the focus group was the use of semi-structured interviews. This was structured so that it occurred with students who were not involved within the focus group but had taken part and filled in the questionnaire. In total 6 students were interviewed with 1 boy and one girl chosen by the class teacher from year 5, year 6, year 7 and year 8. The interview procedure followed a similar pattern in that questions asked were based on the items represented in the questionnaire and as such the students used were volunteers who willingly revealed which questionnaire was there's' . The verbal response data from the interview were analysed in comparison to the questionnaire answers the students had placed with no discrepancy observed in relation to the ranking of lessons and 11 of 12 attitude questions. One attitude item that of 'science lessons are interesting' showed extreme discrepancy (whereby the student had answered agree in the questionnaire but within the interview disagreed) in both individuals interviewed in year 6 but not in year 5, 7 or 8. Further probing suggested that these students had answered the question in regards to science lessons being interesting in regards to *secondary school* whilst answers at interview were in reference to *primary school* science lessons. As such it was decided that this question should be refined (science lessons are interesting in primary school/science lessons are interesting in secondary school) to specifically relate to where the student currently attended lessons.

4.55 Emergent issues for research question 2

As intended the pre-pilot and pilot procedure aided in the further development of the methodological tools applied within this study. In regards to this feedback the questionnaire was changed in numerous ways. An instructional front page with worked examples was included to aid in students answering the sections of the questionnaire. This was to aid in clarity of instruction for the students. The Likert scale component had a tick box inserted to clarify where students could place their answers on the scale. Again this was to aid with clarity for students answering the questionnaire. During the interview process it came to light that year 6 students held different concepts of science in school in regards to secondary school science and primary schools science which affected the measurement of one of the twelve items within section 2 of the questionnaire. As such this item was adapted (science lessons are interesting in primary school/science lessons are interesting in secondary school) dependent on where they currently attended school (I.e. If they attended primary school they were asked about science lessons being interesting in primary school and if they attended secondary school they were asked if science lessons were interesting in secondary school). It also became apparent that a common theme throughout interview and focus group responses was students comparing science lessons *with other subjects*. One of the interesting points made within the educational literature is the idea that students attitude towards school subjects decline over transition but that the subject of science seems to decline at an accelerated rate in comparison to other traditional subjects such as English (Galton, Gray and Rudduck, 2003) . Although the second component of the questionnaire measures if students' attitudes towards science changes over time it does not indicate if this level of decline occurs generally for students' attitude towards school. Upon peer review it was thought best that a third section should be included. In this section students where measured on their general attitude towards school. Again this was adapted from Germann's attitude scale questionnaire. The aim of this was to determine if students' attitudes towards science lessons changed at a different rate than that of school which would be indicated by a direct comparison of results.

Another improvement point pointed out was the potential loss of data in section one as students' where asked to identify their construct of science based on four pre-chosen categories representing the strands of science and only asked to write their own definition if they disagreed with all 4 chosen categories. One of the issues with this is that the categories are based on the traditional view of science as 'product' based and ignored the processes of science enquiry such as making hypothesise. As such students where asked **first** to write their own definition of what they though the subject of science was before then choosing between the four pre-chosen categories representing the strands of science.

Finally although the interview procedure performed well the focus group had issues with logistics and group management. This was rationalised to be the fault of the focus group size and as such the focus group was reduced from 10 students represented to 4 students represented so that individuals could have a better proportion of the time available to discuss their thoughts.

After these changes had occurred validation was obtained with the researcher returning to school 0 with the refined instrument and interviewing a mix of year 5, 6, 7 and 8 students who were involved in the focus group or interview phase. The students supported and agreed that the changes improved the questionnaire and that in their opinion the instrument was understandable and clear to be completed by their peers. This was also supported statistically using Chronbach Alpha which demonstrated a score of 0.89 which was deemed acceptable.

4.56 Evaluation of qualitative data

As qualitative data was collected as part of the mixed method design it was thought wise to make sure that an analytical methodology was decided upon to sieve through the expected large quantity of rich data. As such the preliminary focus group and interview results were assessed to find an adequate tool of assessment.

The qualitative analysis was set up in two stages: that of being assessed by the researcher independent of any other person and then assessed using academic peers who specialised in the area of educational research. The method used by both involved going through the transcripts line by line and categorising each line in relation to a theme which was independently chosen by each 'group'. When this was completed both the researcher and his peers then met and again went through the transcript line by line and discussed which theme had been represented and why this had been chosen. Each line's theme was therefore compared until a consensus was agreed by all. For example the transcript line 'I didn't like science lessons much because we never do practicals' was placed under the theme 'afferent' by the researcher and 'expectations' by the peer group. It was then discussed that it made sense to classify emotive responses under the term afferent as this then matched with the ABC model.

After doing the method for the preliminary data it was viewed by both the research and the peer group that this was an adequate method to assess underlining themes in regards to the rich data received and as such this was then applied to the main study qualitative data collection.

4.57 A defence for methods used

The study is based on cross sectional data collected from 23 English schools covering students aged between 9 years old (Year 5) to 14 years old(Year 8) which were deemed the 'transition years' as these two years cross the primary/secondary school divide. It involved using questionnaires as well as student and interviews with science staff in the secondary schools as well as focus groups. Field notes and audio-recordings were made throughout these visits to aid in analysis. This was discussed with both peers within the University as well as a cross party conference linking early year researchers within Europe. It was decided at these meetings by the researcher that the mixed methods approach was the best available option at the time of data collection. It was viewed that using a ‘tripod’ of data collection points circumvented any weaknesses that individual data collection tools had. As access to schools at specific times of year was difficult it was thought the qualitative tool of a questionnaire facilitated the collection of semi-numerical data (Likert scales) to compare between different age groups, as well as allowing determination of the extent of agreement or disagreement between respondents. To avoid demand characteristics the use of interviews as well as focus groups enabled an immediate understanding of what the respondents actually meant which resulted in introducing validated rigour within the process. It also enabled a richer set of data to be collected and explored giving a greater depth than would otherwise have been available if a Likert scale was the only source of data collection. In reverse the Likert scale questionnaire gave the opportunity to verify the respondent’s accuracy at interview by enabling larger scale comparisons between schools to be observed which may not have come across due to such issues as time constraints.

It is also important to point out at this time the use of observations throughout. It is expected that during the observations of the ‘Open Event’ as well as through observing respondents during interview and focus groups that potentially data could be collected due to ‘unconscious conditions’ or that of communication through body language. As such it was decided during peer discussion that any observations made would follow the ABC model in that respondent’s actions (Behaviours) as well as (Afferent and Cognitive) words would be noted and placed into these categories to better aid in making comparative analysis.

4.6 Identified Objectives

The original aim within this thesis after conducting the literature review was to explore the impact that the year 6 Open Event, a transition event placed on by secondary schools for potential student candidates from primary school, may have on students' attitudes towards science in school. The aim was to answer two research questions that included:

1) What occurs at the year 6 Open Event in relation to science in school?

2) Do Year 6 Open Event's effect students' attitudes towards science lessons in school?

With regards to research question 2, the literature review, pre pilot research and the pilot testing demonstrated a revised semi-quantitative questionnaire was needed that not only measured students attitude towards science in school but also identified what science concept they held and if there was any indication that if attitudes towards science did decline, if this decline was greater or less than students' attitudes towards secondary school in general. As such it was thought that a third research question was needed looking at the effect of an Open Event on students perception of science in school.

As such the aim of this thesis was adapted to answer a third research question:

3) Do Year 6 Open Events change students' perception of what constitutes school science?

With regards to research question one, the pilot study determined that the use of focus groups before the transition event as well as observations during the transition event would be the best procedure to follow.

In regards to research question 2 and 3 the overall idea of a mixed methods approach that applies a semi-quantitative questionnaire before using focus groups and interviews to explore any trends that may have been highlighted was deemed to be still applicable and as such this procedure was followed.

4.7 School selection

To generalise results schools were chosen that could best represent the typical school within England. This dictated that the sample only use schools which were archetypal of schools in size, range of student ability, gender and general nature of the school. This meant that Grammar schools or independent were excluded as where schools which competed with the grammar system and as such may not have the same range of student ability within their cohort. All boys and all girls schools were also excluded as were schools which could be deemed ‘faith schools’ as not representative of the common educational institute that students attend. This led the sample of schools to be made up of either academies or comprehensive schools.

As such this resulted in a sample that represented six counties consisting of 6 secondary schools and 14 feeder primary schools for the main study (see table 2). The sample was opportunistic in that contacts with heads of department in the secondary schools were acquired due to the researcher’s educational background. The 14 primary schools involved were the associated feeder primary schools of these schools.

Pseudonym of school	Primary/Secondary and number on roll	Age range	County	Com or Academy
A	Secondary	11-16	Nottinghamshire	Academy
B	Secondary	11-16	Derbyshire	Academy
C	Secondary	11-16	East Riding	Academy
D	Secondary	11-16	Merseyside	Academy
E	Secondary	11-16	Lancashire	Academy

F	Secondary	11-16	North Yorkshire	Academy
G	Primary	5-11	Derbyshire	Comprehensive
H	Primary	5-11	North Yorkshire	Academy
I	Primary	5-11	Derbyshire	Academy
J	Primary	5-11	North Yorkshire	Comprehensive
K	Primary	5-11	Merseyside	Academy
L	Primary	5-11	Merseyside	Comprehensive
M	Primary	5-11	Lancashire	Academy
N	Primary	5-11	Lancashire	Comprehensive
O	Primary	5-11	Nottinghamshire	Comprehensive
P	Primary	5-11	Nottinghamshire	Academy
Q	Primary	5-11	Nottinghamshire	Academy
R	Primary	5-11	East Riding	Comprehensive
S	Primary	5-11	East Riding	Academy
T	Primary	5-11	East Riding	Academy

Table 4.2 showing sample of schools for main study

Although this method may have resulted in the risk of poor population and ecological validity the aim was to sample a number of schools that offered what Ball (1984) term 'naturalistic coverage' that represented schools in England. Although 12 of the schools were academies and 8 were comprehensive all schools followed the National Curriculum be it there were slight differences in frameworks for individual science topics. Also for all intents and purposes all students followed the same broad experiences in regards to transition between school and macro processes in regards to the subject of science. All schools did not offer a science club option or conducted specific science induction days which may have had an impact on the affective value of the Open Event in regards to students' attitudes towards science.

4.8 Student age range

Although different counties have a different educational school structure in that some schools have a primary, middle and higher school progression the majority of students within England go through only two stages of transfer: that of nursery to primary and primary to secondary school with primary to secondary school being the main focus within this study. As the secondary schools sampled all accepted students from 11 years of age (or started at year 7) it was decided that the age range in this study would constitute from one year and a term of students before and after the Open Event. This therefore meant that students sampled were aged from 10 years old at the end of year 5 up to 13 years old at the start of year 8. The main reason behind this was to give as broad a picture as possible before and after the main event been studied to enable any trends during this time to be observed. This also enabled the best possible chance to meet the research question without it becoming too large a sample to become difficult to conduct appropriately.

4.9 The main study method

The Open Event placed on by secondary schools to advertise their institutions are between September and October within the first half term of an academic year. Although different councils have different deadline dates applications of choices for secondary school places must be completed no later than the 31st of October (www.gov/education/transition.co.uk) by parents and as such Open Events are placed before this date. Due to time constraints within the PhD the main research project chose a cross sectional design looking at changes in regards to the attitude of students towards science in school across different age groups during the transfer from primary to secondary school using a representative sample of typical feeder primary schools and associated secondary schools in England. As determined within the pre pilot study Open Events are generalizable and the selection of schools within this study, that covers 6 counties and are of mixed ability students, can be argued to be representative of the student population as a whole and as such be comparable; that is that a year 7 cohort in a typical secondary school will be generalizable with a year 7 cohort within another typical school. The advantage of using this approach is that data will be able to be collected quickly at the relevant age points were in comparison an approach like an longitudinal study would need to have a follow up process which would be difficult within the available timeframe as the Open Event only occurs once a year.

With the modifications made from the pre-pilot and pilot stage it was thought that the questionnaires were ready to be applied for the main study (see appendix 3 for final version questionnaire). As consistent distribution was key to aid in reducing unwanted complications the questionnaire was handed out each time within the students' science lesson. As per the pilot study a protocol was followed in that the students' involved were informed about the purpose of the study before the questionnaire was handed to them. It was also made clear that they should not leave identifying marks upon the questionnaire, that there were no correct or incorrect answers and that the results would be anonymous. To aid in what Litchman (2010) termed the 'credibility' of results, focus groups and interviews were also conducted after the questionnaire had been administered giving a triumvirate of methods of collecting data so that comparisons could be generated. As timing was of paramount importance as it could be a potential variable questionnaire samples from year 6 in term one before the transition event and after attending the transition event where no more than 25 days either side. In regards to collecting data from science departments on their planning implementation and evaluation of the Open Event discussion with the Heads of Department revealed that the best time to conduct a full department focus group was by attending their weekly department meeting. As such focus groups where conducted by the same researcher with all involved secondary schools within their department meetings. Again as timing of the meetings was seen as a potential variable all Open Event meetings with the science department occurred no more than 2 weeks away from the transition event.

4.10 Data analysis and analytic framework

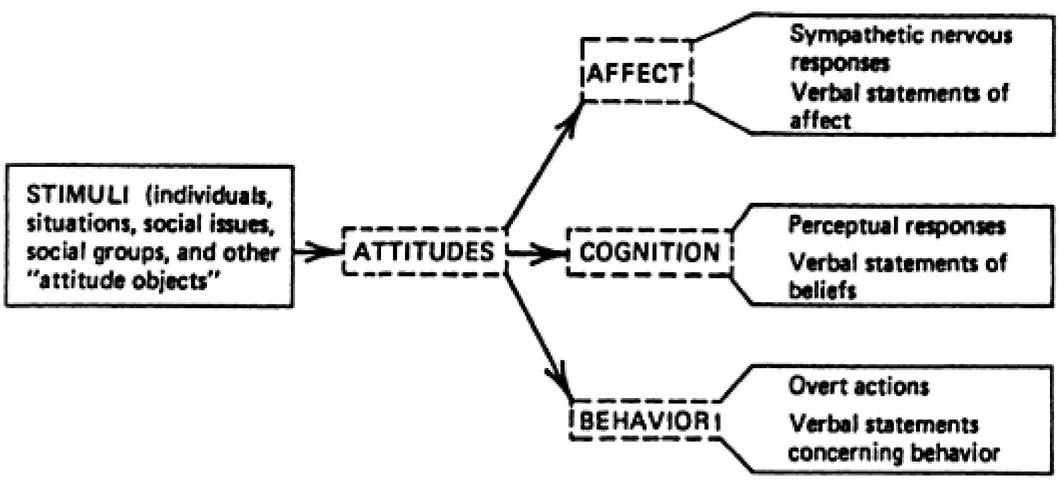
In total data was collected in four formats. To achieve research question one data was collected from field notes from observations of the transition event and recorded focus groups of the science departments within the secondary school before the event.

To achieve research question two and three data was collected from a student answered semi-quantitative questionnaire which in turn informed questioning used in student focus groups and interview recordings that represent the transition years under scrutiny. As such the questionnaire data consisted of samples from year 5, year 6, year 7 and year 8. The overall trends gleaned from the semi-quantitative questionnaire was then be used to inform the questions to be used in the semi-structured student focus group and interviews.

The analytical framework implemented frames the results gained from the data collection as outlined above as well as connecting the findings to previous research as highlighted in the literature review section. As the term ‘attitude’ has no agreed upon definition it is important to note that this research uses a multi-component model consisting of cognitive, affective and behavioural components. This tripartite model presumes that when considering a persons’ attitude towards an object, it is only through evaluating cognitive, affective and behavioural factors that an attitude can be inferred (Haddock and Zanna, 1999). In regards to this specific study it is expected that observing students’ non-verbal and verbal statements in regard to their feelings (affective), behaviour (behaviour) and their beliefs (cognition) within the focus groups and interviews as well as making note of the Likert scale question scores which test for individual tripartite concepts will clearly infer a students’ held attitude towards science in school.

This framework was first highlighted in 1960 by Rosenberg and Hovland (see figure*** below).

Figure ***A model of the three components of an attitude (taken “schematic conception of attitudes” figure 1 in Rosenberg & Hovland, 1960, p. 3)



In regards to this study the way in which affective, cognitive and behavioural components collate to form an attitude therefore should show some form of consistency. For example for individuals that hold a positive attitude towards science in school it would be reasonable to assume that learning about science is stimulating (cognitive), that they like attending science lessons (affective) and that they have an innate interest about the subject of science (behavioural). It should also hold true if the opposite occurs. For example if a student has a negative attitude towards science then they should report that science is not stimulating (cognitive), that they dislike attending science lessons (affective) and that they have very little interest about the subject (behavioural). Ajzen (2005) has also suggested that non-verbal cues could also be used to assess the components that make up a person’s attitude towards an object. For example instead of a student stating that they are interested in science lessons the use of facial expressions that show attentiveness could be an indicator instead.

It must be mentioned however about the difficulty in assessing a students’ held attitude towards an object during the secondary school phase. It has been noted by Krosnick and Alwin (1989), Hodgson (1993), Wilson et al., (2000) and Kruglanski and Stroebe (2005) that during the transition years that students’ are beginning to establish and find their own identities. As such attitudes could be susceptible to change and conflicts could occur between the components of the tripartite model. Rosenburg (1960) argued that this conflict is normal in that changing attitudes often begin by one component being in conflict with the others. This conflict often results in attitudinal change as individuals are observed to adapt their attitude to ensure consistency. It could be argued therefore that it is the strongest attitudinal component that is actually inferred and felt by the student if inconstancies exist. Support for this could partly explain why many students’ claim to like practical work within science but as yet do not choose to study the subject (Abrahams, 2009). This would also suggest that cognitive and affective components are generally more prominent in attitude formation and this is supported by Rosenberg (1960) and Ajzen (2005). In relation to this study therefore, the use of a mixed methods approach may reveal these inconsistences in attitudinal components. This then could potentially indicate which attitudinal component (Afferent, behavioural or cognitive) is more prominent in attitudinal formation.

Using this mixed methods approach, the use of a semi-structured questionnaire followed by interviews, should address any uncertainty in regards to the accuracy of what students' are putting on paper not reflecting their fundamental attitudes as it incorporates the use of triangulation (Laws, 2003). This is where the researcher is able to collect results from different approaches which can be used to collaborate or challenge each other and otherwise highlight areas that the use of a single methodological approach is unable to do.

4.11 Validation and reliability

A challenge with collecting and interpreting data from the use of a questionnaire tool is the issue associated with face validity; that of students' answers actually reflecting their fundamental attitudes and not another construct which they have construed. In relation to attitude studies research indicates that predicting behaviour from attitude is not possible unless a very specific attitude is formed and is oriented toward a behavioural choice (Doll and Ajzen 1992; Smith and Stasson, 2000) with general attitudes actually poor predictors of specific behaviours unless a *multiple-act criterion is adopted* (Fishbein and Ajzen 1975). This was first highlighted by LaPiere (1934) who observed a dissociation between individuals who stated in a questionnaire that they would not serve a specific ethnic group within their restaurants with the actuality being much lower when confronted with the ethnic group arriving at their restaurant. As such in order to address this the use of triangulation (Laws, 2003) was adhered too with the premise that collecting data on the same construct using three different methods will enable the data to be challenged or collaborated reducing bias. This approach also has the advantage of highlighting potential further areas in regards to the data that may not have been apparent if only one method was implemented. As such the questionnaire tool was supported by data collected from focus groups of students as well as individual in-depth interviews. These were conducted by the same individual researcher which in turn reduced the risk of collector bias (Wallen and Fraenkel, 2001).

4.12 Ethical issues in the study

The study adhered to all criteria set by The University of Lincoln's ethical committee and as such confidentiality has been kept throughout this research project. As the study did not require it names of teachers, students and schools were kept anonymous with clear guidance given when administering the methodological tools. When the questionnaire was administered students and teachers were explicitly instructed not to write any form of identification on the document. In relation to the focus groups and interviews of teachers and students no names were recorded and transcript references or field notes used pseudonyms at all times. Of the 6 secondary schools and 14 primary schools all schools agreed by email or by telephone to anonymity with Head teachers being informed of the details of the research before data was collected. As participants were informed explicitly about the purpose and content of the research project no issues involving psychological harm or misunderstanding occurred. Administration of the questionnaire, taking part in focus groups and student interviews were completed during normal school time of the specific school and under supervision of the member of staff who had agreed for their students to participate within the study.

4.13 Summary

The aim of this thesis is to explore the impact of the year 6 Open Event on students' attitudes towards science during transition from primary to secondary school within England. During the literature review and pilot study it was decided that this focused upon finding the answers to the following research questions:

1) What occurs at the year 6 Open Event in relation to science in school?

2) Do year 6 Open Event's effect students' attitudes towards science lessons in school?

3) Do year 6 Open Events change students' perception of what constitutes school science?

Chapters 5, 6 and 7 will each take a research question and discuss the results gained by using the mixed methods approach. Although all three chapters are designed to attempt to fully explore the impact of the year 6 Open Event on students' attitudes towards science during transition from primary to secondary school within England each chapter is specifically dedicated to one of the three research question and as such can be read as a standalone. Chapter 6 will discuss if the year 6 Open Event effects' students' attitudes towards science lessons in school, Chapter 7 will discuss if the year 6 Open Events change students' perception of what constitutes school science whilst the next chapter, Chapter 5 will discuss what occurs at the year 6 Open Event in relation to science in school.

Chapter 5

Constructing what occurs at an Open Event in relation to science in school

5.1 Introduction

The aim of this chapter is to construct what occurs at a secondary school Open Event with a specific focus in relation to the subject of science in school. The term 'Open Event' is in reference to a specific occasion that nearly all secondary schools place on for prospective parents with children who are coming of age to move from their primary education and transfer school. In this study this means that these children are aged between 10-11 years old and in their final year of primary school (Year 6). This also means that they are visiting secondary schools within their catchment areas to peruse what these potential schools' offer to aid them in making their final decision in choosing their preferred school to transfer too. That said an overview of the Open Event in regard to the general secondary school may be informative in giving the context of what surrounds the science department at this event and this is where we start.

5.2 Overview of an Open Event

Given the lack of a clear agreed upon term it is surprising that what occurs at these events is clearly standardised across secondary schools within England. An Open Event generally starts with a talk or lecture from the head teacher and other senior leaders of the secondary school. Generally speaking the head teachers talk follows 4 key strands that consist of comments on behaviour, progression, and attainment as well as that of teacher quality. The head teacher often mentions the expectation they have of their students' behaviour at the start of their lecture and links this with the part parents can play to support this. As one senior teacher at the headship talk stated:

'The Head often communicates his zero tolerance policy towards misbehaviour of any kind. That way the parent doesn't have a leg to stand on if their child gets sent home or gets a detention for something they deem small like not wearing the uniform. They were told on day one what the schools expectations are'.

This is often followed by statements that highlight the individual schools culture and ethos with specific mention on the strength of leadership, governance and teaching within the school. Words such as ‘vision’ ‘future’ and ‘journey’ are common descriptors used in describing the overall purpose of the head teachers talk. As another senior leader commented:

‘The head has to try and strike a balance between what the school has achieved already against improving the school in the future, that is that even if results where great this year, the aim is to do better next year’.

In an interview held by the BBC with a Head Teacher (White, 2015) the ‘desire for unremitting school improvement’ was highlighted as the core principle of what a school does. This idea of continuously improving seems to be one of the clear messages that head teachers try and present to parents. Strengths of the school are often highlighted. This could be the latest OfSTED judgement, the number of extra-curricular opportunities for their students or even any newly refurbished classrooms.

Academic data, specifically linked to student attainment is common. Data is highlighted dependent on the school. What became apparent, after obtaining the PowerPoints used by the Head teachers from schools within the sample, was the fact that all schools used some form of academic data to advertise their school.

It was best summarised by one senior leader that stated:

‘2 years ago we were above national average for English and Maths. That was the headline statistic used. The following year we didn’t do as well and we only met the national target…..but our upper sixth form grades were pretty good so we used that instead.’

Finally the capabilities of their teaching staff, governance, senior leadership team or all of the above are usually the last feature mentioned to finish the lecture. If data is available such as the teaching judgement by OfSTED or the good ratio of staff to students then this is often shown. This generally seems to be a transition point to the next stage within the Open Event: that of the parents going to see individual subjects within the school.

Often represented by Heads of Department and other members of subject specific staff., these subject specific stalls give parents and their children the opportunity to ask subject specific questions to relevant members of academic staff whilst at the same time giving departments a chance to enthuse and show off their subject. It is at this time that parents and their children have the chance to ask questions that they believe are important in determining their choice of secondary school. It is this feature, of specific subjects marketing themselves, that is the purview of this thesis. Abrahams (2007) postulated that the year 6 Open Event could have a potentially negative effect on students' perception of science in school as often the science departments at these events advertise themselves practically and as such misrepresent the reality of the subject – a misrepresentation that the students might become aware of as they progress through secondary school.

Although the logistics of the department stalls seems to differentiate due to practicality (all subjects in one room, all subjects spread across a specific section of the school/ subjects scattered throughout school in subject areas) the general features discussed seemed to be the same. This consisted of samples of students 'best work', the use of student ambassadors to showcase their work, subject specific equipment on display for more practical based subjects, the use of subject specific paraphernalia and the use of statistics to show subject specific academic outcomes. Often parents and their children are split into groups which are assigned either a senior leader or student ambassadors who follow a specific route to showcase the school subjects and facilities. Again this is mainly down to logistics (having over a 100 parents going into one subject area is just not practical).

Finally the Open Event usually finishes with an opportunity for parents to ask questions. A senior leader is usually available to answer any questions from the parents and there is often then the chance for parents and their children to revisit areas of the school if they so wish. Speaking with senior leaders from the sample schools this seems to be the designated opportunity for individual parents to ask questions away from the group and for the senior leaders to gain anecdotal evidence on how the Open Event went.

Within the next section a more detailed look at the Open Event in regards to the role of specific subject, science, is scrutinised. This includes evidence from focus groups from science departments in regard to the planning and preparation of an Open Event subject science stall and observations made of what the science department did at the Open Event using the framework discussed within the methodology section.

5.3 The science departments' planning before an Open Event

6 secondary schools science departments where used in total for this study consisting of in total 76 science specialists involved in the planning and implementation of the science stall at their respective school Open Events (see table for breakdown of number of staff by school). Planning was by all departments conducted after a school day, in their weekly departmental meetings, held after the school teaching day had finished and often within a science teachers teaching room or laboratory. Generally speaking these meeting occurred within 2 weeks of the date of the school Open Event. All department meetings were attended by the same researcher with the remit of observing, in its natural setting, the planning of the role of the science department at the Open Event and as such did not actively take part in the discussion. Only after the discussion was finished did the researcher then talk separately to the Head of Department about questions on any rationale or phenomena that was deemed required further exploration. Meetings where commonly constrained by time allocation in that they were designated to be for only 60 minutes. Of the 6 schools observed 5 went over this limit with the range being from 58 minutes to75 minutes (17 minutes). In the interviews held after the staff meeting had finished with the Head of Department the lengths of these ranged from 28 minutes to 45 minutes (17 minutes).

School Code	Total number of science teachers	Total number of science technicians	Length of meeting (to the nearest minutes)	Length of Head of Department interview (to the closest minute)
A	11	2	65 minutes	41 minutes

B	9	1	70 minutes	28 minutes
C	12	2	58 minutes	45 minutes
D	9	2	75 minutes	31 minutes
E	10	2	68 minutes	33 minutes
F	13	3	69 minutes	35 minutes

Table 5.1 showing data in regards to a science department planning an Open Event

The start of the meeting for 5 of the 6 schools (A, B, C, D, F) consisted of which members of staff where attending the Open Event. Generally speaking this on average was a 5 minute discussion on who could or could not make it to the Open Event. It was in this introduction however that the Head of Department made clear that there was an expectation that teachers with TLR’s (teacher learning responsibility) would be attending the Open Event. For 4 of the 5 schools (A, B, D, and F) this was the Head of Department, Second in Science, Head of Chemistry, Head of Biology and Head of Physics. For school C the Second in Science was a pastoral Head of House and as it was expected that they would have to attend other evening events related to that role they did not have to attend the Open Event. Although school E had a similar conversation as A, B, D and F both the Head of Chemistry and Head of Biology were part time and as such quid pro-quo (in that it was expected that these individuals showed up to the Open Event but as a result missed a parents evening in the future) was discussed with individuals at the end of the meeting. That said by the end of the meeting all 6 schools planned to have 5 members of staff present that included the Head of Department, Second in Science, and the staff designate in charge of Biology, Chemistry and Physics. What is important to note is that from the start, all of the meetings of all science departments structured their plan for the Open Event in regards to the subject of science being represented by the three main individual strands of science that where taught at secondary school. That is that of biology, chemistry and physics. In fact the majority of the conversations never even questioned this structure. For example:

Head of Science in school B:

Ok….lets crack on…..as normal we need to sort the stalls out. We have chemistry, physics and biology……(Name of head of biology) what are you thinking of doing?

Head of Science in school F:

Right we'll start with chemistry……so (name of chemistry teacher) what equipment do you need for chemistry?

Head of Science school C:

So what we're doing………(name of Head of Biology) you still got any rats left to dissect?

When this was explored further within Head of Department (HOD) interviews the common reasoning behind this seemed to be two fold in that they viewed the separated science strands stalls as the most practical way to show case the science department and *that this was what had always been done.* In fact the latter reason was often given first, before when exploring further the HOD expanded. For example from school D:

HOD: Well…..its been done this way in every school I've worked at over my 14 years of teaching

Researcher: How many schools have you worked at?

HOD: Oh…….(name of schools)…5 in total

Researcher: So you do separate science stalls because its always been done?

HOD:….Yeah…….well it's also useful logistically. We want to show what science is to parents

This idea that separating the science strands was best in relation to portraying what science in school is about was common throughout all the HOD interviews. Perhaps because of this, practical considerations where often the focus of the group discussion, with practical requirements to advertise the individual science strands being the centre of the department conversation. The only difference between the general structures of the school meetings across the sample seemed to be in relation to the order of the science strand that was discussed first. The science department meetings followed a simple structure of:

1) Introduction
2) Science strands (Biology/Chemistry/Physics)

3) Paraphernalia and student helpers

As such the structure of the rest of this chapter follows the order of the group planning talks on the Open Event for science.

