An investigation of pupils and teachers at the point of transition from primary to post primary school:

Issues in the teaching and learning of science.

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Declaration

I declare that this dissertation – '**An investigation of pupils and teachers at the point of transition from primary to post primary school: Issues in the teaching and learning of science'** is my own work. All quotations from other sources are duly referenced and acknowledged.

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Abstract

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This research was undertaken to investigate the issues arising among pupils and teachers in the transition from primary to post-primary science education. The study involved an investigation of pupils' attitudes to and experiences of learning science before and after transition to post-primary school. The study was also concerned with an enquiry into primary and post-primary teachers' attitudes to the teaching of science across the transition.

A multi-method approach was adopted wherein pupil and teacher questionnaires and pupil interviews formed the construct of this research. The research was conducted over a one-year period, between June 2010 and May 2011, with a group of twenty three pupils and their respective teachers. Data was collected from the twenty three pupils first in their sixth class of primary school and subsequently at the end of their first year post-primary school. Thus, the collection and analysis of data from the pupils' perspective was grounded in these two strands of investigation. Results from both pupils and teachers produced data based on the attitudes to and experiences of science in the transition from primary to post-primary school.

The evidence from the data indicated that primary pupils hold extremely high expectations of post-primary science and these expectations are often not realised following transition. Pupils at both levels are generally enthusiastic about science education but interest and pupil enjoyment in certain aspects of learning science can decrease following transition to post-primary school. Findings also indicate that pupils experience discontinuity in science curricula and in learning experiences of science across the transition. A crucial sub-theme that pervaded the data was that, by not having a science degree, primary teachers unsurprisingly feel significantly less confident in their teaching of science than their post-primary counterparts. This can lead to issues for pupil learning in particular areas of science prior to and upon transition to post-primary school. Inconsistencies however did emerge where despite high levels of confidence by post-primary teachers, the number of pupils at post-primary level who are stated as enjoying science, who look forward to studying science and who stated that science is their favourite subject decreased. Data also showed there to be no significant communication between junior cycle post-primary teachers and their primary teacher counterparts regarding pupils' previous experiences of learning science.

In essence, the findings of this research reinforce the view that there are numerous issues and concerns arising among pupils and teachers within the transition from primary to post-primary science. These issues, in turn, may lead to a lack of interest and engagement in a continued study of science by pupils once at post-primary school.

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Abbreviations

DES Department of Education and Science/Skills

DETT Department of Enterprise Trade and Employment

JCSS Junior Cycle Science Syllabus

NCCA National Council for Curriculum and Assessment

PISA Programme for International Student Assessment

SSTI The Strategy Science and Technology Innovation

TLRP Teaching and Learning Research Programme

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Chapter 1

Introduction

1.0 Introduction

The provision of science education has changed in Ireland in the past decade. The introduction of the Primary School Curriculum in 1999 and a revised Junior Cycle Science Syllabus (JCSS) in 2006 have radically altered what science and how science is taught in both primary and post-primary schools. Primary science is taught to each class in primary school and the curriculum refers to each of the three science disciplines, while the primary emphasis on investigation is carried through to the revised Junior Cycle programme. However, many authors have recognised a failure to establish a real continuum between primary and post-primary schooling and how this is having an impact on the success or otherwise of students' successful transition (Zeedyk *et al*., 2003; Tilleczek and Ferguson, 2007). Whatever their career intentions, it has become apparent that decreasing numbers of young people continue to study science at school once it ceases to become compulsory, in turn leading to fewer applications for science degrees and thus reducing the supply of science graduates (Gilbert, 2006). It is therefore appropriate to examine if the transition between primary and post-primary school encourages not just the continuity but developmental learning between primary and post-primary science curricula.

In a report based in the United Kingdom, Murphy and Beggs (2005) stated that if the current problem of declining interest in school science is not urgently addressed, it will lead to a reduced number of scientists and science teachers in the future. The Irish government has also recognised the need to change how science is being taught in Irish primary and post-primary schools in response to the declining numbers taking up science at both secondary and tertiary levels (Department of Enterprise Trade and Employment (DETT), 2009). Science is seen as an essential part of the knowledge economy and is considered by many to be one of the ways of getting Ireland out of the economic crisis it now finds itself in (DETT, 2009).