5.31 Biology stall

What became apparent very early on within the group discussion for the biology stall was the focus of the science department on the objects that make up practical activities. Very little if any discussion time was given to the ideas that underpin the practical's chosen within biology. That is not to say that they were not implicitly understood but more that during the planning time allocated science staff focus was on *practical equipment*. The domain of ideas played a relatively minor role in that students were expected to observe an object and notice and remember some things about it. However for practical activities that where discounted the domain of ideas was often the main justification for discarding them. Table 5.2 summarises the practical and non-practical activities discussed whilst table 5.3 summarises the decisions made on what to put at the biology stall.

School that discussed what activity for Biology	Activities discussed
A, C, D, E	Dissection
A, B, C, D, E, F	Microscopes
B, D, E, F	Making a cell using sweets

Table 5.2 Practical and non-practical activities discussed for biology by school

School Code	Planned Activities
A	Microscopes onion slides
B	Microscopes mixed slides
C	Microscopes onion students make
D	Microscopes mixed slides
E	Microscopes onion students make
F	Microscopes onion slides

Table 5.3 Planned activities for Biology by school

Generally speaking all 6 schools where similar in their discussions on what to place at the biology stall. The use of dissection as a tool to showcase the biology stand was debated by 4 schools (A, C, D, and E) but no school planned to place this at the Open Event. For school A and C this was down simply to discussion on scientific objects; that is that they did not have the equipment to appropriately dissect a rodent. For school D and E discussion focused on objects and ideas. For example in school E:

E4: To be honest there's no point doing it. The rat has been in the freezer for what? 3-4 years now? Can we still use it?? Plus I mean what will they get from it?

E2: And some parents may have a problem with it. We don't want to put people off

E4: Plus what do they learn about science from seeing a rat pinned to a dissection board? We can't really justify it if someone complains.

And in school D:

D2: I really want to dissect a rat. Not done it for ages!

D3: You would!

(General laughter)

D8: I'll have to check the equipment. In fact I'm not sure where I stored the dissecting boards.

D2: Can't we just do it in a metal tray?

D8: No you need to pin it down if you're doing it properly. Are you thinking of showing the gut and linking it to enzymes?

D2: (Laugh) No I just want to dissect a rat! And the students' will want to see me dissecting a rat too. They'll love it!

D9: Some won't

D2: Then they can go and see chemistry or something

For school E reasoning for not including a rat dissection was decided based on the risk that if a parent complained they did not believe that they could justify choosing to do it based on what students' would learn from it over other practical's. School D was different however in that although they had discussed what could be learned from dissecting a rat it was the lack of equipment, the object in this case being a 3-4 year old frozen rat that most likely would not be suitable, that determined that most likely dissection was not possible.

Making cells using sweets was discussed with B, D, E and F with all 4 schools not choosing this activity for the Open Event. The task itself was very simple in that students' would have to look at a picture of a specialised cell, such as a nerve cell, and then choose from a mixture of sweets to make a model replica. B, D and F discarded this by using the domain theory of ideas. They did not believe that 'copying' a picture with sweets represented biology or even science. For example in school F:

F7: What's the point?

F3: It's something interactive for them to do

F7: But they're not learning anything?

F8: They'll learn that some cells are different. That they have different structures and are specialised for a function.

F7: No they won't. They'll learn to copy a picture! Where will they learn about specialised features?

F5: I suppose it's very arty isn't it? Is it really representative of biology using sweets to copy a picture?

School E discarded it over a science idea that they believed took precedent, that of not eating in laboratories:

E12: No I'm against it. In all the labs we have 'No food' signs!

E8: (Laugh) yeah we're shooting ourselves in the foot later surely if the first time they go to science here we let them eat.

E3: but we're not saying to eat the sweets, we're saying to use them to make a model cell

E7: We're going to stop a bunch of 10-11 year olds to not eat sweets we give them??

E1: It's a bad precedent to set really. One of the first lessons we'll do is science safety and why you don't eat in laboratories.

Finally the use of microscopes was discussed by all 6 science departments with all 6 doing some variation of planning to use them at the Open Event. The variation of use is important to note as this evolved from departments that just discussed the domain of objects and those that included the domain of ideas. For those departments that chose to use microscopes and incorporate their use with students' showcasing their skills (school C and E), the domain of object and ideas was in evidence. For those schools (A, B, D, and F) that chose to use microscopes and planned to place readymade slides for parents and students to peruse, departments only explicitly used the domain of objects. For example in school E:

E10: Microscopes will be good. It's a piece of equipment that most people associate with science, and we've just finished teaching cells with it with the year 7's so we can get the students to showcase their skills.

E1: That will be good. Can they make their own slides?

E10: Yeah they can. We can even prep them to talk about WHY we use microscopes and the strengths and weaknesses of light microscopes.

E11: Onion slides?

E1: Yeah….we can set up maybe a couple of check cell slides as well maybe?

E10 And get the students to compare them, the cells?

E1: Yeah that will be good!

This is markedly different from the conversations held at the schools that focused more on the domain of objects:

A2: Microscopes then?

A9: What just set them up with some slides?

A2: Yeah and they can have a look and play with the magnification?

A9: Yeah that should work

A1: ok so that's biology stall sorted....what about chemistry?

It's interesting to note that the dialogue that occurred indicated that the primary aim of the science departments was wanting to place scientific objects down that would *stimulate interest* in students and parents about their subject. Although learning, or lack of understanding of an object, was discussed the departments seemed to prioritise choosing objects of interest first (suggested activities) and then stimulating interest with activities that needed *very little impute from the science staff* (Chosen activities) second.

5.32 Chemistry stall

Of the three stalls chemistry had the most diverse discussion in relation to practical's to put on show although the planned outcome was similar for nearly all schools (see table 5.4 and table 5.5).

School that discussed what activity for Chemistry	Activities discussed
A, B, C, D, E, F	Methane bubbles
A, B, C	Acid/Alkali testing
C, D, F	Screaming Jelly Baby
A, E	Group 1 metals
A,B, C, D, E, F	Flame testing
A, B, E, F	Elephant Tootpaste

Table 5.4 Practical and non-practical activities discussed for chemistry by school

School Code	Planned Activities

A	Acid/Alkali testing
B	Methane Bubbles
C	Methane Bubbles
D	Methane Bubbles
E	Acid/Alkali testing and Methane Bubbles
F	Methane Bubbles

Table 5.5 Planned activities for chemistry by school

Of the 6 schools within the sample all schools discussed in some form the use of Methane Bubbles and acid/alkali testing. These two practical's where also exclusively chosen for the planned activates for the actual Open Event.

Elephant toothpaste is a practical that showcases an exothermic reaction. When Hydrogen peroxide and soap water are mixed in a beaker before a catalyst, usually Potassium Iodide, is added a mass amount of foam, or elephants toothpaste, is produced which shots out the top of the container. A, B, E and F discussed this practical as it was deemed 'topical' due to students' knowing about it from a popular TV show. However, it was discarded by all schools based on logistical challenge's around the objects of the practical. For example:

School C:

C2: What about Elephant Toothpaste? The year 8's have been nagging me all year to do it after they watched in on (name of TV show).

C6: Its so messy. And its hard to clean up. How many times would we do it (indicating at the Open Event)? 10-20 times?

C1: Maybe we want something that we can repeat quickly and often

Flame testing is where metal salts are placed in the flame of a Bunsen burner resulting in that flame changing colour. This practical was discussed by all schools and it also seemed to be a practical that has been showcased in the past. However again ideas on challenges with objects needed seemed to be the key variable that caused this to be discarded for another activity:

School D

D3: What about flame testing. We didn't do it last year, I'm not sure why, but we've done it for years and years

D4: It wrecks the Bunsen Burners That's why. I have to disassemble them and clean them all

D3: Surely we just need to use one?

D4: You know how much of a pain it is to disassemble?

School F:

F1: Flame testing is always good. Students' love it

F7: Maybe 10 years ago. But it never really lasts long enough now, the colour change, and they just sort of get bored.

F1: Oh? No then?

F7: Theirs better ones……..

The screaming jelly baby experiment is a simple practical where a boiling tube is oxygenated before a jelly baby is dropped into it. This added glucose then reacts with the oxygen causing an exothermic reaction in which students observe small colourful flames, white smoke and hear the noise (the supposed scream) of the glucose reacting with the oxygen. Three schools discussed this (C, D and F) in terms of the object domain mainly and the ideas domain implicitly. For example:

School D:

D4: Screaming jelly baby? It made ME react when I realised my cells do that every second of every day….just more controlled!

D3: Its such a bad analogy though! The bright kids understand but the low ability students……they literally think their cells are on fire. Plus when you show them you always have one who overacts and coughs with the gases made.

D4: Do it in a fume cupboard?

D3: Sure….but only a few people will see it properly…..and it'll be hell to clean afterwards

School F:

F2: I suppose we could show the jelly baby in the test tube? That's everything you want really. In gives bangs, pops, screams, fire and smoke!

F5: Fume cupboard

F2: I thought you didn't need one for it

F5: you don't NEED it…..but its advised as it releases a lot of gases. Anyone with asthma…….

F2: Ah……I suppose as well it would be hard to explain what's happening wouldn't it?

Group 1 metals are the elements found in group 1 of the periodic table which are highly reactive, especially in water. Group 1 metals was measured as a potential activity by 2 schools and it must be said that this was the only time within the talk about the chemistry stall when the discussion actually covered the domain of ideas. For example with school E:

E1: so for chemistry……I was thinking what about showing the group 1 metals?

E8: Well its embedded throughout the syllabus in Key stage 3 and 4…and 5 as well. Do they do it at Key stage 2?

E2: I'm not sure…..but we can find that out can't we?

E5: I like it. We can link in the big ideas like elements……reaction rates……..

E12: We'll need the fume cupboard out of your doing that

E4: That may be the challenge. You can only get so many people around a fume cupboard safely to see.

E1: Oh yeah…….damn it would have the wow factor….but if not everyone can see it

E12: Plus if you want them to see it you'll need to use larger quantities then what COSHH recommend

E1:….Ahhhh ok…..any other ideas?

This discussion is in contrast to that of acid and alkali's that 3 schools in the end chose to demonstrate at the Open Event:

School A:

A1: Then….what about Chemistry…what have we normally done?

A5: Acid/alkali testing. Get some indicator. Kids love it

A1: ok did it go well last year?

A4: Yeah even the parents liked it. They remember from school themselves!

A1: Guess that decided then. We'll definitely do that.

And School E:

E8: Test tubes. Acid, neutral and alkali substances in some and then get the parents, the children to drop some UV in them.

E9: Acid/Alkali testing?

E12: It'll be easy on the equipment. Its just boiling tubes, their bigger, and UI.

E8. Yeah. Kids like it. I mean it just changes colour but….they REALLY like it

E1: ok we'll do that. Anything else?

It could be that for the teachers present what theoretical science the acid/alkali testing was demonstrating when ‘it changed colour’. If that was the case then the domain of ideas may have been explicit to them but implicit to the observer. To check if this was the case with the Head of Department interview this was explored further receiving similar answers from both schools:

School A:

Researcher: So for chemistry you decided to go for acid/alkali testing…

HOD: yep

Researcher: Why?

HOD: Experience. We know its easy on equipment. We don’t need to order anything special in. And the kids love it and get really excited about it.

Researcher: Will you teach WHY its changing colour

(Pause)

HOD: I’m sure we’ll talk about it at the time but…. (laugh) the main thing is to give them an idea of what chemistry is and make them interested. This does that.

Again, like the biology stall the primary aim of the science departments was wanting to place scientific objects down that would stimulate interest in students and parents about their subject. Unlike biology however the chemistry activities where substantial on teacher input. It must be pointed out however that the activities that where finally chosen by the schools where the ones that where the least time consuming and onerous to set up and repeat. Acid/alkali testing is very simply a number of chemicals in a container which a drop of indicator is added whilst methane bubbles, although spectacular, involves only a piece of rubber tubing connected to a gas tap and a mixture of soap and water. These bubbles are then flammable and are usually set on fire by the teacher using a splint. Potentially due to the easy nature of this very little discussion was conducted in regard to the domain of ideas for this practical. For school B the chemistry component of the discussion was both brief and to the point:

B1: So (name of Head of Chemistry) what are you thinking of doing?

B6: Methane bubbles. Normal stuff really. Just need the long rubber tubing and some fairy liquid. Quick and easy.

B1: Nothing else?

B2: What about doing the flame testing or the acid and alka (interrupted)

B6: Nope. Done this for years. Kids love it. If it works why change it!

(Silence)

B1: Ok that was quick. Ok (name of Head of Biology) what are you thinking of doing?

With further exploration in interview with the Head of Department it was revealed that the Head of Chemistry had been at the school for 32 years and been Head of Chemistry for 28 of those years. As she put it:

He knows what he's doing and who am I to argue? It'll do the job and give the wow factor to the evening so!

Although having such an experience member of staff who was entrenched within the way that they do things may not be the norm for the average school from reviewing the other 5 schools within this data surprisingly, although there was more discussion, the outcome was very much the same in that the chemistry stall had to have the what the Head of Department at B school termed 'the wow factor'. Methane bubbles fulfilled this brief.

5.33 Physics stall

Similar to the Biology stall what became apparent very early on within the group discussion for the Physics stall was the focus of the science department on the objects that make up practical activities. Very little if any discussion time was given to the ideas that underpin the practical's chosen within Physics. That is not to say that they were not implicitly understood but more that during the planning time allocated science staff focus was on *practical equipment*. The domain of ideas played a relatively minor role in that students were expected to observe an object and notice and remember some things about it. However for practical activities that where discounted the domain of ideas was often the main justification for discarding them. Table * summarises the practical and non-practical activities discussed whilst table * summarises the decisions made on what to put at the Physics stall.

School that discussed what activity for Physics	Activities discussed
A, B, C, D, E, F	Van der Graaff
B, C,	Peppers Ghost
D, E, F	Hooks Law sweets

Table 5.6: Practical and non-practical activities discussed for physics by school

School Code	Planned Activities
A	Van der Graaff
B	Van der Graaff
C	Van der Graaff
D	Van der Graaff
E	Van der Graaff
F	Van der Graaff

Table 5.7: Planned activities for physics by school

The discussion on the physics stall was similar in all schools involved in this stage of the research. All schools involved in the study had a Head of Physics and at least one other physics specialised and unlike the discussion on the chemistry and biology stall whereby a general discussion by the majority was conducted about potential options, the physics discussion was often between the physics specialists, with the Head of Department moving the discussion on, and the other members of staff listening. When asked about this phenomena the Head of Department of school A commented:

Researcher: Generally everyone was involved in the discussion about the different activities to place on at the school…..but when it came to the physics stall it just seemed to be the physics members of staff talking…..

HOD: (Laugh) Yeah they know their subject…..its probably a confidence thing. Don't get me wrong we can all teach physics up to Key Stage 4….but we do it by wrote. Page by page. Follow the scheme. I'm a biologist and I'd argue that I'm competent in physics….but of the three (indicating strands of science) I'd say is physics is my weakest and I think a lot of science teachers would say that too. So we keep quiet and let the experts talk.

Potentially because of this; dialogue observed about the physics stall was more technical then what had been observed with the biology and chemistry stalls. There were also less suggestions for potential activities. A demonstration of Hooks law using sweets was discussed by school D, E and F. This was a simple experiment in that masses where attached to the end of different sweets with more masses being added until the sweet stretched or snapped. This activity was quickly discarded however using the same reasoning seen in making cells with sweets in the biology stall discussion in that 'no food and drink' was a fundamental rule within a laboratory which superseded the use of sweet practical's.

Another activity discussed by school B and C was that of peppers ghost. Peppers Ghost is a 1900 century special effects technique that uses mirrors or reflective surfaces to create a transparent image of an object. In the laboratory this can simply be done with mirrors and a Bunsen Burner. This however was also discounted quickly. For example:

School B:

B4: Students really like it or hate it though. It's very hit and miss

B5: Course it is! It depends on the angle the students' stands at in relation to the mirror and Bunsen burner…..well if their close anyway. If you get them standing in the corner of the room it works…..

HOD: is it suitable for a group?

B5: it can be. You just placer a marker on the floor for the student to stand and then the virtual image…..

HOD: (Interrupting) I think we need something that EVERYONE can see no matter where they stand

The activity that all schools chose to perform in the end was that of the Van der Graaff generator demonstration. A Van de Graaff generator is an electrostatic generator that is often used to teach about electrostatic charge within English education. Electrostatic charge is produced by a moving belt which is then accumulated in a hollow globe made of metal sitting atop of a column made of an insulated material on the top of an insulated column. This creates very high electric potential which can be observed when a person touches the globe resulting in their hair standing on end. From the dialogue observed this seemed to be an object that was closely associated with physics in school had, in the past, being something that students' at Open Events had been enthused about. For example in school D:

D7: Well let's dig the Van Der Graaff out. The electrostatic charge demo

D6: Does it still work?

D5: It's about 35 years old but it worked last year when we used it

D7: Students' loved it last year.

D6: Plus it LOOKS scientific doesn't it?

(Laugh)

D6: you know what I mean. Its not something they'll have seen and they'll enjoy it.

This idea of 'enjoyment' was also mentioned by school E:

E5: Van Der Graaff is something they (indicating parents and students) always enjoy

E7: It's definitely something they'll get excited about especially if we can get someone's hair statistically charged.

It is interesting to note that it was often the object of science that was discussed as causing enjoyment and interest but the ideas behind how or why it occurred was implied only.

5.35: Summary

Overall it seems that at the Open Event the aim of the science departments (at least at the planning stage) is twofold in that they want to showcase an image of science that it is above all else a *practical* subject in school and that this portrayed image also includes the idea that science in school is based on *three science strands* that can be categorised by knowledge into Biology, Chemistry and Physics. At least at the planning phase the science departments focused on the domain of objects especially towards individual practical's that showcased a specific category of knowledge. Although it could be argued that that this is not surprising as fundamentally the meeting was about setting up, logistically, the science stall to represent the subject of science, it is important to note that any true representation of science is not just about 'knowledge' but also about 'ideas'. As the Open Event is often advertised to parents as an event that gives the parents an opportunity to see 'what the school is really like', any event that showcases a realistic image of science in school should therefore include activities or parahelia that showcases science as being about both knowledge and ideas.

This is not to say however that the *domain of knowledge* was ignored. The domain of knowledge was often evident when departments discussed reasons why not to showcase a specific practical activity but it seemed that it was the logistical challenge of the activity (object domain) that dictated which practical's' where chosen over others. That said it could be that the domain of knowledge was not made explicit and therefore not something observed by the researcher. As such it was though best that the researcher also attended the actual Open Event to observe if the *planning* of the Open Event was in fact representative of the reality of what the science department *did* at the actual Open Event planned for. The next section are the results of this activity.

5.4 Observations of the science department at Open Events

As the Open Event was held in the evening of a typical academic day most of the science staff involved at the Open Event stayed on at the school after the normal school day had finished. Setting up of the stalls usually began from when the school day finished right up to 30 minutes before parents where due to arrive. In all six schools science departments set up their Open Event areas as they had planned within the afterschool meeting attended by the researcher previously. 4 of the 6 schools (B, C, D and E) set up their science stalls across two adjoining laboratories with chemistry being in one room and biology and physics sharing another. School A set up their science stalls in a typical teaching classroom as all subject stalls where set up in the 'new building' of the school. School F set up their stalls in one laboratory which had just been upgraded the year before. All science stalls where set up on individual islands of desks with signs made to advertise Biology, Chemistry and Physics. School E had student helpers join them at the end of school and these pupils, 8 in total with 2 assigned to each stall, where assigned to help set up the stalls with the teachers. They were also given clear instructions on their roles and lab coats where handed to them as a 'science uniform'.

Schools A, B, C, D and F also had student helpers however they did not show up until 30 minutes before the Open Event started. They also did not have specific assigned roles. They were more of an 'add on' in that it was considered useful to have them but no specific assignment was planned for them.

5.41 Biology stall

All science departments at the Open Event had planned to use in some form microscopes and this is what occurred. Their where slight differences between school E and the rest of the sampled cohort however which may be of note. All schools apart from school E had laid out a row of microscopes with each microscope already containing a glass slide with a different specimen. Students and parent's tasks where quite simple in that they needed to look through the microscope and see the specimen. Specimens where clearly labelled at each microscope. The role of the student helpers seemed very much to be in helping parents and their child focus the microscope and explaining the task to inquisitive guests. By the end of the first hour however the majority of student helpers had left the stall and had wondered over to the chemistry stall instead. As one student helper said '*well its more interesting isn't it?'*.This occurred for schools A, B, C, D with student helpers in school F drifting but then been ordered back to their positions by the Head of Department. As mentioned above however school E had a more structured system for their student helpers and potentially because of this not only did students' stay at their positions all through the evening but also where more interactive with the task at hand. They were observed making cell slides and even helping parents and their children make their own to look at. This teaching of skills was different from the rest of the sample and potentially due to this parents and students spend a proportionate amount of time at the biology stall in comparison to observing what was occurring at the physics and chemistry stalls. It must be said however that although skills of making a slide where being taught a similar level of knowledge in regards to microscopes and cells was imparted in comparison to the other schools in the cohort. Although the researcher stayed at the Open Event until it was finished there was no incidence in any school that where observed that explicitly mentioned to the student or parents about the structure pf a microscope or the structure and function of the cells under scrutiny. Instead what was observed was the focus of staff at the biology stall being directed towards enthusing students' about the microscope as a scientific object that was being sold *as commonly used within science lessons*. For example in school D the biology teacher stated to a group of parents: *Yes, we have a class set of 18 working and we commonly have them on the side in the classroom to use when it's appropriate. Students' use them all the time!* This idea that science in school was hands on was endemic throughout the cohort of sampled schools.

5.42 Chemistry stall

All science departments at the Open Event had planned to either use Acid/Alkali testing, Methane Bubbles or both and this is what occurred. Due to the constraints of rooming in that the science department in school A was not placed in a laboratory they chose to showcase acid/alkali testing due to its logistical ease. This activity was also an add on to the 'main event' of Methane Bubbles for school E. Both schools set up the acid/alkali activity by having a mixture of transparent chemicals which were not labelled. These then where placed into test tubes held in a test tube wrack and the students observed the teacher placed universal indicator into the substance. Acidic substances turned the colour red, neutral substances turned the colour green and alkali substances turned the colour purple. Paler shades of these colours indicated weaker solutions. By the end of the evening school E, when their where less busy, also got students' to place the universal indicator into the solutions themselves. Overall the simple act of observing a colour change caused great excitement with students'. As one student stated *'it's like a magic trick'!*

In comparison more than one student observed that the use of Methane Bubbles was *'like being at Hogwarts'!* All schools set up the Methane Bubbles experiment in a similar way in that a container with water was placed on a desk with a gas tap nearby. Rubber tubing leading from the gas tap was inserted into the water which created flammable bubbles which were then set alight. This not only enthused students but actually caused students and parents from other parts of the room to congregate around the chemistry stall. This occurred in all schools. It must be said however that very little *explicit ideas* about chemistry was observed throughout the whole evening in regards to chemistry. Although objects associated with chemistry like the gas taps where observed by the students ideas about the fundamentals of chemistry or science in general where observed. In fact it was witnessed in school A, B, D and F that teachers actively shunned talking about ideas behind what was on show. For example in school A when a student asked why the solutions changed colour the teacher replied: *'You'll find out when you come here next year'.* This selling of the school in that students would *find outmore later* was a common theme in the chemistry science stalls observed with the later indicating the *ideas* behind what had been observed.

5.43 Physics stall

All science departments at the Open Event had planned to use in some form the Van Der Graaff and this is what occurred. All schools placed the Van der Graaf generator on top of a table next to a power source and had a student helper on hand to demonstrate the electrostatic properties of the object by making them touch it resulting in their hair standing on end. There was a difference with the physics stalls in comparison to the chemistry and biology stalls in regards to the domain of ideas. It was observed in all schools that the rhetoric that the teacher manning the physics stall used, actively explained the fundamental ideas about what the Van Der Graaff could show, in regards to electrostatics. This is different from the Biology and Chemistry stalls observed at the Open Event in that they actively focused on enthusing students using objects associated with their science strands but did not explicitly explain the ideas behind what the activities demonstrated. For example when a parent asked 'How does it work'? in school B the teacher talked for over 10 minutes about electron charges. In school C when a student asked 'Why does it need a belt'? the physics teacher talked for over 8 minutes about the structure of an atom and linking this to energy. These responses were noticeably different from those observed within the biology and chemistry stalls. One reason for this could be the fact that physics teachers are more used to having to explain abstract ideas to students and parents who have very little previous foundational knowledge on the topic. In contrast biology and chemistry ideas are often lesson abstract and students and parents often have a foundational knowledge of the material. Another potential reason is that the physics teachers themselves believed that the domain of ideas is what is more interesting about their subject whilst biology and chemistry teachers may believe that the domain of knowledge stimulates more interest. More research however is needed on this phenomenon.

5.44 Summary

Overall all schools followed through with their plan of representing science as a practical subject using three stalls that represented science as based on Biology, Chemistry and Physics knowledge strands. Although all schools implied that the subject of science was a practical subject in showcasing science objects linked to practical activities very few instances occurred regarding explicitly explaining the ideas behind the activities on show. Of the three stalls, the physics table in all schools seemed to make the most concerned effort to explain the scientific ideas behind the Van Der Graff activity although this was never discussed at the planning stage. This potentially could be due to the abstract nature that is the physics topic (Dillion, 2006). In comparison, the chemistry stalls seemed to actively avoid going into detail about scientific ideas that governed the practicals on show. Their remit seemed very much to enthuse parents, students and themselves by making whizz, bang and pops throughout the evening. Even when specifically asked to explain what was being observed a common answer again and again was that of ‘you’ll learn that when you come here’. For the biology stall school E made a concerted effort to showcase students’ skills of making a cell slide although apart from showing parents and their children *how* a slide was made no evidence was apparent on the reasons *why* certain steps had to be followed, such as the use of sterilised glass slides. Generally however for the cohort as a whole the biology stall simply showcased practical objects associated with biology.

5.5 Review

Although there are slight differences between science departments in their planning of activities and the delivery of these activities at an Open Event the broad brush strokes are similar for all sampled schools. Science departments often represent science in school as knowledge based; that is that science is the study of topics that can be categorised as either biology, chemistry and physics. This differentiation of science strands often donates separate stalls that represent each individual strand. The science department also represent all of these strands as mainly practical in nature and the dialogue observed at the planning stage by the science departments was often similar in nature due to the focus of practical requirements needed to showcase this feature of science. Potentially due to this; focus of the logistics of practical equipment and trying to stimulate an interest towards the subject of science was clearly observed throughout with very little evidence to suggest that science departments were concerned with introducing scientific ideas, cognitive components, at this time. When it came to the delivery of their planned activities at the Open Event all departments followed through with what they had planned. However, their where differences within the rhetoric that the teachers used at the event dependent on the different strands of science. The biology stall focused more on the domain of objects and students observing cells using microscopes. Although ideas about cells and cell structure was implied the focus of the activity seemed to be not to learn about ideas about science but more to simulate interest about a component of science. The chemistry stall also focused more on the domain of objects making spectacular explosions or immediate colour changes by mixing chemicals; the whizz, bang and pop of their subject. Again, focus seemed not be about the reasons *why* these reactions occurred but more about enthusing students about chemistry strand per se. The physics stall was different in that although linking to cognitive aspects of science theroy was not in evidence during the planning phase all stalls observed tried in their rhetoric to explain what students where observing. This was markedly different from the other stalls where any explanations about ideas of science where only observed when directly asked by parents or students.

This theme of style over substance, whereby the science department showcased a veneer of what science in school consisted of, was apparent in all schools observed. In fact, this was also clearly observable throughout the Open Event. Although parents had been advised by local councils and by primary schools that attending an Open Event was a good measure to judge a school, it could clearly be seen that secondary schools themselves where using the Open Event as a potential marketing mechanism to showcase themselves *at their best.* For example, one Deputy Head commented:

Deputy Head: *It's a lot of information to take in for parents but we want the last image they have to be one that staff, ourselves, are available for any problems or questions they might have. I think it's generally gone well tonight.*

Researcher: *How can you tell?*

Deputy Head: *(Small Laugh) because people are still here enjoying the show.*

Researcher*: The show?*

Deputy Head: *Yes, what they are seeing and doing in the different subjects now. They (the parents and students') seem to be enjoying the different activities and that's half the battle really. If they enjoyed themselves tonight then they'll leave with a positive image of the school and, fingers crossed, that will transfer into them choosing this school in their options.*

This conversation was not unusual with senior leaders making a link between parents and their children enjoying and being interested at the Open Event and them then choosing the school in their option choices. Time and again anecdotal conversations at the end of an Open Event with senior leaders led to ideas of the aim of the Open Event being that of enthusing students and parents about the school and this message potentially may have dictated the way in which the science department planned their stalls.

Although it has been noted that 'parents are savvy' (White, 2015) and as such an assumption is made that they know that the school is putting on a marketing show it is less well documented if young children, who are going through optimistic apprehension regarding transferring schools (Morgan, 1999), also understand that the secondary school rhetoric they observe during this event may not be a true reflection of the reality of attending that institution. The effect this could have on students' attitudes towards school generally and towards specific subjects such as science is not known. It is this gap in knowledge towards the subject of science that this thesis is attempting to fill and will be explored further in the next chapter.

Chapter 6

The effect of Open Events on students' attitudes' towards science in school

6.1 Introduction

The aim of this chapter is to assess weather Open Events have an effect on students' attitudes towards science in school, and, if so in what sense. The term 'effect' is used here to denote to a change in a persons' attitude after the person has attended an Open Event which does not fit the expected trend observed in regards to students' changing attitudes towards science in school. That said it makes sense therefore to highlight what the 'expected' attitudinal trend should be.

As discussed within chapter 2 a decrease in attitude from the age of 10-14 (Osborne, Simon and Tytler, 2009) has been observed in numerous studies with a sharp decline seen in year 7 (12 year olds) before a more moderate, but still a decline, is observed until the age of 14. Although there is general agreement of a decline observed after students' have transferred schools the start of this decline is still disputed. Kind *et al.* (2009) observed a decline in students' attitudes towards science from the end of year 7 whilst Brawn (2010) has argued that it starts much earlier than this and can be observed from the end of the first term of year 7. More recently Galton and Hargreaves (2015) have stated that declines in students attitudes towards school start as early as at the end of primary school in year 6. That said the reason why this is not as clear cut as it could be is that the majority of research within this area has been limited by the range of ages chosen to be measured with studies commonly measuring only two year segments (Year 5 and 6, 6 and 7 or 7 and 8) making comparisons difficult. One of the main reasons for choosing to use a cross-sectional sample was to enable a trend from ages 10-14 (Years 5-8) to be observed as this seemed to be a gap within transition research.

In relation to assessing the effect of Open Events on students' attitudes' towards science in school a cross sectional mixed methods approach was applied. Data was collected in three formats. A simple Likert scale questionnaire was given to students, adapted from Germann's 1987 attitude questionnaire, in each term during the academic year in years 5, 6, 7 and 8 across 22 schools within England. As such this meant that each termly sample consisted of between 378-400 student responses for each year group (See table 1). The aim of this was to make a judgement of any changes in a students' attitude towards science in school. After students' had completed the questionnaire a focus group representing 5 students from each yearly class was conducted resulting in 24 focus groups per termly sample. The aim of this was to gain rich qualitative data that may inform what the Likert scale attitude questionnaire was showing. Finally after the Likert scale data and focus groups had been analysed using Rosenburg and Hovlands attitudinal model (1960) two students from each year group in each school where interviewed representing in total 44 interviews. Again this method was used so that any unanswered areas that had come to light after the analysis of the data collected could be expanded upon and as such inform on the bigger picture on the effect of Open Events on students' attitudes' towards science in school.

As such the results in regards to the potential effect of Open Events on students' attitudes' towards science in school uses a methodological approach that uses semi-quantitative data taken from the questionnaire to construct a foundation and then applies qualitative data collected from the focus groups and interviews to expand and build a more detailed picture of the phenomena under study. All interviews and focus groups discussed here have of course been kept as anonymous as possible. That been the case it still may be useful for the reader to understand the context (When the interview was conducted/ gender/ year group/school code) and as such individuals interviews will be labelled by the school code letter, year and term taken as well as gender (M or F for male or female). In regards to focus groups, school code, year and term will be identified with members of the focus group being labelled simply by gender and number. For example if a focus group is made of 2 boys and three girls members will be coded simply as F1, F2, F3 for girls and M1 and M2 for boys.

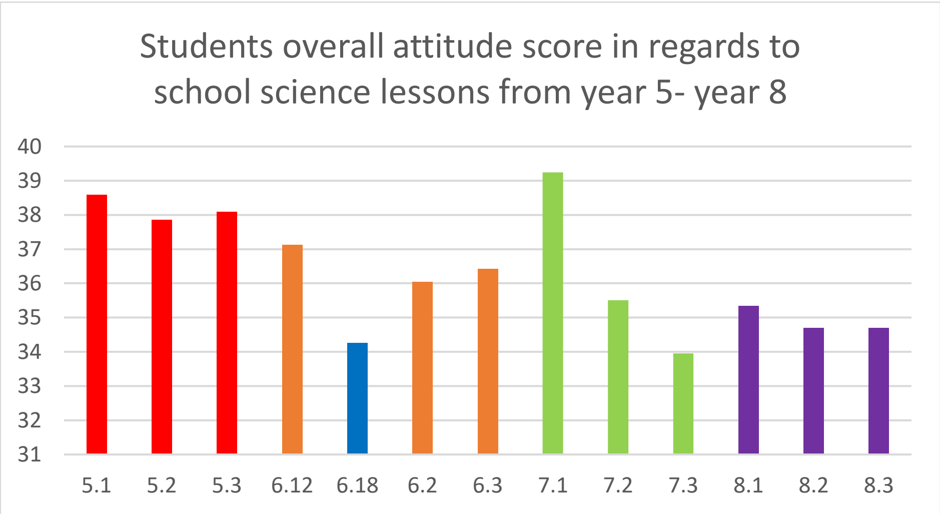
6.2 What was found in regards to overall effect of Open Events on students' attitudes' towards science in school

Overall students' attitudes towards science in school was observed to decline from age 10-14 with the sharpest decline seen after the first term of year 7, the first year after students' had transferred school. At first glance this supports the literature with students' being noted to 'settle' down after the first term (Gray, Galton, McLaughlin, Clarke and Symonds, 2011). However it must be pointed out that although the headline data supports the broad brushstroke picture of a general decline in students' attitudes towards science in school a more detailed analysis illustrates that the picture is much more complex than that (See graph 1).

Graph one shows the overall mean Likert score of students' attitudes towards science in school by year group and term that the data was collected. When broken down into academic terms students' attitudes towards science in school can be seen to be unstable from October of year 6 until the start of year 8. It seems that students' held attitudes towards science in school across all schools in year 5 (9-

10 year olds) and in year 8 (12-13 years) seem to be more stable than in year 6 (10-11 year olds) and year 7 (11-12 year olds). This could be in part due to the fact that year 5 and year 8 are year groups that may not have transition effects acting upon them. That is that year 5 is the year *before* transitional anxiety has been noted to start (Morgan, 1997) and year 8 is the second year after students' have transferred school whereby it has been noted that by this time students have often settled emotionally(Pell and Jarvis, 1990), socially (Galton, 2000) and are not the youngest year group anymore (Galton and Hargreaves, 2002).

Graph 6.1 Overall mean attitude score of students per Year/Term



From the start of term one in year 6 there is a statistically significant drop in overall mean attitude score towards science lessons in school in comparison to the end of term in year 5 (See table 1). One argument for this is what Osborne and Dillion (2008) observed in that science was often squeezed out of lesson time due to the school focus on the upcoming examinations taken nationally across the UK at the end of year 6. That is that science lessons where often few and far between (Pell and Jarvis, 1990), rushed due to time constraints and as a result often done badly (James, 2000) and not given the same priority as the core examinable subjects such as English and Mathematics (Dillion, 2004). This was supported within student interviews of the year 6 cohort. For example in school L one male interview stated:

Student L61.2M: We never do science like science

Researcher: What do you mean?

Student L61.2M: We just watch Youtube videoes and fill in worksheets. Although we haven't done that for a while.

Researcher: What have you been doing then?

Students L61.2M: Writing really…..for English and some maths stuff. I don't think we've had a science lesson this year yet.

Researcher: You've not done one science lesson since you started back? (Primary school starts the first week of September. Student L61.2M had been back at school for 2 weeks)

Student L61.2M: mmmmmmm (thunking)………I think (indicates teacher) planned to but she cancelled it because we did bad at our mock exam.

Unfortunately this statement was not unusual across the sample within year 6. In fact of the school's sampled for the year 6 cohort all schools' had students' who mentioned the lack of science lessons due to exam practise constraints.

Table 6.1 Test to see if a statistically significant change occurred by Term

Independent Samples t-Test

		df	Sig. (2-tailed)
Pair 1	fiveone - fivetwo	378	.212
Pair 2	fivetwo - fivethree	381	.702
Pair 3	fivethree - sixone	381	.001
Pair 4	sixOE - sixtwo	383	.000
Pair 5	sixtwo - sixthree	400	.329
Pair 6	sixthree - sevenone	391	.000
Pair 7	sevenone - seventwo	384	.000
Pair 8	seventwo - seventhree	384	.000
Pair 9	seventhree - eightone	385	.000

Pair 10	eightone - eighttwo	390	.017
Pair 11	eighttwo - eightthree	388	.954

When students' attitudes towards science in school was measured after attending an Open Event within the first term another decrease towards school science was observed. To clarify the timing students' attitude towards science in school for term one where measured between the week beginning 5th September to the week ending the 16thof September with the year 6 cohort measured after attending the Open Event the week beginning 19th September to week ending the 7th October. This means that the maximum possible consecutive days between measurements was a 33 days. Within this short time frame students' mean average attitudinal score dropped from 37.13 to 34.26 which was statistically significant (See table 1). Interestingly the focus groups and interviews revealed a pattern of students' starting to compare science in primary school against what they viewed as science in secondary school based on the Open Event. For example in the school J, the focus group consisting of 3 male and 2 female students conducted within 2 weeks after students'' had attend an Open event:

M2: We never do proper science in school (indicating primary school)

G1: Yeah we do. We made a windmill!

M2: Out of paper! That's art

G2: It was still fun though

M1: But it wasn't really science was it….remember that teacher who dissected that rat? (Indicating Open Even). We don't do stuff like that

M3: Yeah we just watch videos. It's BORING

G2: Well yeah (name of secondary school) do better science but we get to that next year

M2: Wish we could do it now

G1: Well you can't. We have to revise

Comparisons between science *in primary school* and science *in secondary school* became common immediately after students' had attended an Open Event and then declined over time (see table *).

Year and term	Number of interviews that compared secondary school science against primary school science out of max 22	Number of focus groups that compared secondary school science against primary school science out of max of 11
5.1	0	0
5.2	1	0
5.3	0	2
6.12	1	2
6.18	20	11
6.2	12	7
6.3	14	10
7.1	21	11
7.2	9	10
7.3	7	5
8.1	2	5
8.2	1	1
8.3	2	1

Table 6.2 showing against term and year group how many primary school students in interview and focus group compared secondary school science against primary school science

What is interesting to note is that those individuals that used comparisons between secondary school science and primary school science *before* attending the Open Event had more realistic expectations of what secondary school would be like. For example in school I a male was interviewed term 2 year 5 and stated:

I5.2M: I'm looking forward to doing science at (name of secondary school) to be honest

Researcher: Oh? How come?

I5.2M: Well they have more equipment. We get to use Bunsen burners and stuff. I know not all the time but at least we get to do some practicals. We don't really do them here (indicating primary school).

As the above statement indicates this student had the understanding that they would use special equipment (Bunsen burner) but also knew that it would not be in every lesson. It should be pointed out however that this response was different from the norm of students found within the same year and term group.

It is of interest to note that when students attitudinal measures were taken again in term 2 (Week beginning 9th of January-Week ending 27th January) students overall attitude score towards science in school had increased to close to the attitudinal score measured at the start of year 6 in term one before students' had attended the Open Event. This would suggest that the Open Event had a short term impact, at least in regards to students' attitudes towards the subject of science. Unsurprisingly students' where much more focused on upcoming SAT's and as such the subject of science in school seemed to be a secondary consideration for most students. For example when interviewing a student from school T:

Researcher: When you think of science in school, does that give you a good feeling?

T6.2M1: yeah usually….but I don't really think of science alot at the minute. I'm busy revising.

Researcher: Not even before you have a science lesson?

T6.2M1:…….I've not really had a science lesson for a while. We need to concentrate on our English for our exams. I like science but if I don't do well in my SATS then…….well it will not be good (nervous laugh) my mum and teacher will kill me!

Also from school Q:

Q6.2M2: I like science lessons….but I want to be in top sets. So I need to concentrate on getting good grades in my exams. Especially Maths

Researcher: What did you last do in your science lesson?

Q6.2M2: Revise maths. The teacher gave us a worksheet with maths problems. Which was good because I need to practise.

The lack of interest on the subject of science in school at this time seemed to generally stem from a focus on upcoming exams and this mentality was seen across all samples. One rationale for this was put forward by Hidi and Renninger (2006). They argue that interest development has 4 phases that include triggered situational interest, maintained situational interest, emerging (less-developed) individual interest, and well-developed individual interest. It could be argued that the Open Event triggered situational interest towards science in secondary school but over time the lack of science in school did not maintain this.

When students' in year 6 where measured for the final time in term three (Week beginning 6th June to week ending 24th June) students attitudes towards science in school increased slightly but still below the measurement in attitude towards science in school observed in year 6 term one. This slight increase seems to be in relation to both the lack of focus on SAT exams, as these have now passed, but also an increase within teaching pseudo-science content as well as looking forward to attending secondary school. For example in School R a focus group conducted with 3 girls and 2 boys during term 3:

G1: I'll miss (name of primary school) but I'm ready to go to (name of secondary school).

G3: yeah I can't wait!

M2: It's a pity (name of primary school)can't be like this all the time

Researcher: What do you mean?

M2: We're doing more fun stuff in lesson

M1: Yeah we played cricket all morning and then we're making bottle rockets this afternoon!

G3: yeah and soon as the exams where done (teachers name) promised we could do the stuff we missed.

Researcher: You doing bottle rockets you said?

G3/M2: yeah

Researcher: Are you learning about forces then?

M2: No we're just making rockets

Across the sample students reported that the finishing of exam revision had led to more science lessons generally which often where described to this researcher in the context of practical science lessons. It should be pointed out however that then when explored further the learning of science theory in these lessons seemed to not be the focus for the majority of students but more on 'having fun' before leaving primary school and transferring to secondary education. That is not to say that primary school teachers had not planned to use the science practical to teach theoretic science content, it is more that students' revealed that whatever the teachers intentions where, theoretical science content was not achieved for the students using this method of teaching, at this time of year, after students' had just completed their SATS and before they finished year 6 and transferred school to year 7.

In year 7 term one an increase in students' positive attitude score towards science in school is observed. According to Hargreaves (1984) and Gray, Galton, McLaughlin, Clarke and Symonds (2011) the start of year 7, the first year after students' have transferred school, often results in a 'honeymoon period'. That is that the dip seen within students' attitudes towards subjects is not usually observed until after the first term. Not only is this the case but students attitudes towards science in school is statistically significantly higher than at the end of year 6. This was also reflected in students' interviews and focus groups when conducted at the start of year 7. For example in school A in term 1 in year 7:

Researcher: When you go to science lessons do you have a bad feeling?

A7.1F: No. Their great!!!! We got to draw what a scientist looks like and wear goggles and use the Bunsen burners!

Researcher: Are you enjoying the science lesson then?

A7.1F: Absolutely! We learned about the roaring flame and we evaporated water in a basin and got salt. It started to spit and everything!

Although the examples given by the Y7.1 sample differed in the activities they described they were doing in science lesson across schools they still all consisted of practical examples using specialist practical equipment which was often novel for the individual. What is also interesting is the tone of voice and body language that students' within focus groups and interviews exhibited. Nearly all sampled students, once they had started the focus group or interview, showed signs of positive exuberance towards science lessons. Hands where often used to describe a practical activity they did and laughing and smiling during descriptions of tasks they had done or in answering questions from the researcher was more apparent than in any other year group and term sample.

For whatever the reason however by the time students attitudinal measures towards science in school are taken again in term 2 students' attitudes towards science in school can be observed to have dropped sharply. In fact it is the biggest drop in mean average attitudinal score throughout the whole data set (Year 7 term one 39.24-Year 7 term 2 35.51). Although this decrease continues throughout year 7 it is at a much more gradual pace. This was also supported in the interviews and focus groups. For example the focus groups conducted in school B consisting of 3 girls and two boys stated:

G1: There a bit boring really (indicating science lessons)…and really hard!

G3: Yeah, we don't do anything

B1: Yeah we do, we write loads!

G3: yeah but that's boring. All we do is copy stuff

B2: We haven't done a practical for ages either

G2: We did one last week with the candle

B2: the teacher did that. We just watched her

G2: oh yeah…….

B1: And then we had to write what we saw

G3: (Sigh) I don't want to be a scientist so I don't understand why I have to do science

This was common throughout the 7.2 cohort whereby general disengagement in comparison to the Y7.1 cohort could clearly be seen. One point that was brought up again and again was the lack of practical activities which was not apparent at the start of Y7 in term one. To substantiate if this was true requisition forms, forms that science teachers fill in to request practical equipment for their lessons, was requested from the sample schools for the year 7 cohort. Of the 6 secondary schools within the sample 4 schools gave permission and handed copies of the practical requisitions where handed to the researcher. Table * summarises these results.

	School A (8)	School C (7)	School D (6)	School F (8)
Year 7 term 1	87	51	61	76
Year 7 term 2	31	18	20	28

Table 6.3 Total number of practical requisitions requested by science staff at sampled schools for year 7 in term one and two

Finally there seems to be a slight increase in students attitudes towards science in school at the start of year 8 in comparison to the end of year 7 although data in year 8 shows a trend of a steady decline in students attitudes towards science in school over the year. This may suggest another 'honeymoon' period. This is somewhat supported by interview and focus group data. For example in school F a male student was interviewed:

Y8.1FM: My plan is to do better this year and get my target.

Researcher: For just science or…..

Y8.1FM: no……I mean science yeah, I like science and I want to do well but I mean everything as well.

Researcher: Did you like science last year?

Y8.1FM: yeah……I mean it was really hard…..harder than I thought it would be which is why I didn't get my grade. But if I work hard this year then I think I can do it.

Researcher: Did you not work hard last year in science lessons?

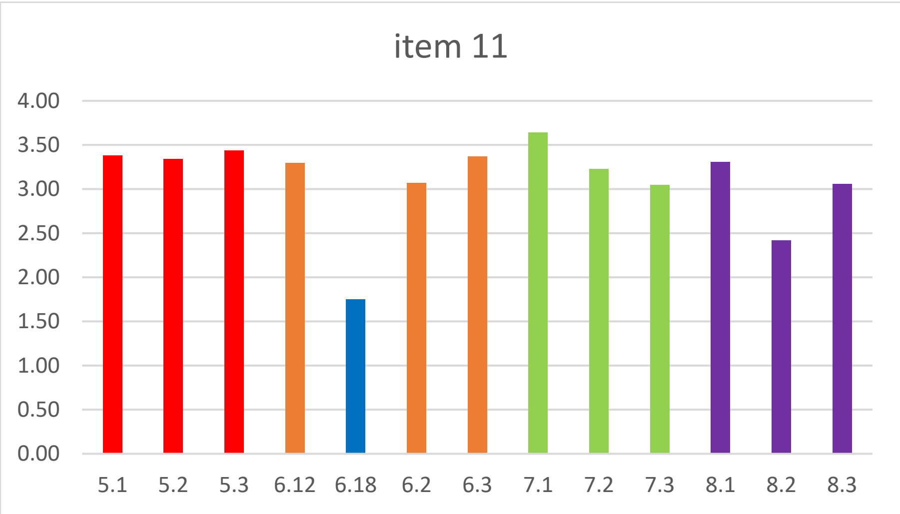
Y8.1FM: yeah………well maybe not at the end of the year. But sir said that we get to do more interesting stuff this year as we're older so!

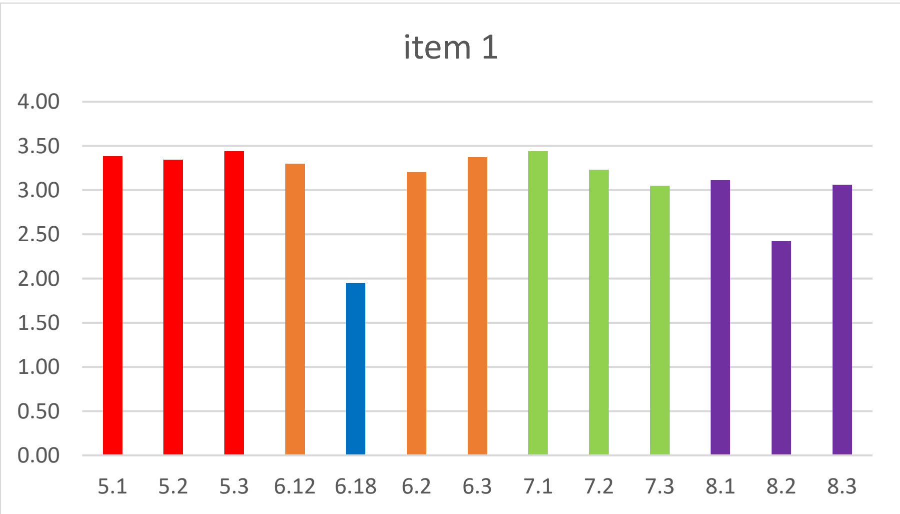
Again this attitude of a 'fresh start' was common throughout the Y8.1 cohort. What was interesting however was this idea of doing *'more interesting stuff this year'*. For whatever reason some students' had an optimistic expectations that in year 8, science lessons would be different from year 7 lessons. Although these optimistic expectations where observed for some students' and where not as numerous as observed in the year 6 cohort and their ideas about science lessons in secondary school, the idea that science lessons would be somehow *better* this following academic year was prevalent.

Overall the effect of Open Events and how it contributes towards the decline in students' attitudes towards the subject of science in school across the transition period of transferring school seem to be more complex than is portrayed within the literature. As such it may be worthwhile to take a more refined gaze at the individual components of the questionnaire used to measure a students' overall attitude towards science in school. Looking at the trends in regards to the individual variables used to give an overall attitudinal score may reveal some more interesting patterns which could inform the picture on the effect of Open Events on students' attitudes' towards science in school. As such this next section analysis the attitudinal data set broken down into its individual component's that made up the students' attitudinal score.

6.21 Attitude questionnaire variable 1 and 11: Science lessons are fun and science lessons are not fun.

Item 1 (science lessons are fun) is the reverse of item 11 (science lessons are not fun) and was placed within the questionnaire as a method of highlighting participant error: That is students that may have answered the questionnaire in as quick a way as possible without actually reading the question. If all students' had read the question properly then the expectation is that Item 1 and Item 11, when reversed, should show similar results. This is what was found (See graph 6.2).





Graph 6.2 showing results by term and year for item 1 and 11 from the questionnaire tool

Generally the data set shows that the variable 'science lessons are fun' is stable throughout year 5 (9-10 year olds see graph 6.2) before statistically significantly dropping after students' had attended an

Open Event at the end of term one in year 6. This effect seems to last only for the term before, when measured again, students average score for item one in term 2 and 3 is not statistically significantly different from before students attended the OE at the start of term one in year 6. Although there is an observed increase in scoring for item one at the start of year 7 in term one after school transfer this only predates a steady decline observed throughout year 7 and year 8.

What is of note however is the range of scoring by the cross sectional sample of students. The majority of individuals using the Likert scale chose either 1-2 or 4-5 (see table 6.4). For example in year 5 just under 40% choose either 1-2 whilst just over 40% choose 4-5 on the Likert scale for this item.

When looking back within the literature this may not be as surprising as first thought. Osborne, Simon and Collins (2003) all noted that the subject of science is often 'loved or loathed' by students'. This is also supported by Dillion (2006) who observed that the subject of science seemed to be oxymoronic in that students' *within the same class* often enjoyed the lesson whilst others seemed less than enthused. In fact this phenomena was reiterated within the focus groups of year 5 students'. In a focus group of year 5 students in term 2 from school G consisting of 3 boys and two girls this dialogue occurred:

M1: Science lessons, when we do them are boring anyway

G1: No their not! You love it when we made those slime balls

M1: No I didn't

M2: yes you did. You even nicked mine on the way home!

M1: Only cos you wrecked mine!

G2: And you even asked the teacher if you could make extra balls

M1: yeah cos I was bored. You can make it in like 5 minutes and we had an hour to do it!

M3: Yeah I did mine in 10 minutes and then just chatted with (friend in classes name)

G1: Well I thought it was fun…especially when (name of class friend) got it in her hair

G2: Yeah she HATES science now

G1: Well it thought it was great. I like science

Table 6.4: Number of students in year 5 by term that choose specific Likert scale score for Item one 'Science lessons are fun'

	Term 1	Term 2	Term 3
Chosen Likert score 1-2	145	139	142
Chosen Likert score 3	90	95	78
Chosen Likert score 4-5	150	146	160

In relation to the drop seen in regards to item one after students had attended an Open Event it was interesting to collect students' reasoning for this. In an interview of a girl from school T after attending an Open Event:

6.18TF: Its bad isn't it that I just want to leave now and do proper science.

Researcher: What do you mean?

6.18TF: Well I liked science….i still like science because we have fun in the lesson….but I never realised we don't really do proper science in school (Indicating primary school) here. Not like secondary school.

Researcher: What do you consider to be proper science?

6.18TF: Doing proper experiments in a lab. Not like…….like I can't remember the last practical we did but ages ago we went outside and we made a sundial. That was proper science where we measured with a meter ruler the shadows and we had to fill in where the shadow fell at what time. But normally we just do art science like make a paper plane or something. It's not EXPERIMENTING.

Researcher: Do you think they do experimenting at secondary school?

6.18TF: yeah! When I went to that Open thingy their where students using microscopes and teachers where dissecting stuff! THAT'S science. Not….not making paper plane or drawing a leaf!

This idea of students' viewing what they have being doing in science lessons in primary school, in comparison now to what they have seen of science in secondary school from attending an Open Event, often led to the view that primary school science lessons was not *'proper science'*. This is supported somewhat by research into 'bridging' in that in the final year of primary school, work associated with primary education is often looked at by the student as 'childish' and 'not grown-up' whilst work done at secondary school is looked at as a sign of 'maturity' and of the student reaching the first stages of becoming an adult (Matthews, 2010). It could be argued therefore that one impact of the Open Event on students' attitudes towards science in school is that of developing unrealistic perceptions of what science actually is which in turn makes the student judge their primary school science lessons as *'inferior'*.

6.22 Attitude questionnaire variable 2: I do not like science lessons and it bothers me to have to study it.

One of the weaknesses of using likert scales in measuring a variable is the risk researchers have in measuring the variable across some form of artificial scale. In the variable of 'attitude' the assumption is that attitude is across a continuum whereby a 'higher score' from a participant will indicate a more positive attitude towards an attitude object (in this case science in school) and a lower score will indicate a less positive attitude held. To control for 'positive bias' within the questionnaire, specific items where purposefully reversed and made 'negative'. That is that the higher the participant scored the less positive attitude towards the attitude object was held. This therefore meant that for scoring purposes items which were made negative where reverse scored so that an attitude continuum could be done. That said all 'negative' items have been reversed in the graphs below. This therefore means that if a participant agreed that they did not like science lessons and it bothered them to have to study it and circled 5 on the Likert scale (Strongly agree) this was reverse coded and marked as a 1. All graphs below which are 'negative' have all been reverse coded and as such to make it easier to read the question asked has also been reversed below.

Generally the dataset shows that the variable 'I like science lessons and it does not bothers me to have to study it' is stable throughout year 5, in fact slightly increasing during this time, (9-10 year olds see graph 6.3) before statistically significantly dropping after students' have started year 6 and dropping significantly again after students have attended an Open Event at the end of term one. That said item 2 shows that generally students' do not like science in primary school and do not look forward to it. What is of note is that, like item one, by term 2 in year 6 the decline in this measure is reversed and in fact is higher than at any other time previously. Focus groups conducted with students' at this time potentially shine some light on this phenomena.

In school Q a focus group consisting of 3 girls and 2 boys in term 2 of year 6 had this conversation:

F1: I'm looking forward to getting the SAT's done and then we can do some experiments!

M2: Yeah I can't wait until after the SATS's

Researcher: What do you mean?

M1: (teacher's name) has said that we can catch up on all the fun stuff we have missed after the SATs' are done

F2: yeah we're going to make Chinese lanterns, and she said we can do the circuits again.

Researcher: Circuits?

F3: the electricity stuff. We lit bulbs and it was really Peng

M1: Anything is better than revising

It seems that item 2 may not indicate that there is an increase in students' liking science lessons per se, but that students' are beginning to prefer and look forward to doing science lessons in comparison to revising for their SATS. This is supported somewhat in previous large scale studies in science education by such projects as ROSE (2006). It seems that students liking of science lessons and how much it bothers them to study it was based on their view of the worth of that subject. That is that the focus groups and interviews conducted indicated that students focus was on subjects related to their SATS. Science therefore was deemed not as important and taking time away from studying SAT related subjects For example these quotes were taken from 4 different individuals from 4 different schools in term one of year 6.

Interview 6.12SM3:

6.12SM3: I need to focus on maths this year or I won't get my grade. I like science…but I really need to spend time on maths.

Interview 6.12TF1

6.12TF1: Yeah it sort of annoys me I have to do science lessons….especially when the teacher is on at us to do well in our SATS's….well give me more revision then!!

Interview 6.12HM2

6.12HM2: Yeah I REALLY need English practice. I'm good a science and I like science but I ned to get my grade or else……..so yeah I like science but….it just gets in the way right now you know??

Interview 6.12MM3

6.12MM3: We've not really been doing science stuff this year. We don't have the time if we want our SAT grades…I like science but if (name of teacher) did science all day tomorrow it would stress me out because I know I could be working on English stuff that I need.

This view that science was not as important as subjects related specifically to the end of year exam also seems to be exasperated for students after they have attend an Open Event. For example this dialogue occurred in a focus group (3 male, 2 female) of students form school T that had just attended an Open Event 10 days previously:

F1: I'm so stressed now

F2: yeah me too

F1: Like I really want to do well in my SATS and going to (name of secondary school) made me realise that its really soon. Like SOON.

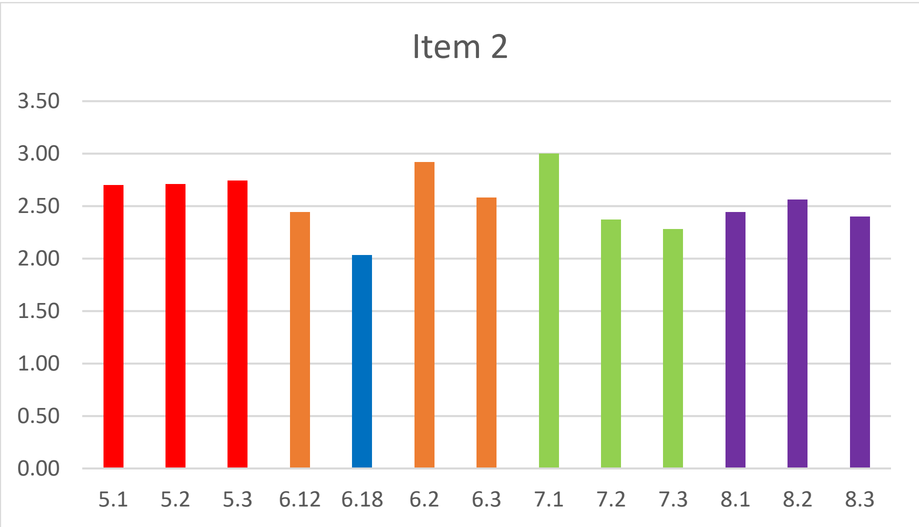
M1: yeah I know what you mean. I need to knuckle down my dad said and he's right.

M2: Not long left

M1: yeah man……I really need to learn about punctuations. Rockets can wait

(General laughter)

The idea that the Open Event had made students' realise that they wold be finishing primary school, and it turn doing their SATS's, was a main theme throughout the focus groups conducted. That said this could potentially indicate why, after the Open Event, students liking of science and how much it did not bothered them to go to science lesson decreased as their apprehension towards doing well in their end of year exams increased.