1.1 Background and Rationale

Spurred on by rapid technological change, 'scientific literacy' has been recognized as central to science educational programmes (DES, 2002). Scientific literacy is the knowledge of certain important scientific facts, concepts and theories, the exercise of scientific habits of mind and understanding of nature of science, its connection to maths and its impact on individual and its role in society (OECD, 2003e). According to the Programme for International Student Assessment (PISA) Assessment Framework (OECD, 2003e), education

for universal scientific literacy will, in addition to enriching everyone's lives, create a larger and more diverse pool of students who are able to pursue further education in scientific fields and are motivated to do so. The Primary School Science Curriculum (1999a) aims specifically to help the child to appreciate the contribution of science and technology to the social, economic and cultural dimensions of society. The revised Junior Cycle Science Syllabus (2006a) developed this further by enabling students to acquire an understanding of the relevance and applications of science in their personal and social lives.

However in a PISA evaluation of science literacy, Irish students were found to rank 20th out of 57 in performance of scientific literacy (Eivers, Shiel & Cunningham, 2008). While this may show students in this country to be performing in the top 50%, it must be noted that students in 19 other countries have a better understanding and knowledge of scientific literacy compared to Irish students. On the same theme of scientific literacy, Varley *et al.* (2008a) also noted that surprisingly few primary pupils made reference to the utility of science as a subject.

There have been further international studies (Jarman, 1984; Speering, 1995; Tobell, 2003) which have shown that an incoherent transition to post-primary education in science is detrimental to student interest and uptake of the subject at later stages of education. With these issues of scientific literacy and engagement in life-long study of science well documented, it is pertinent to establish whether the transition from primary to post-primary school impacts pupils' attitudes and performance in each (Eivers, Shiel & Cunningham, 2008).

The new Primary School Curriculum (DES, 1999a) heralded a change to the content and approaches taken in primary science teaching. Prior to 1999 science was addressed as part of the environmental studies curriculum and aspects of the physical sciences were taught only from 4th to 6th classes. A study conducted by the INTO in 1971 indicated that only 31% of teachers questioned involved their pupils in conducting scientific experiments in science class (Varley *et al,* 2008a). The National Council for Curriculum and Assessment (NCCA) consider the new 1999 Primary School Science Curriculum as the initial stage of pupils' science education (Varley *et al,* 2008a). In keeping with the constructivist philosophy of the 1999 Primary School Curriculum, the science curriculum presents science as both content to be acquired and a way of acquiring that knowledge (DES, 1999a). In 2006, the revised Junior Cycle Science Syllabus was devised with the shortfalls of its predecessors in mind. In

the previous curriculum models there was a complete under-emphasis of the Chemistry and Physics aspect of Junior Cycle Science and over-emphasis on content rather than exploratory practices. It was hoped that the revised syllabus would further link scientific facts and processes to everyday life and consequently, allow teachers to build on students' earlier experience at primary school (DES 2006a).

Studies have shown how pupils' expectations at entering the post-primary science classroom are not being met (Speering, 1995). Student's perceptions of post-primary science are often not what they expected and this experience may have long term implications for their future subject and career choices in the field of science. There is also evidence to suggest post-primary teachers underestimate the abilities and capabilities of entering pupils. Research already indicates a lack of knowledge of the Primary Science Curriculum by post-primary teachers. Varley *et al.* (2008b) have reported that less than 6% of junior cycle post-primary teachers stated they were very familiar with the Primary School Science Syllabus. Parkinson (1999) has reported that lack of curricular linkage and integration between most primary and post-primary science teachers contributes directly to underachievement by a substantial minority of pupils. It would appear that teachers at both levels are unaware of the emphasis the NCCA has put on coherence between the two science curricula.

Estyn (2003) has reported that in around two thirds of English primary and post-primary schools, planning to promote continuity from Key Stage 2 to Key Stage 3 (primary to post-primary), is largely under developed. The level of communication in relation to academic matters at the time of transfer would appear to be of concern. There is currently no Irish educational policy on sharing information between schools and only a minority of secondary principals receive information from primary schools on transfer (Varley *et al.*, 2008b). While the current NCCA (2007) 'Assessment in the Primary School Curriculum' document advocates sharing pupil attainment and assessments with parents, other teachers in-school, the children themselves, as well as outside agencies working with particular schools, however, it is not suggested in the document to pass information from primary to post-primary schools to assist in smoothing transition.