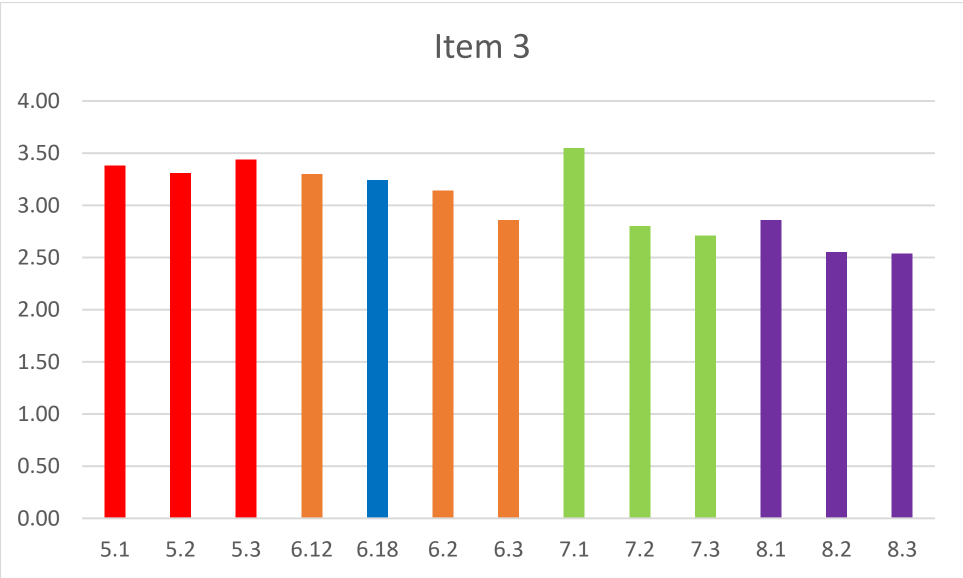
Graph 6.3 showing results by term and year for item 2 from the questionnaire tool

A decline is then observed in the final term of year 6 when the students have finished their SATS's and are doing a mixture of lessons indicating potentially a decline in students' preference of science lessons over other subjects.

Although there is an observed increase in scoring for item two at the start of year 7 in term one after students' had transferred school this only predates a sharp decline from term one to term 2 in year 7 and then a more steady decline observed throughout the rest of the year and year 8.

6.23 Attitude questionnaire variable 3: During science class in secondary/primary school, I usually am interested.

Generally the dataset shows that the variable 'during science class in secondary/primary school, I usually am interested' is stable throughout year 5 (9-10 year olds see graph *) before steadily declining throughout year 6.



Graph 6.4 showing results by term and year for item 3 from the questionnaire tool

In relation to the Open Event there seems to be little if any effect in regards to this item. This is of curiosity as this potentially supports the notion that the Open Event, for the majority of students', may generate only short term interest towards science in school which is lost as soon as the event is finished. When questioned, students had this to say:

Focus group 6.18J2 (3 male, 2 female)

M1: I find science interesting and what they did (indicating Open Event) was…interesting (laugh)…….

F2: I thought all of it (indicating the whole event) was interesting

F1: yeah…..i think science was the most wow though

M2: Yeah….totally….did you see that science guy who had his hair all standing up?

M3 Yeah that was great! I forgot about that!

M1: Yeah like it was good to see what we can do….and that they have all this equipment….

F2: there was so much to take in though…

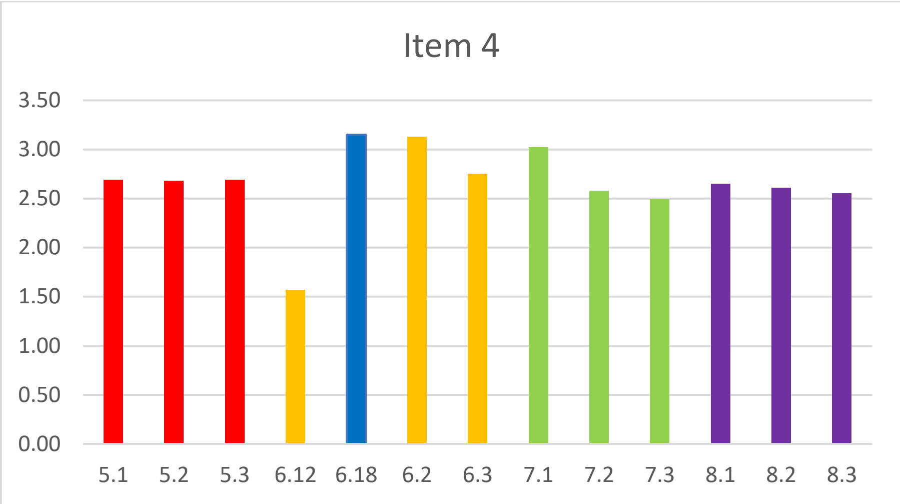
F1: Yeah I was awake for hours after going. I couldn't sleep

This would suggest that although what the science department did, the show they put on, was interesting for the majority of students, it was of a short term nature only.

Although their seems to be an increase in students' interest towards science in school at the start of year 7 this only seems to predate a sharp decline in interest towards science in school by term 2 and 3 and this repeats itself for the year 8 cohort. This potentially supports the idea of a 'honeymoon period' (Hargreaves, 1983) whereby students seem to be generally more engaged both emotionally, cognitively and behaviourally at the start of a new academic year. This is supported within the student interviews conducted and mentioned previously in that students perceive the start of the year as a 'fresh start'.

6.24 Attitude questionnaire variable 4: I would not like to learn more about science

As mentioned previously some items where purposefully made 'negative' to avoid any participant bias. Item 4 is an example of a 'negative' item. For ease of comparison all 'negative' items have been reversed in the graphs below. This therefore means that if a participant agreed that they did not like science lessons and it bothered them to have to study it and circled 5 on the Likert scale (Strongly agree) this was reverse coded and marked as a 1. All graphs below which are 'negative' have all been reverse coded. To make it easier to read the question asked has also been reversed below.



Graph 6.5 showing results by term and year for item 4 from the questionnaire tool

Generally the dataset shows that the variable 'I would like to learn more about science' is stable throughout year 5 (9-10 year olds see graph 6.5) before a sharp decline which is statistically significant is observed at the start of year 6. What is of note is a sharp statistically significant increase observed after students' have attended an Open Event before steadily declining throughout the year. This would suggest that, for some reason, students' rank wanting to learn science as lower at the start of year 6 then when they have just recently visited an Open Event. One justification for this could be the focus of schools on the examinable component taken by all students at the end of year 6. It has been observed by (Pell and Jarvis, 2000) that often English and Mathematics take a larger portion of a student's school time. As such the decrease seen in students' wanting to learn more about science may be a direct result of their understanding that learning science, right now, may not be as high a priority. This is supported within the student focus groups conducted at the start of year 6 with the interviews and focus groups which have been discussed earlier.

This suggests that the Open Event actually causes students to become individually interested and this seems to last longer than the actual event, which is counter to what was observed in item 3. This potentially could therefore indicate that item 3 was measuring a students' situational interest of the Open Event which did not last long after the event whilst item 4 actually measured individual interest of science in school which is longer lasting. This is supported somewhat. For example in focus group held at school R with 3 boys and 2 girls:

F2: They did some crazy stuff I didn't understand like that guy's hair standing up when he touched that ball

F1: Yeah and then there was that teacher dissecting the mouse

M1: That was awesome

M2: Yeah it was so cool, where you their when he got the intestines out?

(General urggggggg noises)

M3: No!!!! really?

M2: Yeah, it stank!

M1: You get to do cool stuff in science

From the tone and general demeanour of the group the students' from school had been generally interested with science on show at the Open Event. When students' remembered what they had observed at the Open Event in regards to science often it was the practical activities which were discussed and that seemed to generate interest. However when further exploration of this phenomenon was conducted:

Researcher: So after seeing science at the Open Event would you sign up to a science club if they had one?

F1: oh no

F2: No probably not. I mean it was interesting to watch but….its not really for me.

M1: I'd think about it but…..its hard science isn't it? I probably enjoy it but I think I'd rather do football after school or something.

M3: If I got to dissect a mouse I would

M2: Yeah me too!

Researcher: So you would like to do what you saw in class but you would not join an after school club or, if you had the equipment, do it at home if you could?

F1: Yeah I'd do it in class because its interesting…..i'd tell my mum about it! But I wouldn't do it as a hobby or anything

F2: Yeah I mean I though science was boring and after seeing that (indicating Open Event) its not as boring as I thought….but I wouldn't do it at home or anything.

M1: I might if I had the equipment…..

M2: I'd do it. It'll be great. My dad would love it too! He steals my science books

F1: He steals your science books?

M2: well not a SCIENCE book….like a predator book with how animals are adapted to survive stuff. It's really cool. Has puzzles and stuff in it.

M3: I'd do it, (indicating science at home) especially in the summer holidays. Something to do isn't it?!

It seems that generally what occurs at the Open Event in regards to science in school generates situational interest especially in relation to the practical tasks on show. For some, like M2 within the focus group, this translates into reinforcing an innate individual interest towards science. Surprisingly however the Open Event seems also to generate a type of semi-situational interest that is not quite individual interest but is not quite situational interest as it seems to be maintained well after the actual Open Event has been attended.

Although there is an observed increase in scoring for item four at the start of year 7 in term one after students' had transferred school this only predates a sharp decline from term one to term 2 in year 7 and then a more steady decline observed throughout the rest of the year and year 8 again supporting the idea of a honeymoon period (Hargreaves, 1983).

6.25 Attitude questionnaire variable 5: If I knew I would never go to science class again, I would feel sad.

Generally this data set seems to follow a similar pattern in year 7 and year 8 as the previous items discussed have done. That is that an increase in the item occurs at the start of the year before a sharp decline and a steady decrease occurs throughout the rest of the year. This would suggest that, in year 7 and year 8, students would feel sadder if they did not go to science lessons in October than in comparison to February of the same academic year. One potential reason for this is ideas about the impact of 'curiosity'. Curiosity has been advocated as a prerequisite for learning and motivation since 1952 (Piaget, 1952). More recently Reio, Petrosko, Wiswell, and Thongsukmag (2006), have constructed a tri-fold model of curiosity whilst Williams (2008) argues that without stimulating a students' curiosity, it does not matter what the subject matter is, as the student will not pay attention. Engel (2011) defines curiosity as "simply the urge to know more…to understand the unknown" (p. 627). This therefore means that at the start of an academic year students' are often curious about their new class, their new teacher and the new science content. This has been supported by the interviews conducted. For example in school D student 8.1F stated:

8.1DF: I'm still going strong!

Researcher: What do you mean?

8.1DF: Well I always try harder at the start of the year. I say to myself that I'm going to remember my pen and not miss homework……well I've still remembered my pen!

Researcher: And the homework?

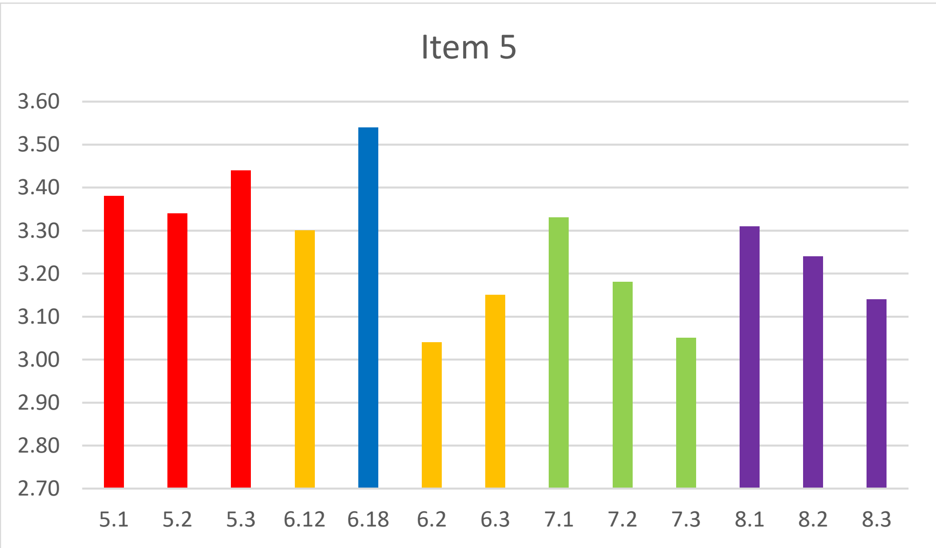
8.1DF: (laugh) nope that went in the first week. (Name of teacher) gave us some work we had done last year. I'm not doing THAT again. Waste of time!

Researcher: Did anyone tell (name of teacher) that you had done it before?

8.1DF: Yeah but he said it was an extension task. It wasn't! But anyway….apart from homework science is alright. We're in the new lab at the minute which is good and it's still not boring yet so!

Researcher: really? Why?

8.1DF: the other room is cold but this is all warm…and new! Plus we're doing biology and that's the good science. I want to know about biology.



Graph 6.6 showing results by term and year for item 5 from the questionnaire tool

The picture of what is occurring in year 5 and year 6 however, before transfer, seems to be much more complicated. In year 5 there seems to be stability, in terms one and two, in how sad students would feel if they did not have to attend science lessons. This however increases, that is that the average student would be sadder if they did not go to science lessons, by term 3 of year 5, before decreasing below year 5 measures at the start of year 6. One potential reason for this could be that item 5 is not just measuring how sad a student would feel if they did not go to science class again but is also measuring how sad the student would feel if they did not attend science class *with their specific year 5* *teacher'.* Evidence to support this comes from interviews conducted with year 5 at the end of the year. For example a focus group conducted in school T of 3 boys and 2 girls:

M2: I do like science lessons with (name of teacher). She makes it fun!

M1: yeah, not looking forward to next year with (name of teacher). She's really strict

F1: We have SATS's too.

(General groans)

F2: I hate that word. I wish no would mention it for a day or something

M3: (Name of current teacher) is good though. She usually doesn't mention it that often

M2: Yeah that's another reason I'll miss this year

F2: yeah I'd rather have (name of current teacher) then do SATS with (name of teacher)

Therefore it could be argued that the drop observed at the start of year 6 is mainly due to the lack of emotional engagement students have had time to develop with their year 6 teacher. This in turn is exasperated when students attend an Open Event and observe a science specialist demonstrating an image of science that is often more exciting then what they have previously experienced (Abrahams, 2006). Focus groups of year 6 after the Open Event demonstrate that students where often more excited about 'what they would do in science lessons', which indicates why a significant statistical increase occurs after an Open Event for this item, whilst by term 2 the lack of practical science lessons due to exam practise constraints would unsurprisingly produce a decrease in this item.

6.26 Attitude questionnaire variable 6: Science lessons are not stimulating to me and I do not enjoy them.

As mentioned previously all 'negative' items have been reversed in the graph. That said generally this data set seems to follow a similar pattern in year 7 and year 8 as the previous items discussed have done. That is that an increase in the item occurs at the start of the year before a sharp decline and a steady decrease occurs throughout the rest of the year. This would suggest that, in year 7 and year 8, students are less stimulated by science lessons as the year progresses and enjoy them less. When asked about this the year 8 focus groups where particularly informative. In school S, a group made of 3 boys and 2 girls had this dialogue:

F2: I don't like science but I don't not like it either

Researcher: You don't like or dislike science lessons?

F2: Yeah….well usually anyway

M1: yeah some lessons are ok but…..it's a bit dull usually

Researcher: in what way?

M1: Well we just write and write and write stuff….following PEE (point/evidence/explain)

M2: yeah I hate PEE

F1: It can be good sometimes…….its just we repeat stuff a lot so it's a bit boring really

F2: Yeah I think that's what I mean…like we've done the periodic table last year and we're doing it again this year?

Researcher: You're doing the exact same lessons on the periodic table?

F1: no…..its just that we're doing that topic again. And we've done atoms loads too

M3: Yeah like I liked science….i still like some science lessosn but we do seem to repeat stuff, the same topic a lot. I want to do different stuff like space and learn quantum mechanics!

F1: quantum what??

M3: it doesn't matter. Sir said I had to wait until 6th form before we can do it (Sigh). Said it would be too hard to do now.

M2: At least it would be different.

And this was followed the next day by a focus group from school Q consisting of 2 girls and 3 boys:

M2: Science can be really hard sometimes

F1: I find it easy

M3: You would

F1: Well it is! It's just facts really.

Researcher: Science is just about learning facts?

M2: yeah, key words and stuff. You have to remember lists. Like MRS GREN.

M1: A bit boring really though. I mean some lessons are good when we had those glass pyramids out

F2: yeah that was fun

M1: But its just a memory thing really. Sometimes you sort of know what the teacher is trying to show you at the start of the lesson but you just have to keep plodding along until everyone gets it.

F1: yeah like when we had to boil the salt water. It toke all lesson and we knew that we were going to find salt! What was the point?

Researcher: Why was the glass pyramids good?

M3: We had to see if we could make the colours go a different order

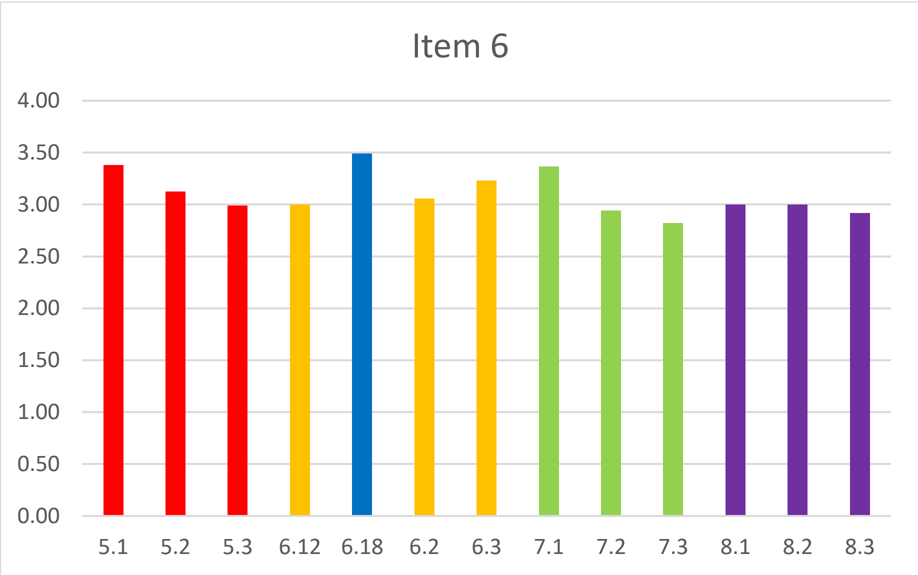
F1: The spectrum

M3: Yeah the spectrum

M2: We got given a challenge to split normal light into the spectrum that makes it up. But we also had to see if we could make the order of colours a different order.

F1: Yeah it made you think

This trend of conversation, on the one hand year 8 students' found science lessons to be hard and challenging whilst on the other students found science lessons boring and dull was endemic throughout the focus groups conducted. These findings are supported by past research such as that conducted by Symonds and Hargreaves (2014) who analysed students on how they felt (e.g. I like science) against their rationale for their attitudes (e.g. ‘when I’m getting on with the teacher’) and who found that school children enjoyed school when lessons where fun, rewarding, challenging and did not enjoy school when lessons where unstimulating or when they experienced conflict with peers or teachers.



Graph 6.7 showing results by term and year for item 6 from the questionnaire tool

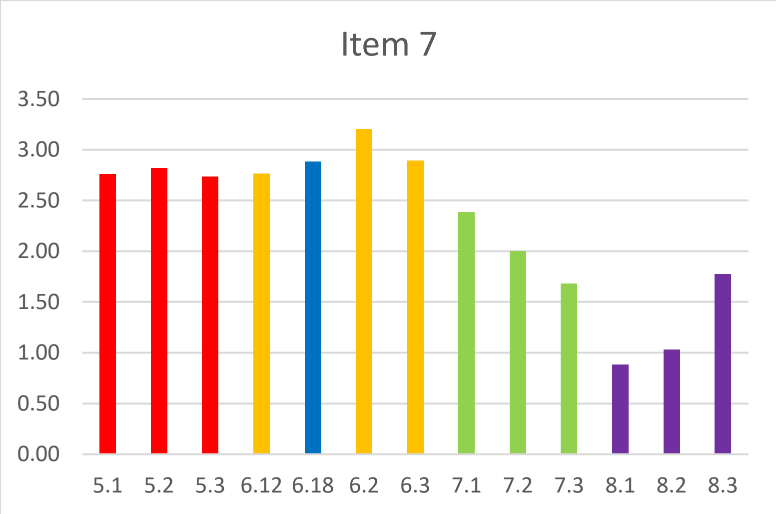
This trend and justification for it by the students also occurred in year 5. In fact the mean average score for students rating the statement ‘science lessons are not stimulating to me and I do not enjoy them’ is very similar to that of the year 7 cohort. It seems that as Osborne and Dillion pointed out in 2003 still stands in that science is either a love or loathed subject (Dillion and Osborne, 2003).

Year 6 however did not follow a similar trend. As said previously the most stimulated a student was in science lessons in year 5, 7 and 8 was in the first term. In term one in year 6 however the mean average score is very similar to the mean average score of term 3 in year 5 (Y5 term 3 2.99 Y6 term 1 3.01). Again this may be due to the priority that other subjects then science have been assigned due to exam practise constraints. Dillion (2007) noted that often science lesson planning was more time consuming then other subjects due to the specialised equipment often needed. When students’ have attended an Open Event a statistically significant increase in item 6 occurs. Focus groups of year 6 after the Open Event demonstrate that students where often more stimulated about what they *could* do in science whilst by term 2 the lack of practical science lessons due to exam practise constraints would unsurprisingly produce a statistically significant decrease in this item. A slight increase also occurs in the final term of year 6. When probed further this seems to be due to students' optimistic apprehension (Morgan, 1999) about starting secondary school and doing secondary science lessons. As one interviewed student in term in year 6 from school Q stated quite succinctly:

At (Name of primary school) we do art and we get told it's a science lesson. But when I go to (name of secondary school) I'll finally be old enough to get to do science which is SCIENCE.

6.27 Attitude questionnaire variable 7: Science lessons are fascinating.

Generally the dataset shows that the variable 'science lessons are fascinating' is stable throughout year 5 (9-10 year olds see graph *) before steadily increasing throughout year 6 before dropping in the final term. This decrease in students finding science lessons fascinating continues throughout year 7 with a sharp drop seen at the start of year 8. Surprisingly however an increase in students finding science lessons fascinating occurs throughout year 8 although it never recovers to year 6 levels. In regards to the Open Event the data shows an increase in mean score of students' fascination towards science which continues to term 2 before starting to decrease. Potentially this may show a propping up effect of Open Events in regards to students' fascination towards science lessons. This has been observed with the 'honeymoon effect' (Hargreaves, 1984) in that any event that stalls the decline in students' attitudes towards a specific subject, by the end of that year, attitudes are less low than if that event had not occurred.



Graph 6.8 showing results by term and year for item 7 from the questionnaire tool

This is supported by research conducted by Galton and Symonds (2015) in a comparative study comparing endpoints of children's attitudes obtained from the replication ORACLE studies in Leicestershire, UK (Galton, Grey, Rudduck, Berry, Demetriou and Edwards, 2003) and Michigan, US (Wigfield and Eccles, 1994). The Open Event may have a similar effect in that without students being fascinated about science based on what they saw at the Open Event then students overall attitudes towards science in school may actually decline lower. More research is needed in this area however to substantiate this.

In regards to the increase seen in item 7 in year 8 further exploration using interviews and focus groups suggest that novel science topics that stimulate curiosity that students have not encountered before may be linked to this phenomenon. For example in an interview of a year 8 girl in school A in term 3:

Y8.3AI2F: Science CAN be interesting but it depends on the topic. Like we did chemistry stuff for ages and it was always the same thing about elements and stuff. That was boring. But now we're doing stuff which is new so it's more….you just pay attention more.

Researcher: You said you did chemistry stuff for ages? Can you expand on that?

Y8.3AI2F: Well like….we did the atoms….elements and compounds and…..mixtures!!! (Laugh)….i always forget that one…..yeah we did them like last year…..and we did them AGAIN this year as well.

It's a bit boring really. Because I know it's like slightly different but it's also slightly the same so you think you know it. It's just…..(laugh) boring.

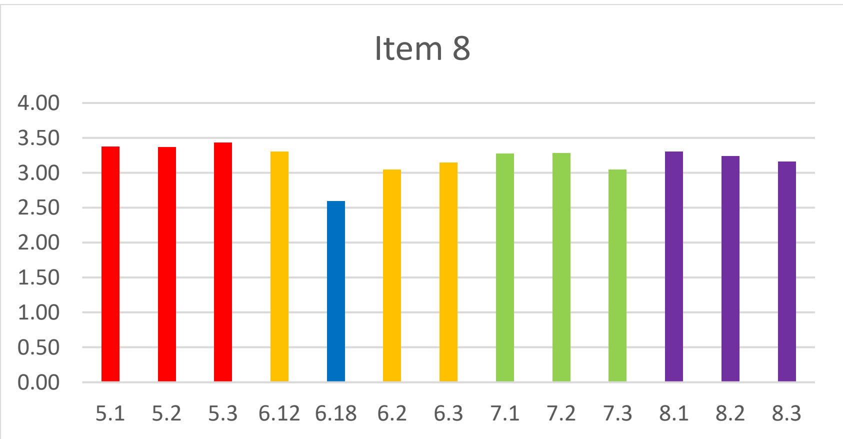
Researcher: And the stuff that is new?

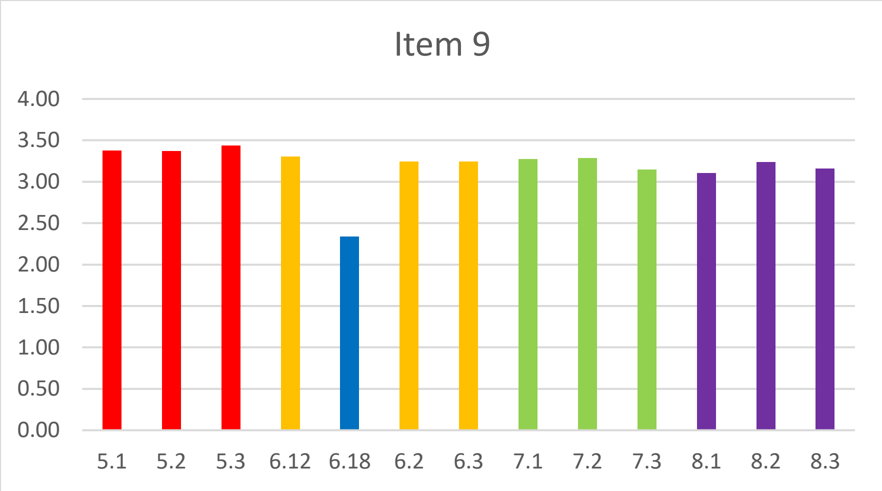
Y8.3A12F: Well like waves…..and light and space! It's really interesting as I've never done it before. Like I said SOME of science is great…but when you repeat stuff again and again you sort of loose the will to live you know…….

And again this idea of students' seeing the science in school more negatively if they believe that they have done the topic before comes up quite often across all the schools within the sample taken in year 8 term 3.

6.28 Attitude questionnaire variable 8 and 9: 'The feeling I have towards science class is a good feeling' and 'When I hear the word science at school, I have a feeling of dislike'.

Item 9 (When I hear the word science at school, I have a feeling of dislike) is the reverse of item 8 (The feeling I have towards science class is a good feeling) and was placed within the questionnaire as a method of highlighting participant error: That is students that may have answered the questionnaire in as quick a way as possible without actually reading the question. If all students' had read the question properly then the expectation is that Item 8 and Item 9, when reversed, should show similar results. This is what was found (See graph 6.9).





Graph 6.9 showing results by term and year for item 8 and 9 from the questionnaire tool

Generally the data set in regards to item 8 ‘the feeling I have towards science class is a good feeling’ and item 9‘when I hear the word science at school, I have a feeling of dislike’ is consistent across years 5, 7 and 8. Surprisingly when students have attended an Open Event the mean score of having good feelings towards science lessons decreases although this does not last. When questioned upon this phenomena it soon became apparent that attending the Open Event had made them judge, in hindsight, their primary school science lessons in a more negative light. For example in school M the focus group conducted after the Open Event for year 6 consisting of three females and two males had this dialogue:

M2: We don’t do science like that at (name of primary school)

Researcher: Oh? Can you expand on that?

M2: well we just sort of….like watch the teacher do it or watch a YouTube clip or something.

M1: Yeah we sort of use paper and glue and make stuff like a windmill or something but we never do proper practical’s really.

F1: (name of teacher) says we don’t have the equipment

F3: And we’ve not dome science for ages anyway

F2: I don’t think we’ve ever done science like in big school

M2: No we haven't

M1: We did those circuits last year

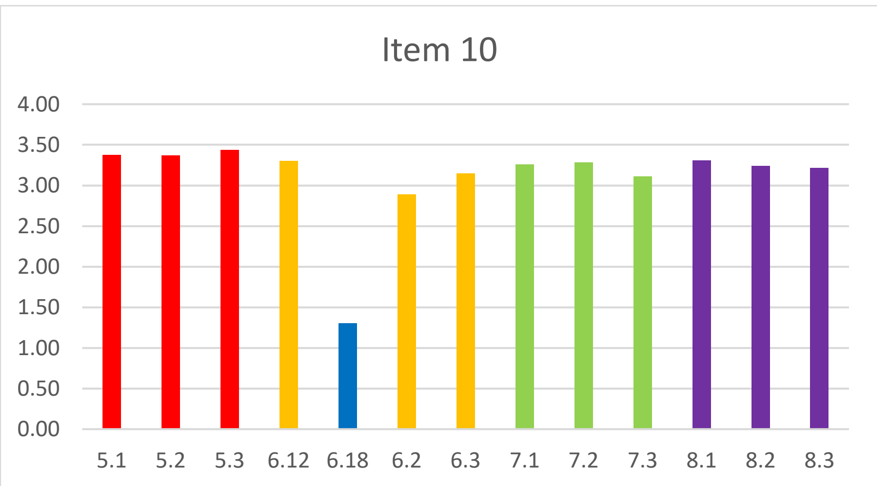
F2: They didn't work have the time. The bulbs didn't light up when they should of

M1: Oh yeah

It seems that attending the Open Event led, at least for some, to science in primary school being seen more negatively in comparison to what students' perceived, from the Open Event, as science in secondary school. In fact the idea that science in primary school was not 'proper' science was not a theme that had been recorded in any interview or focus group before students attended the Open Event.