Murphy and Beggs (2005) have indicated that many children are 'turned off' science at school when they are quite young. More specifically, erosion in interest towards science education occurs predominantly between the ages of nine to fourteen years (Hadden &

Johnstone, 1983). Campbell (2001) argues that commitment and enthusiasm for science built up in primary school decreases on transfer to secondary school. In essence, it is the transition that occurs between primary and post-primary school science that is one of the deciding factors in the declining interest in science (Murphy & Beggs, 2005). This research examines this phenomenon in an Irish context. It is appropriate to review if the transition between primary and post-primary school in Ireland scaffolds and supports the aspirations of improving scientific literacy and accessibility for the future, or if the transition impedes this in any way.

Furthermore, it is the personal motivation of this researcher to gain valuable knowledge and insight into pupils' experiences of learning science, particularly in the final years of primary school. As a primary teacher, it is interesting to view science education from the perspective of the pupil prior to transfer to post-primary school and how issues in the science classroom may affect or distort their attitude to a continued study of science. It is also of significance to this researcher to gain knowledge from teaching colleagues on the issues and concerns arising in their teaching of science.

1.2 Aims of Research

The study is guided by the following research questions:

1. How does the transition from primary to post-primary school affect pupils' attitudes to science and interest in science?
2. What are the issues in the transition from primary to post-primary science which are of concern to teachers in Ireland?

A number of embedded questions further guide this research:

a. What are pupils' attitudes and expectations of teaching and learning in science concerning the transition from primary to post-primary schooling?

b. What science topics and scientific skills do pupils study at primary and post-primary level and what continuity do they experience upon transition?

c. What are the general attitudes of primary and post-primary teachers' to the teaching and learning of science?

d. What knowledge do teachers possess of the science curricula on either side of the transition?

e. Have the new curricula in primary and post-primary science contributed to the development of a more efficient transitional phase?

It is thus appropriate to review if the transition between primary and post-primary level supports the commitment and enthusiasm for science first developed in primary school. This research will examine the transition from primary to post-primary science education in Ireland and in particular, the issues and concerns of teachers and pupils regarding the teaching and learning of science within this transition

1.3 Layout and Structure of Chapters

Literature relevant to how the transition from primary to post-primary school impacts on students and teachers interest and engagement in science is examined in **Chapter Two**. It briefly explores general transition issues facing pupils at the end of their primary schooling and subsequently in the initial stages of post-primary school. It delves into pupils' attitudes to science within the transition and more specifically, their expectations of science learning prior to transfer to post-primary. It examines science curricula continuity from primary to post-primary and also explores teachers' confidence and subject knowledge in teaching science at both levels. While this research was conducted in the Republic of Ireland and speaks to a specific context, transition is a common phenomenon and wider reference is made to similar studies and the related issues. The purpose of the literature review is to orientate the research towards an inclusion of variables associated with transition in science education and may also suggest further research questions for development.

Chapter Three will detail the research methodology employed over the course of the study. It will describe the design and methodology of the study, which is based on a mainly qualitative approach including the use of questionnaire and interview, thereby providing a detailed picture of the experiences of both pupils and teachers across the transition from primary to post-primary science. The design of the research instruments, which include pupil questionnaires, teacher questionnaires and pupil interviews, will also be justified. The rationale for selection of participating schools, teachers and pupils is provided. Reference is made to conducting the research in schools with pupils and teachers and also of the relevant ethical issues. Data analysis techniques are explained, the emergence of themes and sub-themes discussed. The range and limitations of the methods used during the course of this research are also acknowledged.

Following the collection of data as described in Chapter 3, it was decided to present the findings and analysis of participating pupils and teachers separately. This allowed for a more in-depth discussion of the issues relating to the transition from primary to post-primary science from the perspective of first the pupil and then the teacher.

Firstly, **Chapter Four** presents the findings pertinent to the pupils' perspective of learning science across the transition. The representational data collected from pupils was analysed and when key trends emerged, was organised into themes. These themes and subthemes included pupils' attitudes to science across the transition and pupils expectations of science across the transition. Further subthemes also emerged within these. These themes are discussed in detail and are compared to existing literature, highlighting similarities and differences in the discussion.

Chapter Five will continue to present the findings of this study, in particular the transition from primary to post-primary science from the teachers' perspective. The data from the teacher questionnaires was also analysed, with two key themes emerging: teachers' attitudes to science across the transition and science curricula across the transition. As with the pupil findings, numerous subthemes emerged pertinent to the research questions. The teacher related themes were reflected upon in conjunction with the research literature presented in Chapter Two.