6.210 Attitude questionnaire variable 10: Science is a topic I enjoy studying

Generally the dataset in regards to item 10 'Science is a topic I enjoy studying', is consistent throughout the academic year. That is that there is very little change is average mean score from term one in year 5 to term 3 in year 5. This is the same for year 7 and year 8 although a slight decline in enjoyment of science can be observed throughout the year. In the year 6 cohort however this is not the case. From the start of year 6 to after students have attended an Open Event a sharp decline in students' enjoyment of the topic of science can be observed. Although this seems to be short term and by term 2 sharply increases it does not make a complete recovery to levels observed at the start of year 6 until the end of term 3.

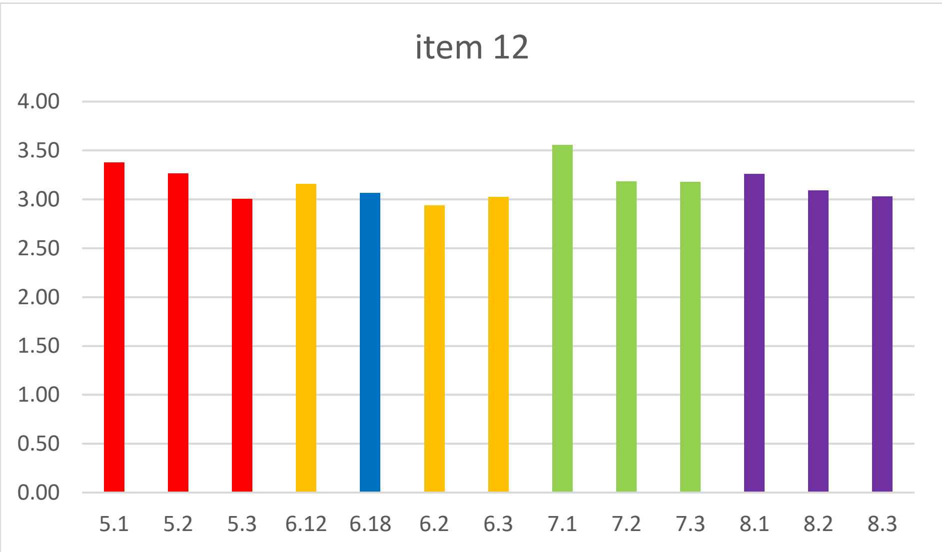


Graph 6.10 showing results by term and year for item 10 from the questionnaire tool

When questioned reasons for this phenomena are similar to item 8 and 9 in that attending the Open Event had made them judge their science lessons in a more negative light.

6.211 Attitude questionnaire variable 12: I feel at ease with going to science lessons and I like it very much.

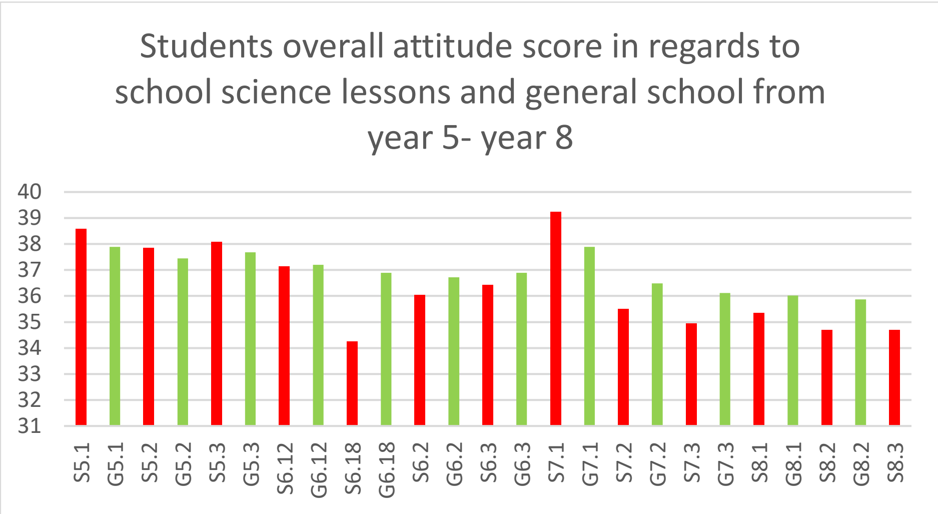
Generally this data set seems to follow a similar pattern in year 7 and year 8 as the previous items discussed have done. That is that an increase in the item occurs at the start of the year before a sharp decline and a steady decrease occurs throughout the rest of the year. This would suggest that, in year 7 and year 8, students gradually feel less at ease with science lessons as the year progresses. This pattern also occurs in year 5 and in year 6 with students attending the Open Event seeing little if no change from this trend.



Graph 6.11 showing results by term and year for item12 from the questionnaire tool

6.3 Comparison between students' change of attitude towards science in school and students' change in attitude towards school in general

Overall students' attitudes towards science in school was observed to decline from age 10-14 with the sharpest decline seen after the first term of year 7, the first year after students' had transferred school. In relation to students' attitudes towards school in general this can also be observed to be the case (see graph 6.12). What is of note however is that although the headline data supports the broad brushstroke picture of a general decline in students' attitudes towards school in general, which is similar to the decline seen in students' attitudes towards science in school a more detailed analysis illustrates that the picture is much more complex than that.



Graph 6.12 showing students' overall attitude score in regards to school science lessons and general school from year 5 to year 8 by academic term

Graph 6.12 shows in red the average score for a student's overall held attitude towards science in school by year and term whilst green highlights students' overall held attitude towards school in general by year and term. There are three aspects which are of importance to note at this time. The first is that the overall trend of both students held attitudes towards school in general and students' attitude towards science in school follows a similar pattern. That is that a slight decline in attitude score occurs year on year before a more rapid decent after term 1 in year 7. This in itself is not surprising as science in school is, by its very nature, a component of school that would make up a persons' overall attitude score towards 'school' as an attitude object. This trend is also supported by previous research (Barmby, Kind, and Jones. 2008;Galton, Gray and Ruddock. 1999;Osborne, Simon, and Collins. 2003;Galton, Hargreaves and Pell. 2007) that highlight a gradual decline before a dip is observed after term 1 in the frist year of secondary education in year 7. The second point to note is that of the more surprising differences between students' attitudes towards science and attitude towards school. In year 5 terms, 1,2 and 3, and year 6 term 1.2 before the Open Event, there is no significant difference between students held attitudes towards school and students held attitude towards science in school. There is however a significant difference observed in year 6 after the Open Event in term 1 before again no significant difference observed in term 2 and 3. This would suggest that either the Open Event, or at least something at a similar time that occurs around the Open Event, causes students' attitude towards science in school to become less positive in comparison to their held attitude toward school in general. In fact this phenomenon, a decline in students' attitude towards science in school, does not recover until term 3 of that same year. Following on from this at the start of year 7 in term 1 student's attitudes towards science in school are significantly more positive than that of their held attitude towards school in general. This however does not last as by the time students' attitudes are measured by term 2 students' attitudes toward school actually becomes less positive than that of students held attitudes of school in general with this trend continuing all the way through the rest of year 7 and year 8. Potentially this phenomenon could explain some differences within research within this area. Although a dip within students' attitude towards school in general and science in particular is well known and documented, the start of this dip is still debated. Dillion (2006) has argued that a decline in attitude towards science can clearly be observed after the first term of the first year of secondary school whilst Rice *et al* (2011) argue that it can be observed as early as the final year of primary school (year 6) and potentially as early as year 5. If, as these results demonstrate, Open Events have an unintended effect of triggering students attitudes towards science to decline at least in the short term, both results from Rice et al (2011) and Dillion (2006) would be possible *dependent on the time of year the data was collected*. That is that Rice et al (2011) may have observed a change in students attitudes in year 6 if their data points where after students' had attended an Open Event in year 6 whilst Dillion would not have observed any change if his data points where taken before the Open Event or at the end of the year when the effect of the Open Event on students' attitudes towards science has minimised.

Finally the third point to note is the change in held attitude towards science in school and school in general after students' had just attended an Open Event. Although there is a slight decline in students' held attitude towards school in general after the Open Event in comparison to the start of year 6 in term one this decrease is not significant. However in regards to students' attitudes towards science in school a significant decrease occurs after students' have attended an Open Event in comparison to their attitude score at the start of year 6 in term 1. To clarify students generally, on average, are significantly more positive towards science in school in late September in the final year of primary school than in late October. This is of interest to note especially as students are equally positive towards school in general in September of their final year in primary school as they are at the end of October. It is within the next section that we explore this phenomenon in more detail.

6.4 ABC model framework

As stated within the methodological section in chapter 4 a common framework applied within science education literature in regard to research involving participant attitudes towards an object is the use of the tripartite model of attitudes consisting of afferent (emotional) behavioural and cognitive components. When designing an appropriate tool for this thesis using Germann's (1989) attitude scale as a template the use of the ABC model as a framework was taken into account. As such each factor within the questionnaire can be linked to either afferent or cognitive components (see table 6.5) with behavioural components implied as discussed within the literature review (Chapter 3) and the methodology section (Chapter 4).

Afferent	Cognitive
1 and 11	3
2	4
5	6
8	7
9	12
10	

Table 6.5 showing items from questionnaire tool and how they relate to attitude components

So far the results from the questionnaire component in regards to students' changing attitudes has been looked at descriptively. That is to say that a discussion has been had about what the surface results can tell us about students' attitudes to science and the changes that occur after students have attended an Open Event. The use of the ABC model however will allow more in-depth exploration of the results gained which will hopefully inform and give greater detail of the picture on the effect of students' attending an Open event on their attitudes towards the subject of science in school. Again it must be pointed out that a students' attitude is made up of all three components (afferent, behavioural and cognitive) but it has been noted that an overall held attitude of a person can be inconsistent from the individual components that make up that attitude (Kruglanski and Strebe, 2005). Especially during transition when students' are finding their identities these inconsistences may be apparent (Hodgson, 1993) as their components that make up attitude are in a state of flux. As such it may be of note to explore and infer from not just the overall attitudinal score of a year group but also what is occurring at the attitudinal component level. As such the next section explores what is occurring in regards to students' components that make up their attitude towards science in school and where appropriate school in general.

6.41 Afferent components in regards to students' attitudes to science in school

As shown in table 6.6 questions 1 and 11, 2, 5, 8 ,9 and 10 where used to assess the afferent component of a students' attitude towards science in school. The afferent component at its core is that of attempting to measure a persons' emotion held towards an attitude object, in this case science in school.

Number of question	Question
1	Science lessons are fun
2	I do not like science lessons and it will bother me to have to study it.
5	If I knew I never had to go to science class again, I would feel sad
8	The feeling I have towards science class is a good feeling
9	When I hear the word science at school, I have a bad feeling
10	Science is a topic I enjoy studying

11	Science lessons are not fun

Table 6.6 showing item number and question related to item.

As seen by graph 6.13 all 7 charts at face value are very similar. Unsurprisingly there is no significant difference observed between items 11 and 1, for any data points collected (see table *). There was also no significant differences observed between item 11/1 and 10. Item 8 and 9 however was more interesting. Although no significant differences where observed between item 10 and item 1/11 and item 8 and 9 for the majority of data points, for data point 6.18, that as data collected from year 6 in term one within 2 weeks after they had attended an Open Event, a significant difference was observed between item 8/9 and all other items that measured afferent components.

When further exploration was conducted on this aspect using focus groups and interviews of students' it soon became apparent that item 8 and 9 at point 6.18 had been influenced by students' opinions on *safety* in the science laboratory. For example in the focus group consisting of 3 boys and two girls in year 6 at school M:

Researcher: In relation to question 8 and 9 then you had to mark if agreed if you had a good feeling, or a bad feeling, about attending science lessons….why do you think some students had a good feeling about attending science lessons?

G1: Safety goggles! You get to dress up in lab coats and wear safety goggles. It's different from other lessons. I can't wait!

B2: Yeah usually you just write and get worksheets and stuff or card sorts but in science you get to do other stuff you don't normally do

G1: Like practical's with Bunsen burners

B2: Yeah with fire and stuff

G2: I didn't like it though because you had to tie your hair back

B1: Yeah (smiling and stroking shaved head) I have that problem too

(Group laughter)

G2: It's true! You had to tie it back or you could get it set on fire by accident! That's not good

B3: Yeah but we got to watch them do these crazy experiments. Plus the teacher was there so I'm sure she wouldn't have done it of it wasn't safe

Graph 6.13 comparing afferent attitude components to items that measured it

G2: Did you see her hand though? She looked like she'd burned it

Researcher: The teacher had burned her hand?

G2: Not at the Open thingy. It looked like an old burn. My mum has one from the oven.

B3: How do you know she didn't do it on HER oven?

G2: I guess I don't but if you mess with fire then you going to get burned and that was what she was doing.

Again in school Q when interviewing a year 6 boy:

Researcher: In relation to question 8 and 9 then you had to mark if agreed if you had a good feeling, or a bad feeling, about attending science lessons….why do you think some students had a good feeling about attending science lessons?

Interviewee: Practical's! You know you won't be bored like in English.

Researcher: And the fact that you might do practicals gives you a good feeling about science in school?

Interviewee:…… yeah…..i mean school is usually boring…I know its useful and stuff but…..we never really do what we want or learn what we want…..at least in science its different. It's like a bit of a break from English and Maths.

Researcher: Why do you think some people might get a bad feeling about science lessons then?

Interviewee: Maybe… they don't like practical's. You gotta listen don't you or you'll get hurt. And some people are stupid and don't listen so they get hurt and stuff. Maybe their worried about that.

In fact looking through the transcripts of focus groups and interviews at the data point 6.18 all 14 primary schools had students that mentioned the difference between science and other subjects as a reason to have a good feeling about science in school whilst 12 of the 14 schools had students that mentioned safety as the main reason why some students may have a bad feeling about science in school. This is supported somewhat by Osborne and Dillion (2006) who found that generally girls worry about their safety during practical lessons whilst boys worry less about this aspect during science lessons. Unfortunately this thesis did not collect data in regards to gender of students sampled in the questionnaire and as such this may be an area of future research to delve into.

As seen by graph 16.13 all seven charts at are similar in that year 5 students' seem to be stable throughout the year and a decline is observed from the start of year 7 which continues throughout the year before stabilising in year 8. What is interesting however is the differences observed in the year 6 cohort between the seven factors. Generally speaking in year 6 students' seem to have less positive feelings towards science in school after attending an Open Event which does not last until the second half term in year 6. As mentioned earlier within this chapter this seems to be in relation to the fact that students start to compare *primary* school science against what they think secondary school science is like resulting in more negative feelings associated with their current primary science lessons. Although this trend of a decline in more positive afferent feelings towards science in school is observed for items 1, 8, 9, 10 and 11 this is not true for item 5 (If I knew I never had to go to science class again, I would feel sad). There seems to be very little effect of the Open Event on this item. One reason for this could be due to the term 'sad'. It has been argued that terms such as 'happy' and 'sad' represent explicit feelings (Herman, 2009). As attitudes often have components that are implicit to the individual who holds them deeming an object like missing a school lesson as making you feel 'sad' could be deemed as quite a strong emotional reaction and as such very few individual students may have such a strong reaction.

Overall students afferent components of their held attitudes towards science in school suggests that the effect of the Open Event is short term only. That said it may be worthwhile assessing what occurs in regards to students cognitive components of their attitudes towards science in school.

6.42 Cognitive components in regard to students' attitudes to science in school

As shown in table 6.7 questions 3,4, 6, 7 and 12 where used to assess the cognitive component of a students' attitude towards science in school. The cognitive component at its core is that of attempting to infer a persons' beliefs towards an object, in this case science in school.

Number of question	Question
3	During science class in secondary/primary school, I usually am interested.
4	I would like to learn more about science and I'll do my best to listen in class
6	Science lessons are stimulating to me and I do enjoy them.
7	Science lessons are fascinating.

12	I feel at ease with going to science lessons and I like it very much.

Table 6.7 showing cognitive item number and associative question.

As seen by graph 6.7 all five charts at are similar in that year 5 students' seem to be stable throughout the year and a decline is observed from the start of year 7 which continues throughout the year before stabilising in year 8. What is interesting however is the differences observed in the year 6 cohort between the five factors.

Items 3 (During science class in secondary/primary school, I usually am interested) and 12 (I feel at ease with going to science lessons and I like it very much) showed very little impact in regards to the Open Event with a gradual decline in students' positivity towards these items observed throughout the year. One potential reason for this cognitive decline towards science in school is the number of actual science lessons students attended in year 6. As said previously due to exam constraints science lessons in year 6 have been reported to be either rushed (Braund, 2002) or do not occur at all (Osbourne and Dillion, 2002). A gradual decline in this component of students' attitudes towards science in school for these items could be in part due to the lack of attending science lessons in primary school. This is somewhat supported within student interviews conducted with 88% of students stating that the last science lesson they had done was at least 'a couple of weeks ago'.

In contrast the Open Event seemed to have an impact on items 6 (Science lessons are stimulating to me and I do enjoy them) and item 7 (Science lessons are fascinating). In regards to item 6 a gradual decline in the belief that students' will enjoy science lessons in year 5 seems to be halted and reversed, at least until the next term, by a visit to an Open Event. For item 7, in increase in student fascination with science in school, seemingly triggered by attending an Open Event, seems to have a more lasting effect. This could be potentially down to the impact of *novelty.* As said within Chapter * the Open Event supports an image of science in school as mainly practical in nature using scientific objects that students' may not have ever come across in their primary school science lessons. For some this equipment was at least known about:

Y6.2IMR: I've seen microscopes on TV but it was the first time I USED one. It was so cool!

For others however certain scientific objects was not known and as such never assumed could be observed and learned about at school:

Y6.2IFR: That Van Der Graaf……I mean………..that was just weird! It was like out of a sci-fi film! And the teacher said we get to do about it in secondary!

The fascination generated by these novel objects and the belief that students would get to use these objects at secondary school could be the potential mechanism for the increase trend observed for item 7. The positive impact of novelty and learning has been known since Hidi in 1990. More recently however Gorges (2016) has noted that novel tasks are more likely to stimulate intrinsic motivation then tasks that have been done, or are seen to have been done, before. This is somewhat supported by the work on 'bridging units' (Braund, 2000). Bridging units where devised to aid in the transition of students from primary to secondary school by setting work that covered topics in Key Stage 2 (primary school) and Key Stage 3 (secondary school). This 'work' was often mathematics or English based and was often started at the end of year 6 in a 'transition workbook' and then asked to be brought to the secondary school on a student' first day. Work on this topic would then be finished by the secondary school teacher. It was noted however that tasks that were deemed 'primary' where often not engaged with by students and it was only when students' had finished their 'bridging books' and went onto 'proper secondary stuff' that students' felt like they had progressed to big school. Potentially what this item is presenting is a similar phenomenon in that after the Open Event students' rate science as more fascinating based on their new knowledge of what can be done within a science lesson.

Finally, it is important to note item for in the first term of year 6 covering the question 'I would not like to learn more about science and I'll do my best not to listen in class '. Item 4 shows a decline in students'' attitudes *before* the attendance of an Open Event with an increase in attitude to similar levels observed in the year 5 cohort registered 2 weeks after the Open Event. This is not observed with the other cognitive factors. One explanation for this when this phenomena was explored further within interviews was the impact of end of year examinations. At the end of year 5 one common theme that pervaded the interviews with students'' was this idea that year 6 would be an exam year.

Year 5 teachers had been given students' in all school a rhetoric that year 6 was the final year in which the End of School exam would be sat. As this exam covers English and Mathematical skills principally students' preference for not learning about science in school at the start of year 6 was due to the lack of importance associated with the subject of science against spending time on examinable components within the classroom. For example, in year 6 term 1 in interview of school P one girl had this to say:

Y6.1PG3: I don't really want to do science right now

Researcher: Oh? How come?

Y6.1PG3: Don't get me wrong……I like science and everything…….but I really need to work on my English…….i just sort of……you know when your like wasting your time and something you can do later?? Like when I get home and Mum makes me make my pack up for the next day….but that can be done after I've had dinner because making dinner should be first because that's the soonest….. Its like that.

Researcher: So science is not a priority?

Y6.1PG3: yeah! Priority. Science isn't the priority because I don't need that right now. I need English.

This theme of science in school being seen as not having the same priority as English and Mathematical lessons, due to upcoming exams, was observed in all schools within the sample. Greene et al. (2004) noted that students' perceptions of classwork aiding them in being successful in the future had a great impact on their cognitive engagement and motivation towards that task. This is supported by work conducted by Blumenfeld, Kempler and Krajcik (2006) who noted that students' often cognitively invest in learning about an object when it is deemed beneficial to them. The results here seem to support this in that as a result of the downgrading of the subject of science in regard to being measured by an examinable component at the end of primary school, student's seemed to be cognitively disengaged towards science lessons as they were viewed as a waste of time in relation to their goal of doing well within the National end of primary school exam.

That said after students' had attended an Open Event students 'seem to become cognitively reengaged in regards to item 4. That is not to say that students' reprioritise science lessons but more that after attending an Open Event students, abstractly, would like to learn more about *proper* science *generally*, but still would prioritise examinable subjects over *primary* science lessons in school. This was perfectly exemplified with one discussion that occurred with a focus group consisting of 3 girls and 2 boys in school P conducted 2 weeks after attending the Open Event:

G2: I didn't even know that was what science was

B1: yeah we NEVER do that stuff here (indicating primary school)

Researcher: What stuff?

B1: The fire balls and the hair thingy with the electricity

G1: Static electricity

B1: Yeah that

Researcher: Do you like science in school?

G2: Usually yeah……we've not done it for a while though

B2: We don't really do science in here (Indicating primary school….not like secondary school

G3: Yeah….it would be nice to learn about proper science

Researcher: If you could make fireballs tomorrow would you want to?

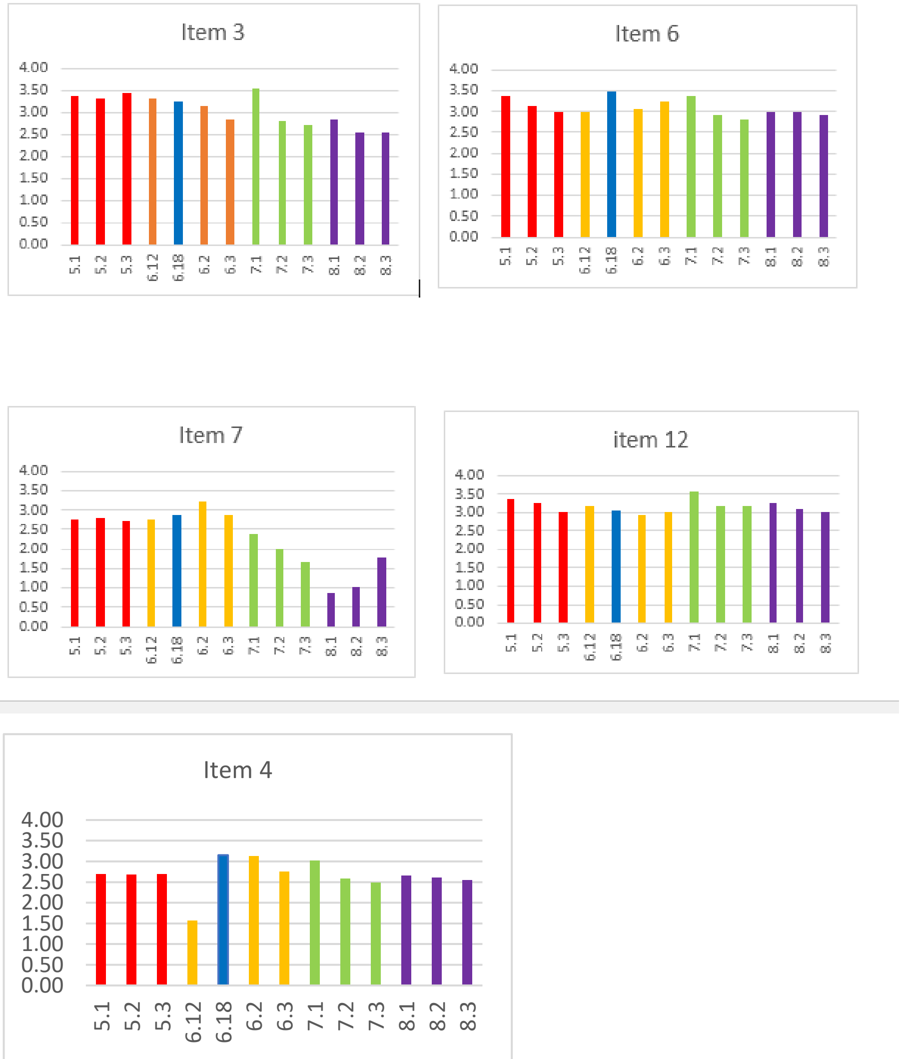
B2: yeah!

B1: It'd be great

G1: I would………..but maybe if we did it later after our exams?

G3: Yeah….like I really want to learn about science but like……I sort of need to relearn maths first.

B2: Yeah it would be better to do it after the exams. Then we wouldn't have to rush or anything. Like you know…….i want to do science…..but I wanna do well in my test.



Graph 6.14 comparing cognitive attitude components to items that measured it

This viewpoint seemed to last throughout the rest of year 6.

Overall students' then seem to become more positive in regards to their cognitive beliefs about science in school at the start of year 7 before a gradual decline is observed until the end of year 8. This makes sense as the start of year 7 is the homeymoon period (Galton and Hargreaves; 2014) whereby students' often have an optimistic view of a fresh start (Morgan, 1996). What is of note however is item 7 (I find science in school fascinating). Item 7 is the only cognitive item which shows a decline in students' cognitive beliefs about science in school at the start of year 7 warranting further exploration. As stated above the fascination generated in regard to science in school by attending an Open Event and observing novel scientific objects could cause students' to believe that they would get to use these objects at secondary school. As such a potential reason for a decline seen within this item could be the students' did not actually get to use the novel equipment as expected. This rationale was supported within student interviews and focus groups. For example in school A, a year 7 term 1 interview of a male individual stated:

Researcher: Is science like what you thought it would be in secondary school?

7.1IM2A: Not really

Researcher: How so?

7.1IM2A: Well…..like we had to do all this safety stuff which was ok……….but we're not going to doing the Van der……faff this year.

Researcher: Do you mean Van Der Graaf?

7.1IM2A: yeah that's what I said

Researcher: ok….did you expect to use the Van Der Graaf this year?

7.1IM2A: Well……yeah. And we do a lot more writing too then I thought.

And in school C a focus group consisting of 3 boys and 2 girls had this conversation in year 7 term 1:

B3: I can't wait until safety stuff is done

B1: yeah like lets get on with it!

Researcher: What do you mean?

B3: Well like……we have to make sure we're safe first before we can do practical's

G1: Sir said that we can't do any practical's until we can be safe. We have the test on it next week

G2: We can't even do the flame ball anyway

B1: What do you mean?

G2: Sir said its to dangerous so only teachers can do it

B1: What????!!!!

B3: No way!!!

B2: That sucks!!

G1: We're using the microscopes though next term he said

B1: That's like…..after Christmas!!

G1: (Shrugs)

B2: Really? When did he say that?

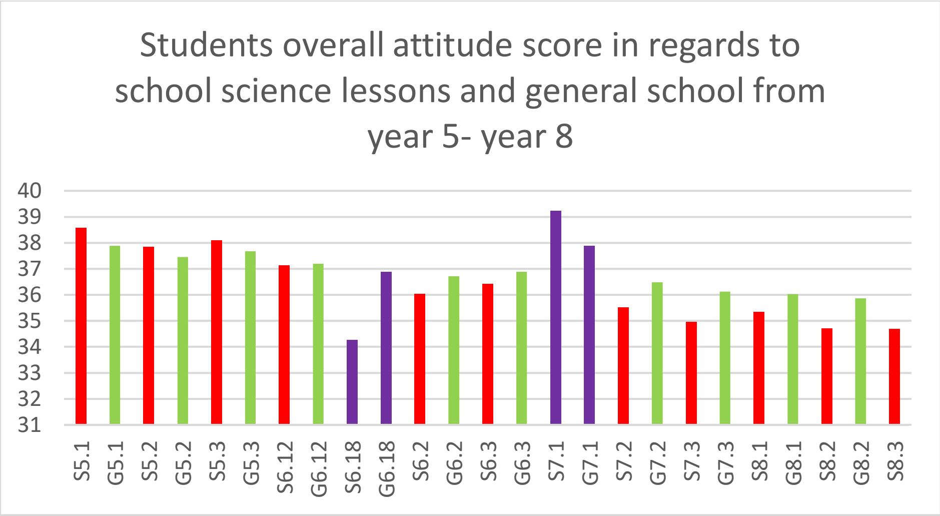
G1: Last week

B3: Man……we never do anything fun. I bet it's just more card sorts

G2: It's still better than English

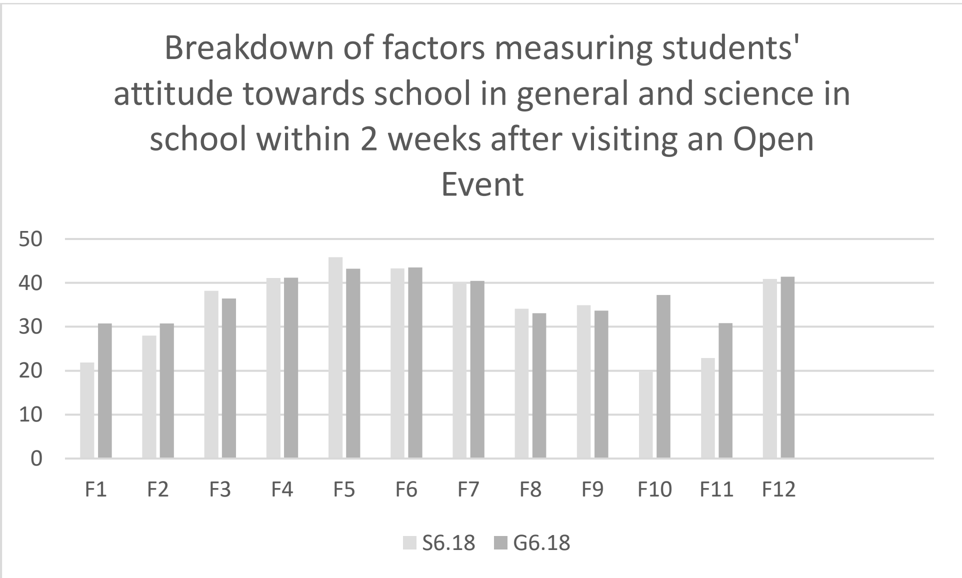
This idea that science lessons are 'still better than English' may also be a potential reason why only item 7 shows a decline in students cognitive component of attitudes whilst the other items do not. Generally speaking students' at the start of year 7 where positive in regards to their science lessons. Although item 7 may indicate the first signs that students' image of science is not matching their belief's about science in school it is not until term 2 that an overall decline can be observed. This observation that students' potentially see science in a more positive light then other subjects or school in general is also important to note. Although students' attitudes towards other subjects where not gathered as this was not the focus of this thesis, it may be worth comparing individual factors that make up students attitudes to science in school and the individual factors that make up students' attitudes to school in general as this may inform how the Open Event effects students' across the transition from primary to secondary school.

6.43 Differences between students' attitudes to science in school and students' attitudes to school in general



Graph 16.15 showing students' overall attitude score in regards to school science lessons and general school from year 5 to year 8 by academic term

Graph 16.15 shows students overall attitude score in regard to school science lessons against students' overall attitude score towards school in general covering the transition years starting from year 5 in primary school up until the end of year 8 in secondary school. As it can be clearly seen science lessons in year 5 in school are seen more positively by students then school in general and this continues at the start of year 6 before the Open Event. When measures were taken of students' that had visited an Open Event a significant difference occurred between students overall attitude towards science in school against students 'overall attitude to school in general with students attitudes towards school in general significantly more positive then students' attitudes towards science in school. As discussed previously the decline in students' attitudes towards science in school seems to be due to the fact that students', after visiting an Open Event, begin to perceive primary school science as not 'proper science'. The effect of the Open Event on students' attitudes towards school in general is however negligible suggesting that something specific that effects students' attitudes towards the subject of science in school occurs at the Open Event. Although this significant difference between students' attitudes towards science in school and students' attitudes toward school in general only lasts until the next half term, it must be pointed out that from then until the end of year 8 students' attitudes towards science in school is lower, not significantly lower but still lower, at every data point apart from the start of year 7, than students held attitudes towards school in general. That said the start of year 7 is the only other data point that observes a significant difference between students held attitudes towards science in school and students held attitudes towards school in general. Unlike just after the Open Event however students' attitudes towards science in school is significantly more positive then students' attitudes towards school in general. As these 2 data points, 6.18 just after students attended an Open Event and 7.1 the first term of a new school in year 7, show significant differences between students' held attitudes towards science in school and students held attitudes towards school in general it was thought that a breakdown of the individual factors that made that score was worth exploring. As such graph 16.16 and 16.17 shows by factor the data point for 6.18 and 7.1.



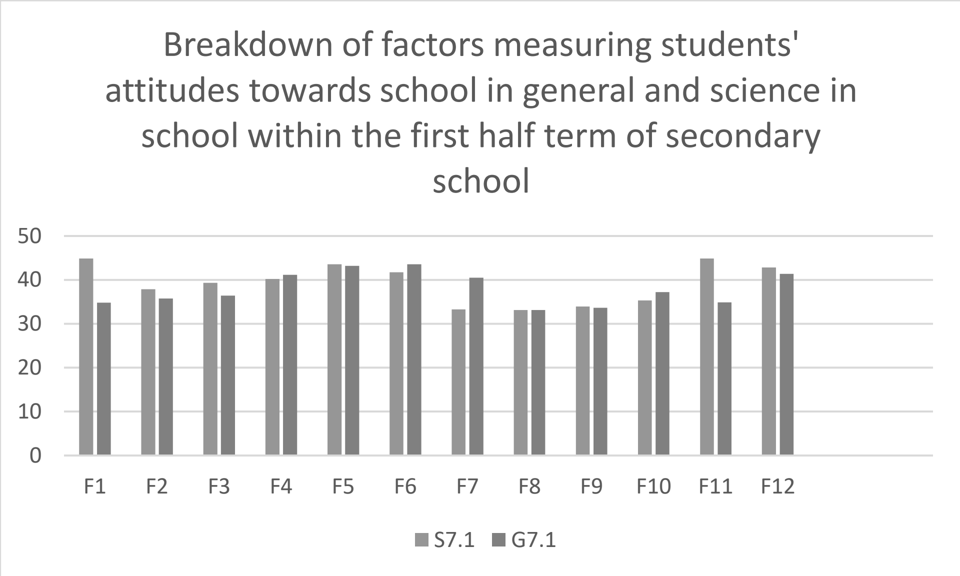
Graph 16.16 showing a breakdown of items that measured students' attitudes to science in school within 2 weeks of attending an Open Event.

In regard to data point 6.18, the first data point after the Open Event, Factors 2, 3, 4, 5, 6, 7, 8, 9 and 12 where not significantly different between students held attitude toward science in school and students held attitude towards school in general. There was a significant difference found however with three factors (see table 6.8).

Factor Number	Component of Attitude	Significant difference to 0.05	Question
1	Afferent	0.028	Science lessons are fun
10	Afferent	0.012	Science is a topic I enjoy studying
11	Afferent	0.031	Science lessons are not fun

Table 6.8 showing significant items from questionnaire after Open Event

All factors that where significant where of the afferent component of attitude. This is somewhat surprising as their seemed to be more variability in regard to students' cognitive components of held attitude towards science in school. However, although students' had more variability in regards to their cognitive components of attitude these components where consistent for both students held attitude for school science and student's held attitude for school in general. It must also be noted that factors 1 and 11 are reflections of each other. As such it should be expected that if one of these factors was significant then therefore *both* of these factors should be significant. This is what occurred with a small difference of 0.003 separating factor 1 and 11. It seems that after students have attended an Open Event, one result of this attendance is a decline in students' perceiving science in school as 'fun' which is more pronounced then their feelings towards school in general. As said previously this is not suggesting that students' don't find science fun but that when they *compare* what was done in regards to science at secondary school in comparison to what they expect to do in primary school in lessons then they begin to perceive their primary school lessons as not as fun. In other words the Open Event seems to give students' *greater expectations* of what should be done in science lessons which they believe will not be fulfilled in primary school. This then seems to impact on their *enjoyment* of science in school (factor 10) in that this greater expectation of what can be done in science leads to less enjoyment in regard to what is actually done in primary school lessons. All of this results in some students' holding attitudes towards science in school more negatively then their attitude towards school itself.



Graph 16.17 showing a breakdown of items that measured students' attitudes to science in school after transfer from primary to secondary school.

In regard to data point 7.1, the first data point after the transfer of school, Factors 2, 3, 4, 5, 6, 7, 8, 9, 10 and 12 where not significantly different between students held attitude toward science in school and students held attitude towards school in general. There was a significant found however with two factors (see table 6.9).

Factor Number	Component of Attitude	Significant difference to 0.05	Question
1	Afferent	0.025	Science lessons are fun
11	Afferent	0.018	Science lessons are not fun

Table 6.9 showing significant items after students' transfer school

As said previously all factors that where significant where of the afferent component of attitude. It must also be noted that factors 1 and 11 are reflections of each other. As such it should be expected that if one of these factors was significant then therefore *both* of these factors should be significant. This is what occurred with a small difference of 0.007 separating factor 1 and 11. It seems that after students' have transferred school and started secondary school (year 7) one result of this transference is that science in school is significantly seen by students' to be more fun than school in general. This could be in part due to the image portrayed at the Open Event in that students' are finally getting to take part in what they termed 'proper science'. Although this would suggest that attending the Open Event is therefore a positive step in fostering a more positive attitude of students' towards science in school it must be noted that although a significant difference between students' attitudes towards school in general and students' attitudes towards science in school does not occur in term 2 of year 7 this is in part due to a decline observed by the second term of year 7 in students' attitudes towards science in school which continues until the end of year 8. This decline seems to be, in part due to students' image of science not matching the reality of what students termed 'proper science'.

6.5 Review

In review, this chapter highlights a trend of declining attitudes of students towards science in school is observed within the transition years which is a well observed phenomenon within the transition literature within England. However, this thesis would also suggest that this decline in students' attitudes towards science begins around the time students have attended an Open Event; that is within the first term of year 6 which is the last year of primary school and that attendance of this Event is a catalyst for the decline observed in students' attitudes towards science in school. A closer scrutiny of the data suggests that the Open Event in regard to science has both positive and negative effects. On the one hand students seem to reassess and re-evaluate the importance of science in school. This somewhat cancels out the effect of science in school being not a priority due to upcoming End of school exams. Another positive effect is the fascination and interest that attending an Open Event triggers in students toward the subject of science which seems to last at least a term. On the other hand, students seem to leave the Open Event with expectations of what they deem 'proper science' which causes some students to have a less positive attitude towards their primary school science lessons. These new student expectations of what to expect in science lessons also seem to result in an increase in positive attitude towards science in school straight after transfer in year 7. Across the data set however when these unrealistic student expectations and beliefs of what is expected to be done in science in school, fostered by attending the Open Event, are not met; a sharp decline in students held attitude towards science in school is observed which continues at least until the end of year 8. This chapter then frames these findings within the ABC model of attitude with the result that it seems that it is students afferent components, specifically relating to science lessons being perceived as ‘fun’ or ‘not fun’, that is a key denominator in students’ declining attitudes towards science.

Chapter 7

The effect of Open Events on students' perception of school science

7.1 Introduction

One of the main challenges within research on school science is clearly identifying what perception the respondents hold when investigating 'science in school'. The past literature clearly indicates a difference between students' views of science in general and students' views on the science that occurs in science lessons (Ebenezer and Zoller, 1993) which then impacts on the held construct that students' have of science in school. It has also been noted that students' hold different attitudes, interests and motivation towards individual strands of science such as Biology in comparison to other strands of science such as Chemistry (Collins, Reiss and Simon, 2006) which means that any attempt at measuring these variables in regards to science in school needs to make sure that steps are taken to clearly identify what the respondent believes 'science' to encompass. To exasperate the problem further it has also been noted that when students' go through the transition process and transfer school, constructs of individual subjects such as science could be fundamentally changed as students' try and adapt to their new surroundings (Galton, 2014). As of yet however there are very few studies that attempt to make clear what perception of science in school students' hold and if this construct changes across this transition from primary to secondary school (Osbourne and Dillion, 2006).

To understand what was found regarding the overall effect of Open Events on students' perception of school science it may be worthwhile to quickly summarise the method used to collect this data. A cross sectional sample of students covering 22 schools where asked to answer one simple question. The question was open ended and asked the student to write a definition of science. After this task was completed students handed in their responses to the researcher. This was given to students in every term in years 5 and 6 in primary school (9-11-year olds), the last 2 years before transfer of school, and years 7 and 8 in secondary school (11-13-year olds) which represented the first 2 years of secondary school after transition. The year 6 cohort were also asked to answer the questionnaire a fourth time within 2 weeks after attending an Open Event (see table 7.1).

Year Group	Sample 1	Sample 2	Sample 3	Sample 4
Year 5	First half term		Forth half term	Sixth half term
Year 6	First half term	Second half term	Forth half term	Sixth half term
Year 7	First half term		Forth half term	Sixth half term
Year 8	First half term		Forth half term	Sixth half term

Table 7.1 showing structure of administration of questionnaire tool

A selection of students' where then interviewed from each participating school for each year group data was collected from after each sample. This usually consisted of one male and one female being chosen by the class teacher who they deemed could be available for questioning by the researcher and was usually conducted on the same day the researcher collected sample data on students' perception of school science. Overall this resulted in open ended written answers in regards to students answering 'What is science?' as well as transcription records of further explorative discussions of individual students and groups of students answering the same question.

Based on the pilot study and previous research within this area the framework used to analysis the data was adapted from Rosenburg and Hovland (1960) which consisted of separating student responses into the categories of knowledge or ideas. Knowledge is defined here as student responses that define science using subject specific topical information. For example, a student knowledge based definition of science could be 'the study of animals and plants' or 'the use of chemicals and Bunsen Burners'. Ideas are defined here as a student response that defines science in terms of thinking scientifically. An example of a student ideas based definition of science therefore could be 'Science is about making predictions' or 'Science is testing hypothesis'. To further assess knowledge based definitions of science, as previous research suggest that this could be important in terms of attitudes towards science are different for strands of science, students' knowledge based definitions of science where placed into a further four categories. These four categories where associated with the 3 main knowledge strands that consist of science within English schools covering Biology, Chemistry, Physics and a Combined strand consisting of all three strands. These strands had previously been designed within the pilot stage of research by using experts from the Royal Society of Biology, Chemistry and Physics to define their individual science strands and then agree upon a combined knowledge based science definition. Students' responses then where first decided by the researcher to be knowledge or ideas based and then sorted by the researchers' peers using the definitions agreed upon as a 'key'. For example, the previous knowledge based example was 'the study of animals and plants' which closely matched the biology 'key' and as such this was labelled a Biology knowledge definition of science whilst 'the use of chemicals and Bunsen Burners' more closely matched the chemistry 'key' and as such was labelled a Chemistry knowledge definition of science.

In this chapter an overview of what perception of science in school students' hold across specific points across the transfer of school is alluded too before looking at the Open Event and analysing if this has any impact on the way that students' perceive science in school using the framework of Rosenberg and Hovland (1960). This is then broken down by year group to further analyse any changes in students' perception of science. Potential reasoning for any observed phenomena are given throughout.

7.2 What was found regarding the overall effect of Open Events on students' perception of school science?

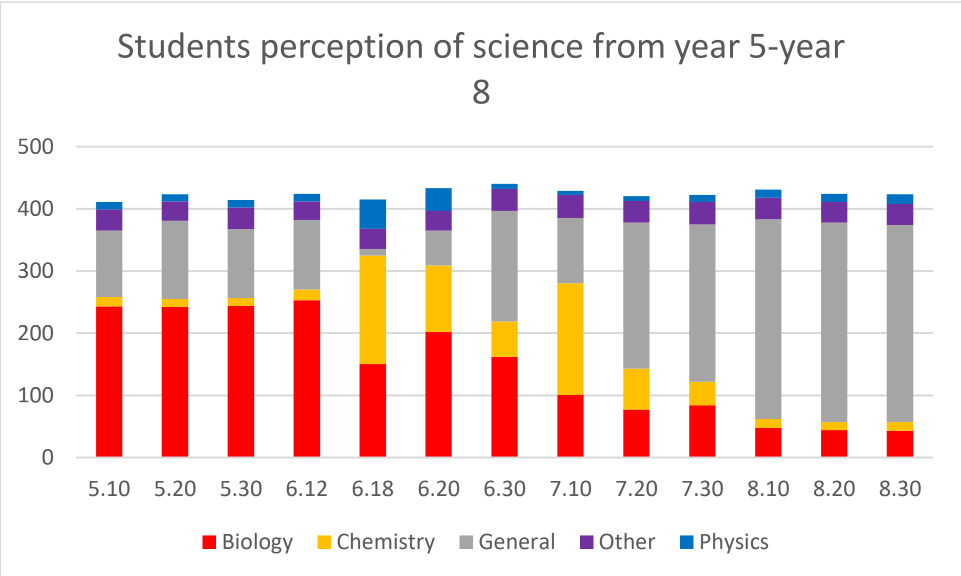
Overall measurements taken just before students attended an Open Event and within 2 weeks after students had attended an Open Event showed a shift in students who perceived science as knowledge based but not for those students' who perceived science as ideas based (see table 7.2).

Year and Term	Biology	Chemistry	General	Physics	Ideas
5.10	243	15	107	12	34
5.20	242	13	126	11	31
5.30	244	13	110	12	35
6.12	253	17	112	12	30
6.18	150	175	26	47	33
6.20	202	107	56	36	32

6.30	**162**	**57**	**178**	**8**	**35**
7.10	**101**	**179**	**105**	**7**	**37**
7.20	**77**	**66**	**235**	**11**	**35**
7.30	**84**	**45**	**253**	**11**	**36**
8.10	**48**	**14**	**321**	**13**	**35**
8.20	**44**	**13**	**321**	**13**	**33**
8.30	**46**	**15**	**317**	**15**	**34**

Table 7.2 showing a shift in students who perceived science as knowledge based but not for those students' who perceived science as ideas based

Before this, students' perception of science had been consistent throughout year 5 with a small, but not significant, change seen at the start of year 6. However from around the time that students' attend the Open Event (End of September to the beginning of October) students who perceive science as knowledge based, and who specifically associate science to a specific strand of knowledge, shift their stance on *which* strand of knowledge they perceive science to be (see graph 7.1).



Graph 7.1 showing the breakdown of how students perceive science in school across year 5 to year 8.

That is not to say that overall raw numbers change. In fact it is interesting to note that a similar number of students perceive science as knowledge based across all year groups suggesting that the way in which students' perceive science, based on the categories of ideas and knowledge, is embedded before the transition years begin (see table 7.3).

Year and Term	**Number of students who perceive science as knowledge based**	**Number of students who perceive science as ideas based**
5.10	**377 (92%)**	**34 (8%)**
5.20	**392 (92%)**	**31 (8%)**
5.30	**379 (92%)**	**35 (8%)**
6.12	**424 (93%)**	**30 (7%)**
6.18	**398 (92%)**	**33 (8%)**
6.20	**433 (93%)**	**32 (7%)**
6.30	**440 (93%)**	**35 (7%)**
7.10	**429 (92%)**	**37 (8%)**
7.20	**389 (92%)**	**35 (8%)**
7.30	**393 (92%)**	**36 (8%)**
8.10	**396 (92%)**	**35 (8%)**
8.20	**391 (92%)**	**33 (8%)**
8.30	**393 (92%)**	**34 (8%)**

Table 7.3 showing by term and year students who perceive science as knowledge or ideas based

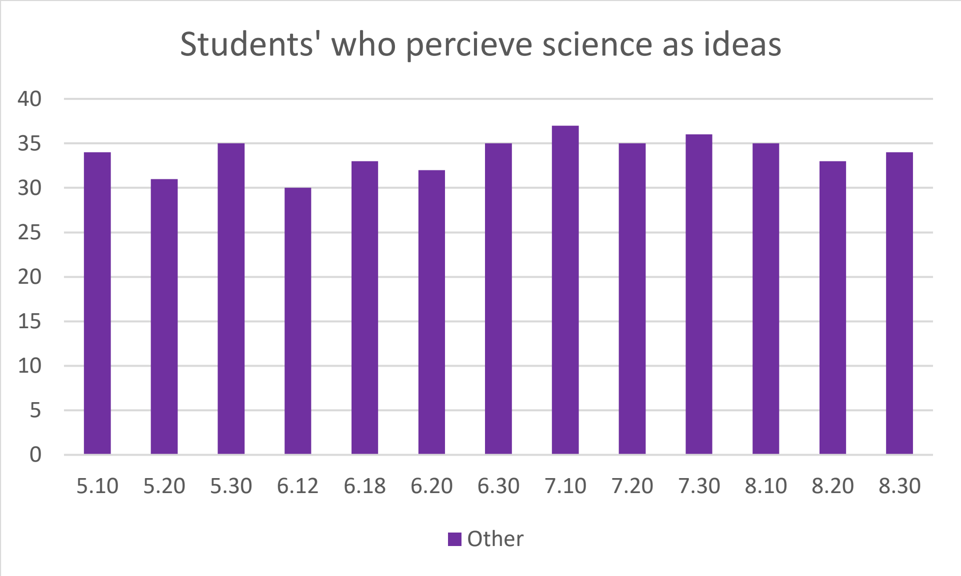
It is also worth noting that the number of students that perceive science as 'ideas' does not seem to change and this is consistent throughout the sample taken. Unfortunately, further exploration of this was hampered by the design in that questionnaire's where anonymous. Due to the small numbers (8%) of students' that perceived science as ideas based as well as an opportunistic sampling method used in the selection of students chosen by the class teacher to take part in interviews only 4 interviewees (one in year 5, one in year 7 and one in year 8) identified themselves as perceiving science as ideas based. That said exploring this phenomenon further with the four individuals that perceived science as ideas based was quite revealing.

7.3 Ideas based perception of science in school

No effect was observed in regard to students' which perceive science as ideas based and attending the Open Event. In fact what was soon realised was that very little change was observed for the number of students that categories science as about ideas in any year within the sample. This would suggest that students' who perceive science as ideas based, that is that science is about *investigating* phenomena, was embedded before students had reached the age of 9.

YearTerm	**Other**
5.10	**34**
5.20	**31**
5.30	**35**
6.12	**30**
6.18	**33**
6.20	**32**
6.30	**35**
7.10	**37**
7.20	**35**
7.30	**36**
8.10	**35**
8.20	**33**
8.30	**34**

Table 7.4 showing number of students who perceived science as ideas based



Graph 7.2 showing number of students by term and year who perceive science as ideas based

This is supported somewhat within the interviews conducted. For example in an interview of a male student in school D in year 8 term 1 said this statement:

Y8.1FID: Science is about how to think

Researcher: In what way?

Y8.1FID: Well science is about thinking through a problem or a challenge. And not making assumptions.

Researcher: Can you expand on that?

Y8.1FID: Its like………(sigh) its thinking things through properly. Like we did a practical with electricity and circuits and we had to make a series circuit…but it didn't work……and its knowing that you have to like…..problem solve because it may not work because the equipment is faulty or you've made a mistake and not connected it up properly…or maybe because it actually doesn't work!....but you have to repeat it just in case. Its just thinking through something….properly. Like I like working with (name of student) because he thinks things through properly but (another student name) just doesn't think that way. I think you sort of do or don't. Like I've always thought this way'.

It's of interest to note this idea of students' thinking logically or scientifically and that Y8.1FID has 'always thought this way'. This is somewhat supported in another interview of a student in year 7 term 2 in school F:

Y7.2MIF: I've always though science was about exploring and experimenting

Researcher: What do you mean?

Y7.2MIF: Well…. Its about thinking logically isn't it? Like if you see a rainbow and you look at the order of the colours and you then see another and another and another…..and the colours are always in the same order…….but I know that all I can say is that rainbows in THIS country have the same order of colours……not even that really…all I can say is the rainbows I have SEEN have the same order………its thinking like…..logically……

Researcher: Scientifically?

Y7.2MIF: Yeah! Thinking scientifically like a scientist does. And that's what science is. Learning to think like that.

It must be noted that this viewpoint was vastly different from the norm in regard to students' being interviewed, however that could be due in part, to the other students' identifying science as knowledge based and not ideas based. It also must be pointed out that this is only based on 2 individual interviews be it that represented 66% of students that perceived science as ideas based. The only other student, a male student interviewed in school A in year 5 term one had this to say on the subject:

Y5.1M2S: Science is about everything

Researcher: Everything?

Y5.1M2S: Yeah like it's about how you know…..observing and recording stuff. How it works. Why it works that way.

Researcher: Can you give an example?

Y5.1M2S: Well………it's like its sunny now. And science will let you predict if it's going to be sunny or rainy this afternoon. And they then look at all the things that could effect it like wind and where it's raining now and clouds and…..other things (laugh)…..like when the weather has been similar before what has happened….. and then they make a guess about the future but its better then a guess because they've been scientific.

It is interesting to note that all 3 students' who identified themselves as people that perceive science as ideas based mentioned this idea of scientific thinking. Kuhn (2007) argued that:

'by at least age 4 some children can come to understand that mental representations, as products of the human mind, do not necessarily duplicate external reality….. Yet, this differentiation of assertion and evidence sets the stage for the coordination between more complex theoretical claims and forms of evidence that are more readily recognizable as scientific thinking. Unfortunately this innate ability is often ignored for more knowledge based learning within schooling and can often stay unformed until formal training occurs in upper school. Those that show this skill seem to have an innate interest in thinking about thinking' *(Page 6, What is scientific thinking and how does it develop?; Kuhn, 2007).*

She believed that scientific thinking was a skill that developed at an early age but was often ignored by current schooling methods. Of those individuals that could 'think scientifically', Kuhn argued that this was due to an innate fascination and interest that made them learn this skill outside of the classroom (Kuhn, 2008).

It must be noted however that due to the small number of students' that were identified as holding a perception of science that was ideas based that this phenomenon needs further exploratory research using a larger sample before any potentially valid rationale can be put forward. That said a more detailed picture of the effect of the Open Event on students who perceive science as knowledge based can be alluded too and this is discussed within the next section.

7.4 Knowledge based perception of science in school

A knowledge based perception of science in school is defined as students' perceiving science as based on topics of interest (Lederman, 2007). As it has been observed that students perceive science based on different knowledge strands (Hogarth, 2009) it therefore made sense to categorise student's responses into theses strands. Students' responses where first decided by the researcher to be knowledge or ideas based and then sorted by the researchers' peers using the definitions agreed upon as a 'key' (see table 7.5).

Strand of science	Definition 'key'
Biology	I think science in school is all about the study of living things like plants and animals and how they all live together and interact.
Chemistry	I think science in school is all about the use of chemicals and how you can react them together and make new substances.
Physics	I think science in school is all about forces, matter and energy and how they all work together
General	I think science in school is about everything in the world around us. It's the study of living things, the use of chemicals, matter and energy.

Table 7.5 demonstrating the pre designed 'key' to sort student responses.

A random sample of student definitions which had been coded but not labelled on the items by the researchers peers where then handed to another group of peers at the ESERA summer school to be coded again. Coding from both groups where then compared with no discrepancies found. The only discussion point was for those students' that had defined science using two different strands. For example if a student defined science as 'About animals and pollution and how we recycle things' then a discussion was conducted on whether that constitutes as only biological, chemical or general. The outcome of this was that both peer groups, independent of each other, chose to categories such as definition as general as it showed more than one strand of science within that students' perception of science and this rule was followed with all student definitions collected.

7.42 Biology

A large proportion of students' in year 5 who had a perception of science as knowledge based catered towards defining science as biological. This is supported by the literature in that it has been observed that Biology is often seen as the most applicable to students as it involves learning knowledge about themselves (Dillion and Osbourne 2008). Throughout year 5 and the first half term before the Open Event of year 6 the number of students' that perceive science as mainly biological was observed to be stable. However when students' were asked to define science after attending an Open Event 2 weeks later a significant decrease in the number of students that perceive science as biological occurred (see table *). This was also clearly highlighted within interviews conducted:

Year 6.1 Male in school Q	**Year 6.18 Female in school Q**
Researcher: So that's what you think science I about? *Y6.1M3Q: Yeah…..i mean what else is it? Its like how animals are adfated* **(meaning adapted**) *and how they survive in harsh places.* *Researcher: Oh like where?* *Y6.1M3Q: Like the desert or next to a volcano……oh and we're animals but we're different.* *Researcher: Different?* *Y6.1M3Q: Yeah we can CONTROL nature* *Researcher: How do we control nature?*	*Researcher: So you would define science as…?* *Y6.18F1Q: Predators and how they survive in the wild.* *Researcher: Oh? Like what?* *Y6.18F1Q: Like……the bear and stuff…..and how they survive in the woods.* *Researcher: Anything else?* *Y6.18F1Q:Well…science can be about explosions as well and how we make chemicals to poison animals and stuff. But its more to do with animals.* *Researcher: Explosions and stuff?* *Y6.18F1Q: Yeah like I went to (name of schools) to look around and they did explosions*

Y6.1M3Q: Well…..we chop it down don't we? And kill the animals that would hurt us. We've domestied it/ *Researcher: Domesticated?* *Y6.1M3Q: Yeah that's it!*	*and made a fireball but I think he was just being a bit mad really.* *Researcher: Mad?* *Y6.18F1Q: Yeah like I guess every school has to have a mad scientist. But it's not science is it? It's just a boy being silly.*

Table 7.6 comparing two student interviews

It is interesting to note that the majority of students who identified themselves as seeing science as mainly biological and who were interviewed before attending the Open Event were very firm in their perception that science was about biological topics *only*. After the Open Event however their where more individuals who, when prodded, at least mentioned other topics of science from a different strand.

YearTerm	**Biology**
5.10	**243**
5.20	**242**
5.30	**244**
6.12	**253**
6.18	**150**
6.20	**202**
6.30	**162**
7.10	**101**
7.20	**77**
7.30	**84**
8.10	**48**

8.20	**44**
8.30	**43**

Table 7.7 showing number of students who perceived science as knowledge based in biology

This would suggest that one effect of the Open Event could be that of revealing to students' that science covers a *spectrum* of topics and potentially makes them reassess what they think science actually is. For some this seems to be only a short term effect which can be clearly seen with an increase observed in the number of students who perceive science as biological. For others however, the idea that science covers other strands or a spectrum of science topics seems to be longer lasting. Not only can this be observed by the fact that the number of students' that perceive science as purely biological never reaches pre Open Event levels again but is also supported within interviews conducted at that time. For example in school T in term 2 year 6 a male interviewee stated:

Y6.2M4T: Well…….its about our bodies……and I guess its about stuff we've invented too like……..i'm not sure the name of it.

Researcher: What does it look like? Where did you see it?

Y6.2M4T: It's like a metal helmet on top of a pole and when you touch it your hair stands up with static

Researcher: A Van der Graaff generator?

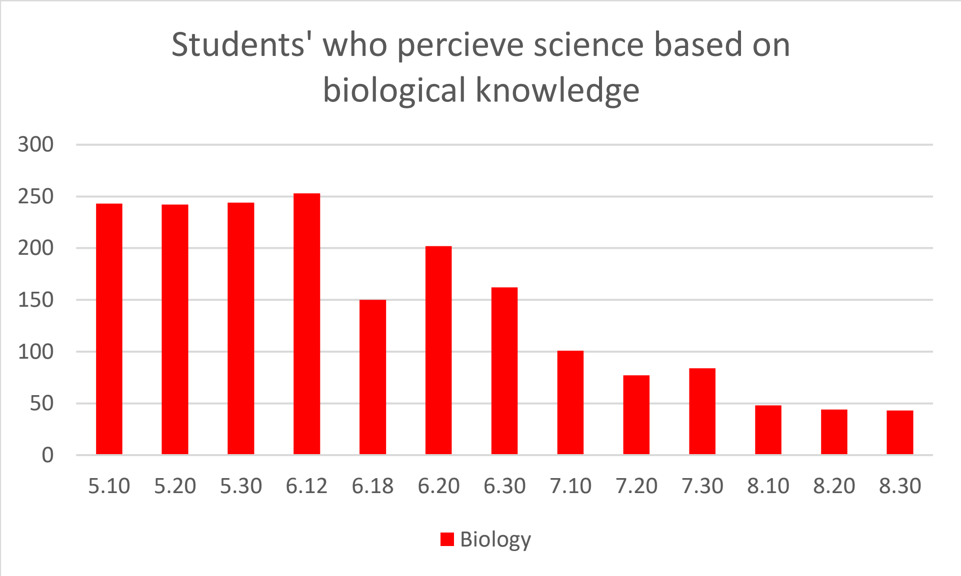
Y6.2M4T:YEAH!! That's it. Like science is about your body and stuff but its also about the machines you make and how they work like the Van deee……

Researcher: Van Der Graaff generator

Y6.2M4T: Yeah that and like electricity that makes it work and….conductors?

Researcher: Yes that's right conductors

Y6.2M4T: (laugh) Yeah conductors and erm…….and I've forgot but yeah……it's not just us science is like electricity and stuff too.



Graph 7.3 showing number of students by term and year who perceive science as biology knowledge based

The data collected and the exploratory interviews conducted would suggest that the Open Event gives the opportunity for students' to see aspects of science that they have never associated with science in school before. In regards to those that perceive science as mainly about biological knowledge the Open Event seems to be an event that potentially starts a change in students' perception of what science *is* by showcases objects and ideas that do not fit with the image they have of science in school. Although this change does not occur for everyone overall a gradual decrease in students' that perceive science in school as mainly biological decreases gradually from term 2 of year 6 until the end of year 7 before becoming stable within year 8. In fact for those individuals that still perceive science as mainly biological when explored further this seems to be a case of student's refusing to see science as anything but biological as they *prefer* biology over the other science strands. For example in year 8 term 2 one girl stated:

Y8.2F3S: Biology is the only good science

Researcher: What do you mean?

Y8.2F3S: Well the others are rubbish aren't they? Who wants to learn about power??? Its boring

Researcher: Why is it boring?

Y8.2F3A: It's not science its like….maths or something. Like science should be just biology. We don't need to learn the other stuff. We should be able to choose!

Researcher: If you had to define science then what would it be?

Y8.2F3S: I answered that on your thing. Its to do with the human body like organs and cells and tissues.

Researcher: Not anything else?

Y8.2F3S: Nope everything else isn't science.

And again in year 7 term 3 a male student said:

Y7.3M2B: Science should be just about biology

Researcher: What else is it about?

Y8.2F3S: Chemistry and stuff

Researcher: Stuff?

Y8.2F3S: Yeah like……energy and compounds and elements…..acids……its not what I thought it was

Researcher: How so?

Y8.2F3S: Well……..i just thought we'd do more fun stuff…..more practicals and things. We NEVER do practicals…..and we never do biology……its always book stuff…..and that's not science.

Researcher: What is science then?

Y8.2F3S: Not what we do. It should be like….studying animals and stuff and like going outside and like collecting fish from a pond or something to cut up and look at inside. Disexting

Researcher: Dissecting?

Y8.2F3S: Yeah that.

Researcher: So knowing what you know now how would you define science?

Y8.2F3S:like……….about our body and plants and how they work and interact

Researcher: Nothing else?

Y8.2F3S: About food chains and stuff

What these two examples seem to show is an understanding by students' that science in school is made up of more than one strand of science but that they ignore this knowledge to define science as their preferred strand; in this case biological. Overall this suggests that although the Open Event can change students' perception of science by giving students knowledge about different science activities, for some students, this change is only short term as they have an inherent preference to the strand of biology then the other strands that constitute science.

7.43 Chemistry

In contrast to the biological knowledge strand in that a large proportion of students' in year 5 had developed the perception of science as biological the number of students that perceived science in school as chemical was quite low (See table*). That said similar to the students that perceived science in school as biological, the number of students' in year 5 and the start of term one in year 6 who perceived science in school as mainly chemical was stable. This however completely changed when students where sampled again within 2 weeks after attending an Open Event.

YearTerm	Chemistry
5.10	15
5.20	13
5.30	13
6.12	17
6.18	175
6.20	107
6.30	57

7.10	**179**
7.20	**66**
7.30	**38**
8.10	**14**
8.20	**13**
8.30	**14**

Table 7.8 showing number of students who perceived science as knowledge based in chemistry

An increase from 17 students to 175 was observed for those that perceived science as mainly chemical in nature. One reason for this, suggested earlier, seemed to be that students' had not actually been aware until attending an Open Event about the chemical strand in science. This is unusual in that Key Stage 2, which is the syllabus that the majority of primary schools follow, incorporates in their science teaching topics that include chemistry. When explored further however it seemed that the abstract nature of the chemical topics at Key Stage 2 and the rarity that they had science lessons had caused students' to not even consider them as 'science'. For example, in an interview in school T with a female in year 5 term 3:

5.3IF3T: Well like…….i can't really remember when we did science last.

Researcher: Ok…well thinking back what's the last science lesson you remember?

5.3IF3T: erm…………..we collected……… collected sunflower seeds and talked about how they grow.

Researcher: When was that?

5.3IF3T: Erm……ages ago…….well it couldn't be too long ago because the sunflowers wouldn't have grown……but yeah….a while ago.

Researcher: Ok moving on…..what lessons have you done this week?

5.3IF3T: Everyday?

Researcher: yes, lets see if you can remember them

5.3IF3T: Erm……Monday was English in the morning, we're writing a story about where we want to go on holiday…….then we had maths………Tuesday……….we did more maths and finished the booklet……and then we went outside and collected stones……..erm Wednesday we did our English story all day and then we had to swop and check for spellings and punctuations and stuff….and then this morning we did some more maths and then I think we're looking at the rocks we collected this now and this afternoon.

Researcher: Why are you looking at rocks?

5.3IF3T: I don't know really…..i think we're going to draw them or something.

And in a separate interview with a male student in term 1 year 6 at school Q:

6.1IMQ1: We don't really do science…….well we draw stuff but that's not science is it?

Researcher: Draw stuff?

6.1IMQ1: yeah like last week we had to draw what we saw when (name of teacher) put different things in water. He said it was science but its just drawing. Or Geography. I think we had to group different rocks once into a table.

Researcher: And that's not science?

6.1IMQ1: Not really. I mean science is like animals and predators and stuff. Not rocks….and like I think we're doing about recycling today in our science lesson but I bet its just a way for (name of teacher) to make us clean up the classroom or something.

This lack of understanding in perceiving biology related topics as science and everything else as *not science* seemed prevalent in the interviews conducted before the Open Event. What is interesting however is that after the Open Event students still maintained this idea that the only science in school they did was biological in nature. The tasks mentioned above still seemed to be perceived by the students' as *not science* however there was a noticeable shift in that students' who had developed a perception of science as mainly chemical or physical believed that they did not do science at all within their science lessons. For example, in year 6 term 1.8 after the Open Event one male student from school R interviewed stated:

6.18IMOR2: When never really do proper science here (indicating primary school)

Researcher: What do you mean by proper science?

6.18IMOR2: Like….using Bunsen Burners and blowing things up!

Researcher: Is that all what proper science is?

6.18IMOR2: Well its about….chemicals as well. Making potions and stuff too. But we never do it here (indicating primary school)

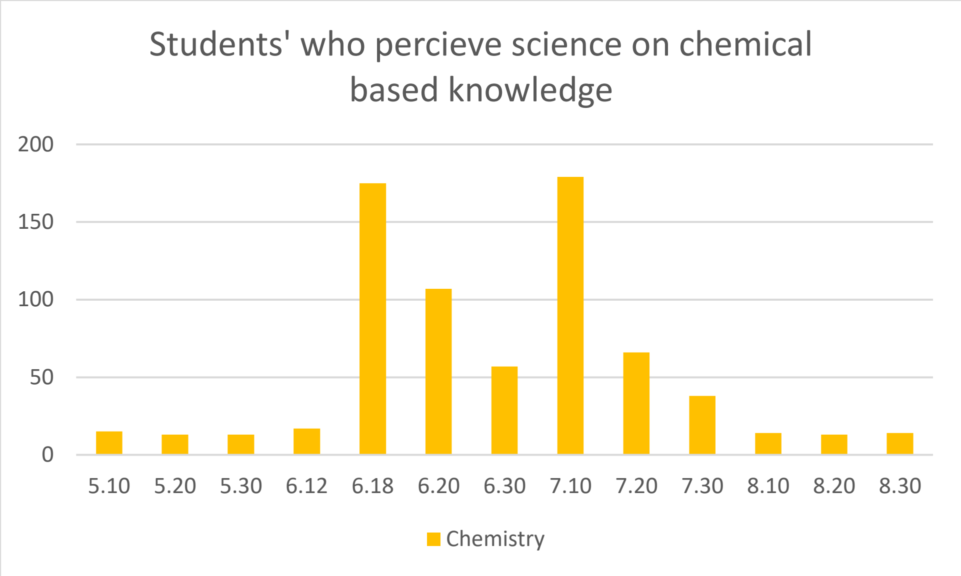
Researcher: What do you do in science classes here?

6.18IMOR2: Animals and stuff……which is fine but like……we don't really do it anymore because of CATS and its not science SCIENCE is it?? .

Researcher: Anything else? What was the last science lesson you remember?

6.18IMOR2:………..Erm…………….i don't think we did science in it. Like last week, on…….Wednesday I think it was because I had football after………we did this thing with like glue and scissors and stuff. We had to make a windmill thing. But that's not science its art……

It seems that attending the Open Event gives students', at least those which perceive science from then on as chemically based, an image of science which results in students' holding expectations of what *should* happen in science in school. When this does not occur students' seem to rationalise this as having not done *'proper science'* or even science at all resulting in negative feelings towards the subject. This expectation of what science should be in school however seems to dissipate with time, for some students, which is highlighted with a decline in the number of students' that perceive science as mainly chemical in nature by term 2 and term 3 of year 6 (See graph *).



Graph 7.4 showing number of students by term and year who perceive science as chemistry knowledge based

It is only after transfer, when students leave primary school and start to attend their chosen secondary school that this reverses and an increase, to similar levels, of students' that perceive science as mainly chemical, occurs. One reason for this could simply be due to *reinforcement of the image of science marketed at the Open Event.* Students that had perceived science to be mainly chemical after seeing the objects associated with science at the Open Event may in turn have this perception reinforced as soon as they see these objects again by attending lessons at secondary school within a laboratory. This is somewhat supported with anecdotal evidence that suggests that common practise across secondary schools is to focus, at the start of year 7, on scientific equipment and science safety which is often associated with the strand of chemistry. Unfortunately, this image of science as chemically based does not seem to last with the sharpest decline of individuals perceiving science as chemical dropping by the start of term 2. When exploring this phenomenon further, using interviews of students from the sampled cohort, it soon became apparent that the issue students' where struggling with was the image of science as a practical based subject against the reality of science lessons consisting of other components, such as book work, which was more frequent than expected. For example, in school B on interview one male student in year 7 term 2 had this conversation:

Y7.2IMB2: We just……I guess we just never do practical's.

Researcher: Never?

Y7.2IMB2: Well…we did at the start of the year but…..we've not done it for ages. And now when it is a practical its like….a video or a demo that the teacher does and we can't do.

Researcher: What did you think science would be like?

Y7.2IMB2: Better! More practical's. Like we never really do chemistry anymore either or if we do we just do book work.

Researcher: do you like chemistry?

Y7.2IMB2: When we do practical's yeah……but like I said we've not done it for ages.

And again, in school D a female student interviewed in year 7 term 2:

Y7.2IFD1: Science is good…….i just want to do more practical stuff though

Reseracher: Oh? What do you mean?

Y7.2IMB2: Like we did loads of practicals when we arrived in September but we've not done any for ages………well we did one last week but that was just a observation thing so it wasn't really a practical.

Researcher: Observation thing?

Y7.2IMB2: We had to watch if different items sank or floated…..it was boring.

Researcher: What would you consider a good practical?

Y7.2IMB2: Using Bunsens! We've not used them for ages. We've just been learning about like atoms…..

Researcher: Is that not science?

Y7.2IMB2: Well yeah it is……but its not the good science……doing practical's and mixing chemicals and stuff.

It is interesting to note that of those students' that identified themselves as believing science was about chemistry, the use of practical's to teach chemistry was strongly interlinked. That is that even doing a chemistry theory lesson was still disenchanting to those students that perceived science as chemically based as they saw science as inherently *practical* as well. This disenchantment between what students' perceived science to be against the reality of science in secondary school could be argued to be one of the key denominators in the decline of numbers in regards to students' perceiving science as chemically based, originating from the Open Event in year 6, which continues from the start of the second term in the first year of secondary school and continues until the end of that year. It is not until year 8 that this decline begins to stabilise with surprising similarities between the numbers of students who perceived science as chemically knowledge based in year 5 before students actually attended the Open Event.

7.44 Physics

A small proportion of students' in year 5 who had a perception of science as knowledge based catered towards defining science as physical. This is supported by the literature in that it has been observed that Physics is often seen as abstract in nature and therefore difficult for younger students to conceptualise (Dillion and Osbourne 2008). Throughout year 5 and the first half term before the Open Event of year 6 the number of students' that perceive science as mainly physical was observed to be stable. However when students' were asked to define science after attending an Open Event 2 weeks later a significant increase in the number of students that perceive science as physical occurred (see table *). The data collected and the exploratory interviews conducted supports the assertion that students' leave the Open Event with a wider spectrum of knowledge about what science actually is. As such the increase in students that perceive science as physics based seems to be those individuals who either already had an innate interest in physics or who *prefer* the physics strand of science to chemistry, biology or a general concept. This is supported with student interviews. For example, in school A year 6 term 1.8 just after the Open Event one male student stated:

Y61.8IM2A2: We don't really do science anymore

Researcher: Oh? What do you mean?

Y61.8IM2A2: Well we're revising all the time so we don't have time Ms said

Researcher: When did you last do science?

Y61.8IM2A2: erm…….i don't know. Not last week or the week before that. Maybe the next one.

Researcher:3 weeks ago?

Y61.8IM2A2: Yeah maybe

Researcher: What did you do?

Y61.8IM2A2: we made circuits and stuff

Researcher: Did you enjoy it?

Y61.8IM2A2: Yeah it was good playing with the wires and making the bulbs work. I like that sort of science. The rest of the stuff we do isn't really science.

Researcher: like what?

Y61.8IM2A2: Well we were going to do science last week but it never happened as we told Ms it wasn't science so she said if it wasn't science we could do more revision!

Researcher: What do you mean? What happened?

Y61.8IM2A2: Well Ms was planning to do these windmill things and she said it was science making them but me and a couple of others (he names 4 names)…..yeah well we said to Ms that that wasn't science and then she got mad and said that if it wasn't science there was no point doing it so we'd better revise instead.

Researcher: Making windmill's is not science?

Y61.8IM2A2: Not really. I mean I suppose it could have been….but she just wanted us to make a model. That's like…….art or something. I'd rather do proper science.

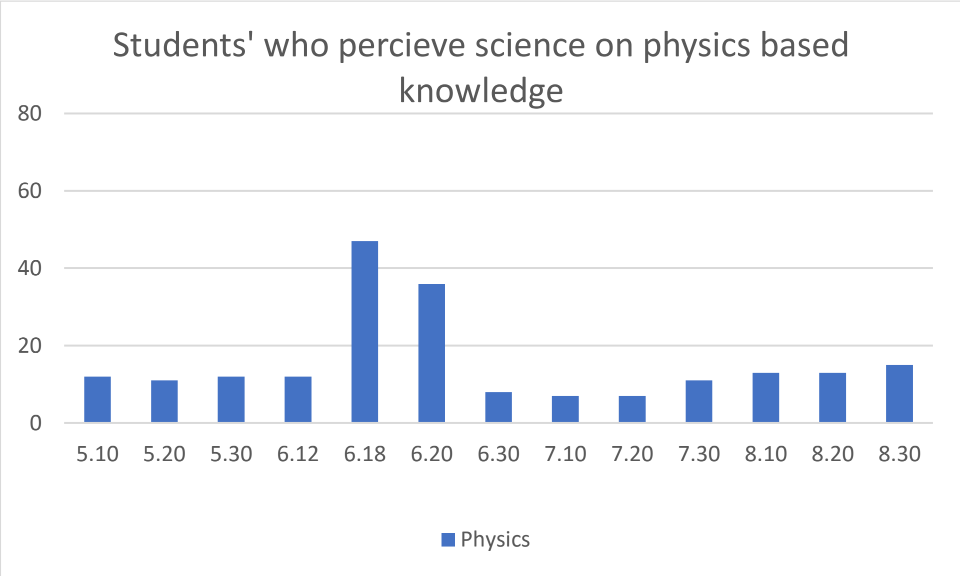
Researcher: Like what?

Y61.8IM2A2: Like the circuits…or the Van der thing……Graft I think it was. That's science.

YearTerm	Physics
5.10	12
5.20	11
5.30	12
6.12	12
6.18	47
6.20	36
6.30	8
7.10	7
7.20	7
7.30	11
8.10	13
8.20	13
8.30	15

Table 7.9 showing number of students who perceived science as knowledge based in physics

This perception that certain designated science lessons in primary school where in fact not science but another subject comes up time and again throughout the transcripts *after* the Open Event but is conspicuous by its absence *before* students attend the Open Event. Similar in regards to what was observed in individuals who had a perception of science as mainly chemical in nature it seems that attending the Open Event gives students', at least those which perceive science from then on as physically based, an image of science which results in students' holding expectations of what *should* happen in science in school. When this does not occur students' seem to rationalise this as having not done *'proper science'* or even science at all resulting in negative feelings towards the subject. This expectation of what science should be in school however seems to dissipate with time, for some students, which is highlighted with a decline in the number of students' that perceive science as mainly chemical in nature by term 2 and term 3 of year 6 (See graph *). Surprisingly however unlike students who perceive science as chemical reinforcement of the image of science marketed at the Open Event by transferring from primary to secondary school does not occur for students that perceive science as mainly physical in nature. In fact by the end of term 3 in year 6 numbers of students' that have an image of science as physical remains stable throughout year 7 and 8 (see graph 7.5).



Graph 7.5 showing number of students by term and year who perceive science as physics knowledge based

Exploring this phenomenon further was unfortunately hampered by the anonymity of the questionnaire limiting the number of students after year 6 term 3 who identified themselves, through interview, as having an perception of science as mainly physical. That said one female student who identified themselves as having a perception of science as physical in year 7 term 3 had this interesting comment to make:

Y7.3IFE: I've always liked physics….space and electricity. Physics is like the fundamentals of science. I wish we did like quantum theory and stuff but Sir said I can't really do that until university.

Researcher: What about other aspects of science?

Y7.3IFE: What about them?

Researcher: Do you like other topics that aren't about physics?

Y7.3IFE: They ARE no topics that don't include physics. I mean even like plants need energy from the sun and that's physics. Its everything!

Researcher: You said you've always been interested in physics?

Y7.3IFE: Yeah.....dad takes me to the space centre in Leicester all the time since I was little. Its GREAT.

This could indicate that those individuals that see science as mainly physical in nature, after the Open Event effects have worn off, may in fact be the individuals that also have an innate interest towards that subject. Much more research however is needed in this area to conform this at this point.

7.45 Combined Science

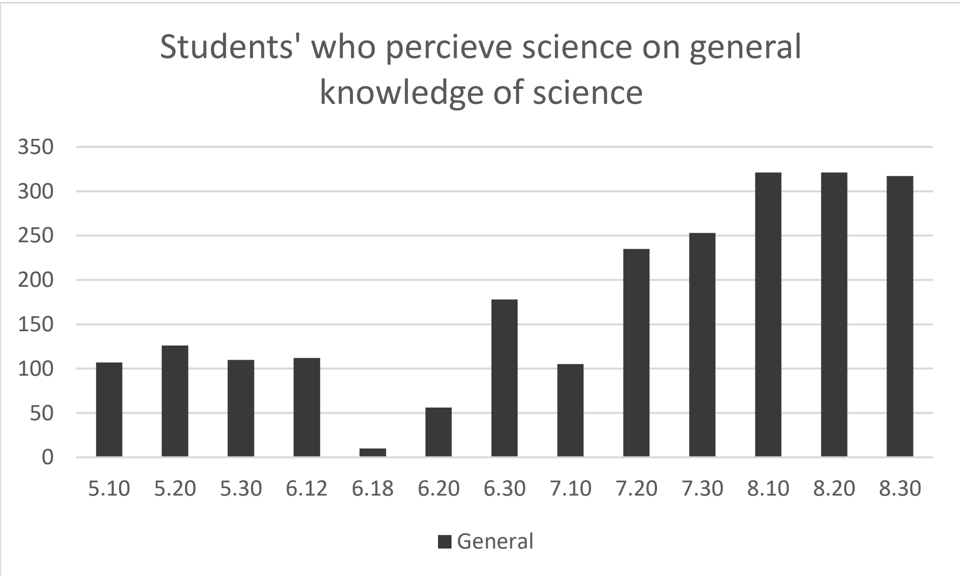
A proportion of students' in year 5 who had a perception of science as knowledge based catered towards defining science as a combined science including all three strands. This in itself is not surprising as the Key Stage 2 science syllabus covers general science knowledge across all three major strands. Throughout year 5 and the first half term before the Open Event of year 6 the number of students' that perceive science as combined was observed to be stable. However when students' were asked to define science topics after attending an Open Event 2 weeks later a significant decrease in the number of students that perceive science as combined occurred (see table *).

YearTerm	General
5.10	107
5.20	126
5.30	110
6.12	112
6.18	10
6.20	56
6.30	178

7.10	**105**
7.20	**235**
7.30	**253**
8.10	**321**
8.20	**321**
8.30	**317**

Table 7.10 showing number of students who perceived science as knowledge based generally

It is interesting to note that the majority of students who identified themselves as seeing science as mainly a combination of the three strands and who were interviewed before attending the Open Event were very firm in their perception that science was about general science topics



Graph 7.6 showing number of students by term and year who perceive science as general knowledge based

After the Open Event however their where more individuals who, when prodded, preferred one strand of science over the other. This seems oxymoronic in that as said previously the Open Event seems to have given students an image of science that covers a broader *spectrum* of topics then known previously and potentially makes them reassess what they think science actually is and as such the expected outcome should be an increase in the number of students' who have a perception of science as combined which does not occur. In fact the exact opposite is true with a sharp decrease observed in student numbers who perceive science as combined. One argument to explain this is the structure of the science department at the Open Event. It has been noted previously that students' often seem to prefer one science strand over another (Sharpe, 2013). As explained within the transition chapter science departments do not set themselves up at an Open Event as one singular subject entity but as 'stalls' representing individual strands of science. The rhetoric observed at the Open Event by individual stalls representing the three main science strands is also highly monodal in that each stall is at heart marketing *itself* and not the subject of *science* per se. This seems to impact on those individuals who have an image of science as combined by making them reassess what science actually is.

Generally the effect of the Open Event, for some, does not last with a slight increase observed in students that perceive science as general by the end of term 2 and an a larger increase observed in term three in year 6. In fact this increase in term 3 is means that the number of students that see science as combined of the three separate strands is higher than before students attended the Open Event suggesting a potential lasting effect in regards to students perceiving strands of science that they may not have been explicitly aware of. Although a dip is observed at the start of year 7, which can be associated with a resurgence of individuals perceiving science to be chemical in nature, an increase in students' perceiving science as combined increase term by term from then on until stabilising by the start of year 8 (see graph). Overall this is not surprising as generally science in school, up until the end of year 9 is taught generally with topics representing all three strands being taught throughout the year. What is of note however is how long it takes for some students' to perceive science as consisting of all three knowledge strands and that, for some, this does not actually occur by the end of year 8.

7.5 Summary

In summary the number of students that are noted to have perceived science in school as either ideas based or knowledge based are not affected by the Open Event or by the transition from primary to secondary school within England. This would suggest that this viewpoint is embedded before the age of 9 in students. He data would suggest however that there may be the potential to move *within* the category of knowledge at least. The majority of students in year 5 seemed to perceive science as biologically based. This sharply decreased after the Year 6 Open Event however with a similar sharp increase observed in the number of individuals who perceived science as chemically based or physics based suggesting that students' perception of science in school had transferred to these strands of science. In regards to biology although there was a slight increase of individuals who perceived science as mainly biological by the next half term a general decline was observed from this point until the end of year 8. In contrast at the same time a gradual increase was observed in students' that perceived science as general. In interviews it was suggested that individuals that perceived science as mainly biological where beginning to perceive science in school as more general across the transition phase as time went on. In regards to physics although there was a sharp increase of students' that perceived science as physics based after the Open Event this seemed only short term with the percentage of students who perceived science in school as physics based returning to a similar level as that observed in year 5 by the end of year 8. Finally a sharp increase in those that perceived science is school as chemically based was observed after the year 6 Open Event. Although this seemed short term for some students' the percentage of students' that perceived science as chemically based was still significantly higher at the end of year 6. What's more the start of year 7 observed a resurgence of the number of students perceiving science in school as chemically based to a similar percentage of students as observed within 2 weeks after the Open Event. This is supported within interviews conducted suggesting a renewal of student interest towards the chemical strand in science in school. This however did not last and a sharp decline is observed in the next half term which continues until the end of year 8.

7.6 Review

The fact that the percentage of students by term is consistent in regards to the number of students that define science as knowledge based and those that define science as ideas based would suggest that students perception of how they see the subject of science in school is embedded as knowledge *or* ideas before the age of 9. That said the Open Event clearly effects students in regards to what *knowledge* strand of science students perceive science to be constituted of. In one way this is helpful.

It has been noted in the literature (Osborne and Dillion, 2006; Dillion, 2007) that students within the primary school years have a perchance to perceive science as mainly biological. This potentially is due to the abstract nature of both Chemistry and Physics (Coffey, 2013) the confidence of their primary school teachers in the teaching of the different strands of science (Demetriou, Goalen, and Ruddock 2000) or the lack of resources (Galton 1989). For whatever the reason the attendance of an Open Event is an opportunity for students' to observe an image of science that is not just biological and showcase strands of science that they may not have been explicitly aware of. The results clearly show that it works in that the percentage of students who perceive science as mainly biological, who recently have attended an Open Event, decreases whilst the percentage of students who perceive science as mainly chemical or physical increases exponentially. Surprisingly the percentage of students who perceive science as mainly general in nature and constituting the three main strands of science also decreases. When explored further this seems to be due to that fact that what students' observe at an Open Event causes them to *prefer* one strand over the others and it is this *preferred* strand that dictates their perception of science in school. The increase in the percentage of students perceiving science as chemically based was in a large part due to students' preference of doing themselves the practical activities on show. Unfortunately, for some, without any further event to support this new perception of science the overall percentage of students for the individual strands of science starts to fall back into its pre-Open Event levels. That said this does not occur for all students' as by term 2 in year 6 the percentage of students for all strands of science are still above (for chemistry and physics) or below (for biology and general) pre-Open Event levels. All of this occurs before students' actually transfer from primary to secondary school which in itself has been noted to be a time for students to reassess their believes and values (Hargreaves and Galton, 2015). The fact that the Open Event seems to destabilise their perception of what is science therefore has the potential to be magnified by this process making the held image of science for some students' changeable until at least the beginning of year 8.

Overall this chapter has argued that attending an Open Event, on the one hand, aids in students' developing a more holistic image of science that does not just constitute the biological strand of knowledge. However, on the other hand, the Open Event does not seem to alter those students that perceive science as ideas based whilst for those that perceive science as knowledge based the Open Event seems to destabilise their perception of what science *is*, which in turn is then exasperated by transferring school. This destabilisation of the image of science seems to start around the same time as the Open Event and stabilise at the start of year 8. To exasperate the problem further students' seem to develop an unrealistic image about the knowledge strands that make up science perceiving the strand of chemistry especially, but also biology and physics as mainly *practical based*. Finally this difference between the held image of science being frequently practical based and the reality of science in school being infrequently practical based causes, for some, a discordance which often is processed by the individual as negative feelings towards science in school.

Chapter 8

Conclusions and implications

8.1 Introduction

The aim of this section is to highlight the key findings discussed in chapters 5, 6 and 7 and evaluate what this means to the wider context with regards to its implications for teachers, future researchers and policy makers. As such this chapter is split into 4 key segments. The first (8.2) summarises the two previous chapters that have addressed the research questions set out in section 3. The second (8.3) gives a retrospective account of the study and evaluates the implications of the decisions and choices made and how this could have affected the outcome. The third (8.4) discusses how the study has contributed to educational knowledge and understanding and makes suggestions on areas in which it may be advantageous to carry out further research. Finally, the fourth segment (8.5) suggests some implications of the findings in regards to research and educational practice for key stakeholders, and proposes some tentative suggestions on Open Events in regards to the subject of science in school.

8.2 Research Findings

In this segment each research question will be revisited so that a reasonably brief answer can be summarised. It is not the aim to repackage and present the key findings in full in regards to each research question as this has been addressed in chapters 5 and 6. Instead the aim is to signpost the key findings of the study so as to make clear the implications this may have for future researchers, teachers and policy makers.

8.2.1 What occurs at an Open Event in relation to science in school?

In general it was found that an Open Event portrayed science in school to both parents and prospective students' alike as a purely practical based subject. The focus of staff was often that of attempting to enthuse and advertise a specific knowledge strand of what makes up science in school. As such the area assigned to the science department at the Open Event was often broken into separate stalls that highlighted biological, physical or chemical components using specific practical experiments to differentiate themselves. These chosen experiments where often picked not to give a true representation of what occurs in a typical science lesson in school but to generate interest in what could be done within science in school. There also was apparent a competitive undercurrent between science staff and what they perceived to be a science department from competing schools as well as competition between biology, chemistry and physics teachers within the same school.. This often led to unrealistic experiments being chosen to represent their subject strand with the aim of outshining their rivals. Although science staff where generally aware of this they often rationalised this behaviour in terms of that if they did not produce an image of their science strand as ‘fun’ then this would put them at a disadvantage in enthusing students about both their subject strand specifically and what the school could offer generally to perspective students. Although science teachers genuinely wanted to excite students about their subject the majority of science teachers agreed that getting ‘bums on seats’ was also a consideration in their planning. When attending the planning meetings within the science departments sampled a focus on giving students a veneer of an image of science seemed to be the main priority. Although a plethora of practical based objects where used as part of the Open Event the fundamental ideas that these objects where supposed to stimulate where often ignored at the event in favour of stimulating enthusiasm and interest in the subject. Although this aspect in itself cannot be deemed as negative, as any interest or enthusiasm generated towards science in school can only be deemed a good thing, there is an inherent risk in this tactic. That is that portraying science as a subject taught primarily by practical experimentation based on knowledge strands, whilst ignoring the underpinning theories and ideas explaining the phenomena under purview, could lead to student misconceptions about what science in school is about. This in turn could affect students’ lifelong perception and attitudes towards the subject of science when their expectations of science in school do not meet the reality of school science lessons. Although this was almost certainly true for some parents more research needs to be conducted in this area the majority of parents understand this. Their also seemed to be very little awareness by the senior leadership teams on the effect this image could potentially have on students’.

8.2.2 Do Open Events effect students’ attitudes towards science in school?

By and large attending an Open Event does effect a students' attitude towards science in school. A decline in students' held attitude towards science in school is clearly observed which has been linked to students' perceiving primary school science as not 'proper science' after attending an Open Event. Although for the majority of students' this attitude towards their primary school science seems to last for only a term it could be argued that for some students' this image of primary school science seems to be longer lasting. As expected, due to primary school science being seen as not 'proper science', when students' transfer to their secondary school where it is assumed by many that 'proper science' is conducted there is an observed increase in students' positive attitude towards science in school. Unfortunately, this increase in positive attitude is not maintained past the first term after transfer with the majority of students showing a sharp decline in their attitude towards science by Christmas. A more gradual decline in held attitude towards science in school continues throughout the rest of year 7 and 8. In contrast students' held attitude towards school in general seems to be not effected by attending an Open Event. Although there is gradual decline of students' held attitude towards school in general starting from the first term of year 6, the final year before transfer, this decline seems to be constant throughout the year. Although an increase in students' held attitude towards school in general is observed at the start of year 7 after transferring from primary to secondary school this increase is less than that measured for students' attitudes towards science in school. Similar to students' attitudes towards science in school, a sharp decline is observed in regard to students' held attitude towards school in general, with a more gradual decline in held attitude towards science in school continuing after Christmas and then throughout the rest of year 7 and year 8. The increase noted at the start of year 7 just after transfer seems to be due to two main reasons. The first reason seems to come under the umbrella term of student's honeymoon period in that the majority of students seem to have an expectation about what they think the future of attending secondary school will be like and are 'trying their best' to do well in this novel situation. This honeymoon period most likely accounts for the increase in students' attitude towards school in general and for some of the increase observed within measures of students' attitude for science in school. The second reason, with regard to science in school, seems to be linked to students' enjoyment of attending science lessons. Students' enjoyment within the afferent measure of attitudes seemed to be the single variable that effected students' overall held attitude towards science in school. This increase in enjoyment at the start of year 7 seemed to be triggered by students finally getting to take part in 'proper' science lessons, an idea developed from attending an Open Event in year 6. For most of the sampled schools 'proper' science lessons seemed to cover lessons on 'science safety' whereby novel scientific equipment was used by students to do tasks such as use a Bunsen burners safely to boil water in glass beakers. Although simple these practical activities seemed to generate interest and enjoyment for most students. Unfortunately, a sharp decline in enjoyment towards science in school and as a result a decline in students' overall attitude towards science in school contrast sharply with a decline in the number of practical activities conducted by the class as more theory led topics are taught.

8.2.3 Do Open Events changes students' perception of what constitutes school science?

Overall the Open Event does change some students' perception of what constitutes science in school. The majority of students' before the Open Event perceive science in school as knowledge based, that is that science is based on topics of science that cover biology, chemistry, physics or general science. In fact, a large percentage of this group perceive science as about biological related topics *only* with few mentioning chemical or physical topics. However, after attending an Open Event a shift seems to occur in that students' seem to perceive science as mainly chemical in nature which lasts for at least a term. With regards to biology although there was a slight increase in the number of students who perceived science as mainly biological by the next half term a general decline was observed from this point until the end of year 8. In contrast at the same time a gradual increase was observed in students' that perceived science as general. In interviews it was found that individuals who perceived science as mainly biological where beginning to perceive science in school as more general across the transition phase as time went on. In regards to physics although there was a sharp increase in the number of students' who perceived science as physics-based after the Open Event this seemed only short term with the percentage of students who perceived science in school as physics-based returning to a similar level as that observed in year 5 by the end of year 8. Finally a sharp increase in those that perceived science is school as chemically based was observed after the year 6 Open Event. Although this seemed short term for some students the percentage of students that perceived science as chemically based was still significantly higher at the end of year 6. What's more the start of year 7 observed a resurgence in the number of students perceiving science in school as chemically-based to a similar percentage of students as observed within 2 weeks after the Open Event. This is supported within interviews suggesting a renewal of student interest towards chemistry. Finally it was noted that the percentage of students that identified science as ideas-based and not knowledge-based, that is that science in school is about the testing hypothesis, did not change throughout all of the sampled students across the transition years. This would suggest that it is highly likely that perceiving science as knowledge based or ideas based is embedded *before* the transition years with the Open Event having very little effect on this.

8.3 An evaluation of the study and its findings

It is often important to evaluate a study retrospectively as this gives the chance to determine to what extent choices and decisions during the study- in this case, the use of a mixed methods, cross-sectional, sample to assess the effect of the Open Event on students' attitudes towards science in school- have affected the findings. As such this sub-section focuses in particular on both internal and external validity, as well as the reliability, of the findings obtained before assessing the effect of external constraints on the type and quantity of data collected.

8.3.1 The internal validity of the findings

The internal validity of mixed methods research findings involving both quantitative and qualitative data relates to the degree to which the reader agrees with the conclusions reached by the researcher on the basis of the data collected. In point of fact a strength of the mixed methods approach to data collection is that of the ability to triangulate results. The fact that the use of a semi-structured questionnaire, the use of semi-structured interviews and focus groups produced similar data with regards to students' attitudes towards science in school provides evidence that it can be reasonable to assume that internal validity was achieved.

The design of the instrument itself went through multiple stage of development and the internal validity was therefore checked at different points throughout its construction. This included pre-piloting and piloting the tool where students actually completed the questionnaires and then validated their answers through focus groups and interviews. Through matching what students answered on the questionnaire against students' verbal responses agreement was reached with regards to what was though the question was asking against what the student meant by their answer.

The Hawthorn effect was also considered with regards to the procedure in handing out the data collection tool. This meant that it was only the researcher that handed out the questionnaire and collected in back in. Students were informed before commencing the questionnaire that their responses would be anonymous. It was made clear that this meant that even their own teachers would not know who answered which questionnaire in any particular way. They were also clearly informed that they should try and answer the questionnaire to demonstrate their thoughts on the topic or choose an option that they *most* agreed with. Students were also specifically asked not to copy their peers in anyway or look at the particular way that they were answering. To aid in the monitoring of this the class teacher was also always present in the room.

Instrumentation threats in regard to the internal validity of the study were also considered and controlled by making sure that the researcher conducted all focus groups and interviews. The risk of course of this is that the researcher could indicate, by accident or design demand, characteristics that could lead student responses. As a mechanism to protect this from occurring all interviews and focus groups where recorded and a random sample was selected and re-evaluated by the researcher's peers at the ESERA summer school with a specific focus on noting any leading remarks. Agreement was reached by this peer group that this had not occurred.

It should also be noted that the research tool attempted to measure affective and cognitive components only of attitude. The aim was for the questionnaire to provide a foundation so that findings could be further explored and extrapolated within interviews and focus groups. It was hoped that this constructed and systematic procedure would reveal phenomena on the trends, and the reasons why these trends occur, of the effect of attending an Open Event on students' attitudes towards science in school across the transfer from primary to secondary education.

One weakness that needs mentioning in regards to the internal validity of the study is the number of students' that identified themselves during focus groups and interviews as having a perception of science as mainly physical. Although the questionnaire revealed that some students had developed this perception because of the low percentage of these individuals very few students who had this perception where actually interviewed or identified themselves during focus groups. Although what interviews and focus groups conducted on individuals who perceived science in school as mainly physical where in agreement with each other which is favourable it must be noted that caution must be exercised in findings in relation to the reasons why this group of students' perceive science in school in this manner and especially in regarding applying this externally to a larger body of students as a whole.

Overall, it must be noted that one of the underlying justifications for applying a mixed methods approach for collecting data to answer the research questions was the ease of then using triangulation to compare data collected. It then could be reasonably argued that data collected in three different formats, (questionnaire, focus group and interviews) that seem to support each other would therefore indicate that internal validity had been achieved.

8.3.2 The external validity of the findings

External validity at its core is the idea that the findings of a study can be generalizable to a group, case or wider population. From a strongly quantitative tradition this can also include the idea of 'replicability' and the notion that the results should be reproducible by the groups that generalisations are intended to encompass. In contrast qualitative researchers within education focus more on ideas of "naturalistic coverage" (Ball, 1984, p. 75) or naturalistic generalizations (Stake, 1978) with the aim of collecting findings from a representative sample that is not too dissimilar from the wider group that it is drawn from so that it can be reasonable to assume that the results gained can be broadly applied to the whole population. Within this study a cross-sectional sample was used to gather data as it was reasonably thought that a student in a specific year group from one 'typical' school would be not too dissimilar to a student in the same year at a different 'typical' school. As the results gained from a 'typical' school in one county have no significant difference from a 'typical' school in another county it is reasonable to accept that the sample was not too dissimilar from each other. To clarify, a 'typical' school was thought to be those that had a 'comprehensive cohort' of students which the majority of students in England attend. Although this means that the sample is not representative of students that attend grammar or independent schools, which cater for between 2-15% of the student population, dependent on the specific local education authority, it was thought that the sample chosen was representative enough to the wider population to enable the findings to be generalizable.

8.3.3 The reliability of the findings

At this juncture it is important to clarify what is meant by the term 'reliable' or the 'reliability' of a given piece of research. Bell (1987) defined reliability as "the extent to which a test or procedure produces similar results". In the context of qualitative educational research this can also be expanded so that a reliable measure is one that 'provides consistent and stable indications of the characteristics being investigated' (Anderson *et al*. 1975). What is consistent with the majority of definitions on reliability is ideas of 'stability' of the data (Carlson, 2009) and that a reliable measure is one that produces similar results in similar circumstances. One of the areas of difficulty in establishing the reliability on findings that attempt to measure an attitude held by a person is the challenge that a person's attitude towards an object has components that can only be inferred by indirect observation. Understanding this it was thought best to employ a mixed methods approach that would enable the findings from the focus groups, interviews and the questionnaire to be triangulated and increase what Johnson and Christensen (2012) termed the "credibility and trustworthiness" of the data collected. It was thought that if the data collected from three different methods provided consistently similar findings then this would indicate stable characteristics and in turn indicate the reliability of the findings. Data collected from 'typical' schools' in one county in comparison to other 'typical schools' in a different county showed no statistically significant differences between findings. It would therefore be reasonable to assume that data collected using the mixed methods approach from the sampled schools, would in terms of reliability, likely to be similar if collected from other similar schools not within the sample.

Given this consistency of data obtained within the study the suggestion would therefore be that the findings provide a reliable measure of the effect of the Open Event on students' attitudes towards science in school across the transition from primary to secondary school.

8.3.4 External constrains on the design of the study

The design of the study was carefully chosen due to the external constraints of the transition event under scrutiny. The Open Event only occurs for a 'typical school' once every year often before school placement choices are made by parents and their children. As the majority of counties have the deadline for their school transition choices around the same time this meant that the majority of the Open Events were placed on by schools around the same time which impacted on the number of participant schools that it was feasible to get to within the timeframe available. Another external constraint was that of the number of primary 'feeder schools' obtained for the study. This was dictated in part by the contacts that the secondary schools' had with them. This meant that some secondary schools had four or five feeder primary schools attached to them which became part of the study whilst other secondary institutions only had access to one or two feeder schools. Finally, although transition years 5, 7 and 8 did not have an exam focus and as such schools were keen for these years to be used in focus groups and interviews the year 6 cohort was an examinable year for the primary feeder schools. It is understandable that Year 6 teachers and the associative school were more cautious about agreeing to any request that might possibly impact in a negative way on this cohort's examination results. Although the questionnaire was designed so that it would not require much time for completing the numbers of students able to be involved in interviews and focus groups was more problematic and, as such, this meant that it was not possible to interview as large a sample of individuals in all year 6 groups in term 3 (The examinable term) in comparison to other year groups.

8.3.5 Changes to the study design

A change to the initial design of the study became necessary when pilot testing was conducted with a sample of secondary institutions and their associated feeder primary schools. Although the science in school attitude measure was deemed simple, clear and not time consuming for students to complete, it soon became apparent that a section needed to be included that ranked the subject of science in school in comparison to their other subjects. As a held attitude has affective cognitive and behavioural components it was thought that the inclusion of a ranking system for schools subjects would further substantiate changes in their attitudes towards science in school- that is that if students' attitudes towards science in school and not just school in general changed then this would be seen in changes to the ranking of the science subject in comparison to others.

Whilst the questionnaire was suitable for measuring students' attitudes to school science lessons, the benefit of interviewing students and conducting focus groups was informative and provided richer data. It may be beneficial in the future to replicate the study and conduct more interviews and focus groups so that a higher percentage of students are covered. This is especially true in the case of the year 6 cohort in the third term. Although external constraints limited the number of schools within the study that this individual researcher could visit it may also be worthwhile to collaborate with fellow researchers and collect data from a larger sample of schools, including not just 'typical' schools but also atypical schools such as independent and grammar schools.

Finally, the focus of this study was of the effect that Open Events had on students' attitudes towards science lessons in school across the transition from primary to secondary school. It looked specifically at changes in attitudes towards science in school based over time by term from Year 5 to Year 8. It did not however differentiate between genders or other variables such as socioeconomic status of the students' family and it may be interesting to conduct further research into the impact of Open Events in regards to these other variables.

8.4 Contribution of the findings to knowledge and understanding

Having discussed the studies findings in terms of its validity and reliability it makes sense to place this now in the context of itys contribution to our knowledge and understanding in this area.
Whilst some of the results are not in themselves unexpected - the decline in students' attitudes towards science in school across the transfer has already been examined (Osbourne and Dillon, 2014)

- this study has, through the use of triangulation, enabled the collection and analysis of data that has provided a considerable amount of constructive evidence that might have only been otherwise circumstantial.

The starting point of this thesis was a statement made by Abrahams (2007) in which it was claimed that science teachers ‘are their own worst enemies He in that whilst other departments used Open Events to showcase students’ work the science department used it to inculcate an image of science as being primarily a fun, exciting and enjoyable practical activity” (p.2). It is the confirmation of what the science department does with regards to the Open Event and the impact that this has on students across the transition period that has been the focus of this work.

Although the importance of students having a ‘good transition’ and the dangers of students’ having a ‘bad transition’ in the transfer of schooling are well known within England (Galton, 2002) there has been a lack of research on the effect that specific events have on students within that transition period. As such this thesis contributes in part to providing some insight into what is actually occurring at one such event, the Open Event, in regards to the subject of science. It seems that the Open Event does develop an image of science in school as primarily a practical based subject by portraying, at best, a veneer of science as one about the study of scientific objects and practical skill acquisition, and at worst, that science in school is all about making whiz, bang and pops. The inherent danger is that the Open Event does not seem to explicitly portray that science in school also covers more everyday methods of educating students within the subject of science such as book work and the study of scientific ideas that underpin the foundation of the subject of science. Secondly this thesis has contributed to our knowledge and understanding on the effect the Open Event has on students’ attitudes towards the subject of science in school across the transition period. It supports the current literature that indicates that this decline in attitude towards science in school begins as early as the last year in primary school but also reveals that this decline seems to be catalysed around the time students have returned from attending an Open Event at a secondary school. Thirdly this thesis has contributed to our knowledge and understanding on the effect the Open Event has on students’ perception of what constitutes science in school. It seems that the majority of students' have an image of science in school that is knowledge based (Biology/Chemistry/Physics/General) which a large proportion perceiving science as mainly biological. Attending an Open Event seems to cause this perception to alter for some students with students' perceiving science as mainly biological declining and students' perceiving science as chemical and physical increasing. This seems to last for at least a term. Finally this thesis has contributed to our knowledge and understanding in regards to the honeymoon period observed at the start of year 7 after transfer has taken place and the resulting 'crash' in attitude towards science in school observed within a term after this. The results suggest that attending an Open Event, and gaining an unrealistic *practical* image of science, results in students perceiving primary school science lessons as not 'proper science' with the knock on effect that students' generate expectations of secondary school science as being both 'proper' and more practical. Although students at the start of year 7 largely take part in practical science due to teachers focusing on science practical safety, by the end of this first half term, focus of teachers shifts to other non-practical topics. This discordance between students' expectations of science in school being mainly practical against the reality of science in school covering a mixture of practical and none-practical components seems to be the key denominator for some students in not thinking science in school is 'fun' anymore. This then results in the drop in attitude towards science in school observed within the literature.

8.5 Implications for practise

'Stop trying to sell with marketing- instead use marketing to help customers'

Anon taken from The Book of Irish Poetry by Anon (2014)

What Anon (2014) is referring to here is that marketing, especially within education, should be used to *inform.* Anecdotal evidence would suggest that the advent of the school Open Event was set up so that parents could be informed about what their school was doing within the community and that parents could have the opportunity to inform the school what expectations they had about the institution they were going to send their child too. In contrast this study has found that the Open Event has remained, as Abrahams (2007) suggested a decade ago, little more than a marketing tool to showcase an educational establishment in the best possible light in order maintain, and ideally increase, student numbers. This thesis has specifically looked, in regards to the science department, on the impact of the Open Event on students' attitudes towards science in school across the transfer from primary to secondary education. The main implications in regarding the practice of using Open Events to aid in the process of transition that have arisen from this thesis will now be discussed within this next section.

8.5.1 Implications for science teachers

For science teachers the main implications of this study seem to indicate that focus needs to shift from planning an Open Event that cultivates an image of science as mainly practical to one that is more realistic to the everyday running of science in school. That is not to say that the practical aspect of science in school should be ignored but more that any practical on show should be chosen as part of a whole showcasing other aspects of science in school that are just as, if not more important. That said this thesis would suggest that any plan for what occurs in relation to science at the Open Event should include:

1) Portraying science as about both knowledge strands (Biology/Chemistry/Physics) and ideas (Hypothesis/Predictions/Reliability)
2) Students' class work representing what commonly occurs in lesson time
3) A well planned practical component that showcases objects of science as well as stimulating the ideas that underpin this.

Especially at Key Stage 3, which covers the first two to three years of secondary school, science is often not taught as separate knowledge strands which is how it is represented at the Open Event. A more holistic plan may be more warranted in that the science department at the Open Event showcases their subject as a whole instead of by the use of piecemeal practical activities. Focus on just one well planned practical activity which is designed to showcase not just science objects but the ideas that arise from this may be better warranted which in turn is supported by other aspects of science. A good example could be a showcase of students work testing hypothesis and drawing associated graphs and tables with data collected with a demo of that practical set up. This could then be linked to the appropriate scientific theory. Although this would not have as much ‘wow’ factor as what is currently done it would be more realistic to what actually occurs during science lesson time.

8.5.2 Implications for parents and pupils

One of the fundamental changes that occurred in 2010 by the then current education secretary Michael Gove was his attempt at giving ‘power to the parents’ (Uitto, 2014). That is that he believed that if an educational establishment was not doing a good enough job in the eyes of the parent then they should be easily be able to then move to a competing educational establishment which potentially would give their child a ‘better deal’. For parents and their children the Open Event is a chance to ask pointed and focused questions to see what the educational establishment is willing to provide in relation to both academic and pastoral pursuits. If a school oversells however the parent has every right to then move their child to a different and competing institution.

8.5.3 Implications for policy makers

For policy makers the main implications would suggest that schools may benefit from Open Events having suggested guidelines. This thesis would indicate that there is an inherent risk, at least for the science department, in the Open Event having both short and a long-term impact in regards to students’ held attitudes towards science in school. Having guidelines that suggest what should or should not be included in an Open Event may be useful for both parents, students, schools and county councils alike. Currently the only literature that seems to exist on Open Events seems to be in regards to councils advertising to parents that they should visit them. However there is lack of clear guidance on what is expected to occur at them. One way to monitor if this is occurring could simply be employing ex teachers or educationalists to attend school Open Events and monitor what occurs. Similar to a mystery shopper role schools could them be randomly sampled and feedback given. This of course presupposes a set of guidelines that their Open Day can be compared too.

8.5.4 Implications for future researchers

For future researchers this thesis does its best to explain the impact of the Open Event on students' attitudes towards science in school across the transfer from primary to secondary education. It would therefore be interesting to see if this phenomenon also similarly effects other practical based subjects such as Design Technology or Music and indeed if it effects at all subjects such as English and Humanities that can be considered to be non-practical. There is also scope for future researchers to investigate if the Open Event effects groups of students' with more or less severity. These include gender influences, racial heritage, students with special educational needs and students who have been identified as being Gifted and Talented. This thesis also suggests that any future research within the area of transferring students between schools should be careful in making sure that they understand what students are talking about when they say 'science; and also what the students' are responding too in regards to their primary school science lessons or their perceived secondary school science lessons.

8.6 Final thoughts

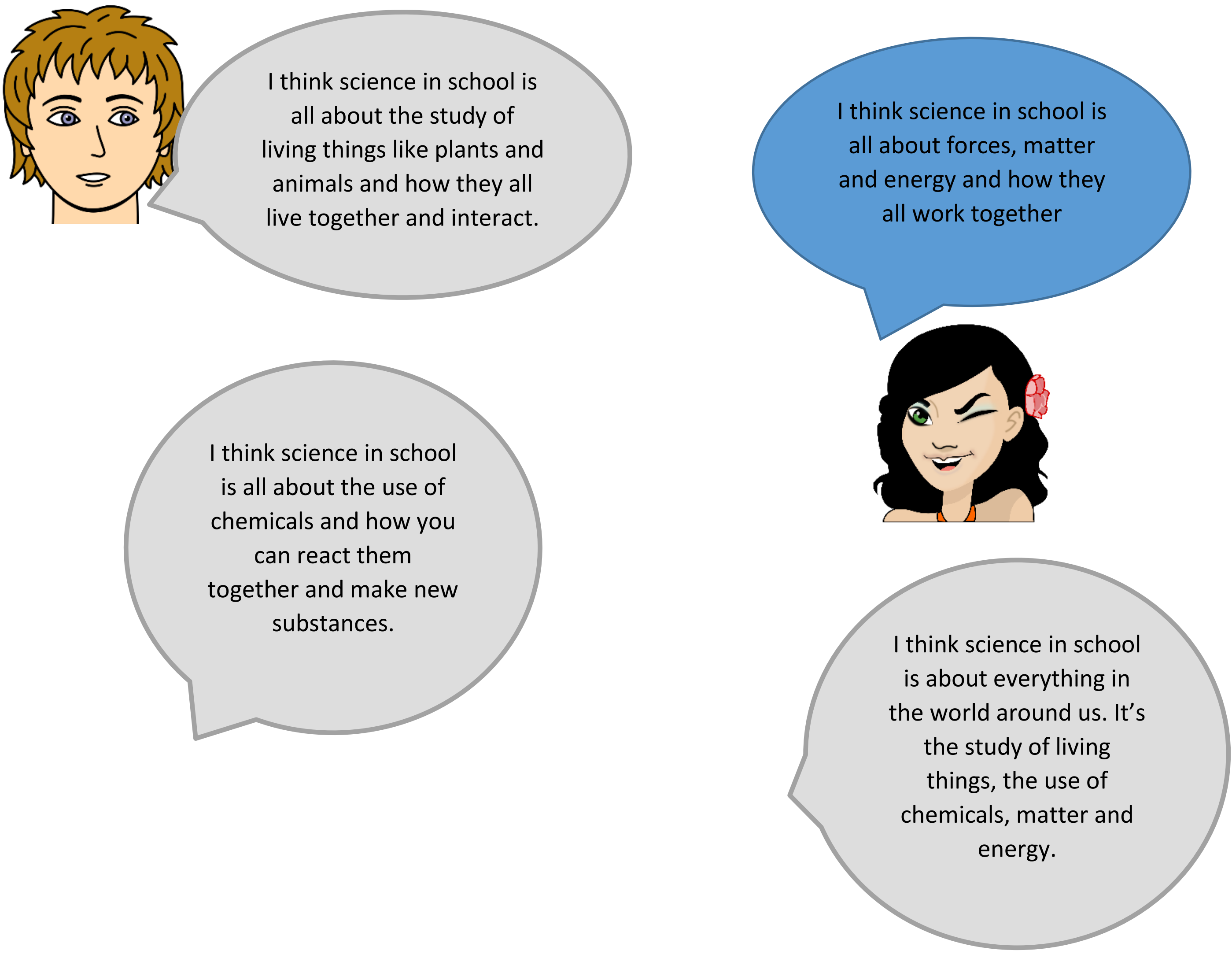
The Open Event placed on by secondary schools brings together and seems to directly cater for the duel aim of shared teacher-parent responsibility and educational choice. This 'one off event' is during the time of transition when students reach the age to transfer from a primary stage of learning to the more advanced secondary stage of education. It provides one of the few opportunities for clear communication between what the parents want and expect for their child in regards to their secondary education whilst at the same time providing the platform for the secondary institution to define what their school can offer. Unfortunately, the subject of science, in trying to market itself and generate student interest, inadvertently develops a misconstrued image of science in school that can adversely affect not only students attitudes towards science in primary school which is now viewed as not 'proper science', but also change some students' perception of what science is constituted of, which has a negative impact on their held attitude towards science in school when students transfer. If science teachers are keen to generate lifelong interest in their students towards their subject it may be advisable to represent science at secondary school by using an intelligent, thoughtful and well-informed presentation that showcases science in school. Not only would this be more realistic but it may, in the long run, be more beneficial to generating a lifelong positive attitude towards the subject of science.

Appendices

Appendix 1: Pilot study questionnaire

Section 1:

4 individuals are having an argument about what science in school is all about. Circle the person who matches yours opinion the closest. If you have a different opinion than please write this down in the box provided.



My opinion differs from the 4 people above. I think science in school is about____
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Section 2: Please indicate your level of agreement with each of the following items (circle the appropriate number).

	Item	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
1.	Science lessons are fun.	1	2	3	4	5
2.	I do not like science lessons and it bothers me to have to study it.	1	2	3	4	5
3.	During science class in school, I usually am interested.	1	2	3	4	5
4.	I would not like to learn more about science	1	2	3	4	5
5.	If I knew I would never go to science class again, I would feel sad.	1	2	3	4	5
6.	Science lessons are not stimulating to me and I do not enjoy them.	1	2	3	4	5
7.	Science lessons are fascinating.	1	2	3	4	5
8.	The feeling I have towards science class is a good feeling.	1	2	3	4	5
9.	When I hear the word science at school, I have a feeling of dislike	1	2	3	4	5
10.	Science is a topic I enjoy studying	1	2	3	4	5
11.	Science in school is not fun	1	2	3	4	5

12.	I feel at ease with going to science lessons and I like it very much.	1	2	3	4	5

Appendix 2: Primary school questionnaire tool

Student questionnaire

DATE:________

School name:____________________________

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Instructions

These questions are looking at your opinions. Answer as honestly as possible. In section 1 you are expected to write a sentence or more on an open ended question. In section 2 you are expected to rate a statement on a scale of 1-5 by circling your chosen answer. If at any time you do not understand a task please put your hand up. Before your time starts the researcher will take the time to explain what is expected. Please listen carefully. You have the right to withdraw at any time.

Section 1:

4 individuals are having an argument about what science in school is all about. What is your opinion to the question: What is science in school all about?

I think science in school is about:

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Section 2: Please indicate your level of agreement with each of the following items (circle the appropriate number).

	Item	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
1.	Science lessons are fun.	1	2	3	4	5

2.	I do not like science lessons and it bothers me to have to study it.	1	2	3	4	5
3.	During science class in primary school, I usually am interested.	1	2	3	4	5
4.	I would not like to learn more about science	1	2	3	4	5
5.	If I knew I would never go to science class again, I would feel sad.	1	2	3	4	5
6.	Science lessons are not stimulating to me and I do not enjoy them.	1	2	3	4	5
7.	Science lessons are fascinating.	1	2	3	4	5
8.	The feeling I have towards science class is a good feeling.	1	2	3	4	5
9.	When I hear the word science at school, I have a feeling of dislike	1	2	3	4	5
10.	Science is a topic I enjoy studying	1	2	3	4	5
11.	Science in school is not fun	1	2	3	4	5
12.	I feel at ease with going to science lessons and I like it very much.	1	2	3	4	5

Appendix 3: Secondary school questionnaire

Student questionnaire

DATE:________

School name:____________________________

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Instructions

These questions are looking at your opinions. Answer as honestly as possible. In section 1 you are expected to write a sentence or more on an open ended question. In section 2 you are expected to rate a statement on a scale of 1-5 by circling your chosen answer. If at any time you do not understand a task please put your hand up. Before your time starts the researcher will take the time to explain what is expected. Please listen carefully. You have the right to withdraw at any time.

Section 1:

4 individuals are having an argument about what science in school is all about. What is your opinion to the question: What is science in school all about?

I think science in school is about:

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Section 2: Please indicate your level of agreement with each of the following items (circle the appropriate number).

	Item	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
1.	Science lessons are fun.	1	2	3	4	5
2.	I do not like science lessons and it bothers me to have to study it.	1	2	3	4	5
3.	During science class in secondary school, I usually am interested.	1	2	3	4	5
4.	I would not like to learn more about science	1	2	3	4	5
5.	If I knew I would never go to science class again, I would feel sad.	1	2	3	4	5
6.	Science lessons are not stimulating to me and I do not enjoy them.	1	2	3	4	5
7.	Science lessons are fascinating.	1	2	3	4	5
8.	The feeling I have towards science class is a good feeling.	1	2	3	4	5
9.	When I hear the word science at school, I have a feeling of dislike	1	2	3	4	5
10.	Science is a topic I enjoy studying	1	2	3	4	5
11.	Science in school is not fun	1	2	3	4	5
12.	I feel at ease with going to science lessons and I like it very much.	1	2	3	4	5

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