The main conclusions drawn from the findings of the research as presented in Chapters Four and Five are summarised in **Chapter Six**. Recommendations focus on issues of local and national concern, namely the factors influencing pupils' continued study of science, in a context which remains relatively under-researched, it should be a valuable resource to educators and policy makers, locally, nationally and internationally.

1.4 Summary

This chapter provided an outline of the rationale and background to the research undertaken. It is now appropriate to examine if the transition between primary to post-primary school encourages continuity between primary and post-primary science curricula, but also the aspirations of improving ease of access in science teaching and learning. Chapter Two explores the current research literature in this field providing a frame-work for this study.

Chapter 2

Literature Review

2.0 Introduction

A considerable amount of literature has been published on transition issues in science education including those of Speering (1995), Jarman (1993), Sears and Sorenson (2000), Murphy and Beggs (2005) and in the Irish context Varley *et al.* (2008b), and Smyth *et al.*, (2004). This chapter provides a comprehensive review of the literature on the transition from primary to post-primary science education and in particular, the issues and concerns of pupils and teachers regarding the teaching and learning of science within this transition. It will explore the following issues in detail:

- **Transition in Education** – will examine the findings from various studies based on the issues and difficulties affecting pupils negotiating a transition within educational settings. It will examine the transition from primary to post-primary school in particular and issues of school size, social change and development, pupil streaming, achievement and transition initiatives aimed at smoothing transitional problems in primary and post-primary schools. Each theme is elaborated upon in order to provide an overview of the relevant literature related to this research, thus developing the general theme of transition and putting transition and science into context.

- **Transition in Science Education** – will review numerous studies (Campbell, 2001; Murphy and Beggs, 2005 and Varley *et al.*, 2008b) that have stated it is the transition from primary to post-primary school that is one of the deciding factors in the present lack of interest in the uptake of scientific studies by students. According to Supovitz and Turner (2000), pupils' perceptions of learning science are important to their future interest and attainment. Research concerning both primary and post-primary pupils' interest and attitudes to science across the transition will be reviewed here. Furthermore, literature based on primary pupils' expectations of science prior to transition and their experiences of science following transition are assessed.

- **Science Curricular Continuity** - will assess various literature concerned with the evaluation of primary and post-primary science curricula and the level of continuity within the transitional phase from primary to post-primary. According to a number of authors (Sears and Sorenson, 2000; Smyth *et al.*, 2004), there are many conceptual and practical issues regarding curriculum continuity to be addressed in both primary

and post-primary science curricula. Thus literature concerning the discontinuity in curricular learning experienced by pupils once at post-primary school is referenced and furthermore the differences experienced in teaching methods of the curricula across the transition are reviewed.

- **Teacher Subject Knowledge and Confidence**- Much work has been done regarding primary school teachers' beliefs regarding the teaching and learning of science and their science content knowledge (Hewson *et al.*, 1995; Smyth and Lloyd, 1995; Murphy and McCloughlin, 2003). This section will review the appropriate literature in relation to the alleged relationship between the level of science instruction at primary school and its effect on the uptake of science following transition to post-primary.

2.1 Transition in Education

Transition in education, whether from pre-school to primary, primary to post-primary or post-primary to tertiary level, is a time of considerable disparity and readjustment for many students (Ferguson and Fraser, 1998). Transitions generally entail changes in social cultures, increased academic demands and shifts in peer groups which can be difficult to negotiate (O'Brien, 2001). Transitions can be best conceptualized as a journey along a path across momentary gaps and shifts in schools. While the pathways are diverse and can be successfully bridged by students, educators, parents and communities, transition is nevertheless an important and normative life event that can affect different students' experience of education in different ways (Tilleczek and Ferguson, 2007).

A number of researchers have argued that many educational settings fail to deal with the social, contextual and pedagogical aspects of transition (Jarman, 1984; Naughton, 1998). O Brien (2001) demonstrated that in the Irish context, schools varied in the attention they paid to the transfer process, the resources that they had at their disposal and the knowledge they had about the impact of their policies and processes on the transition. It is significant to note therefore, that according to Siedman *et al.* (1994), the more young people experience 'daily hassles' in transition within education, the more they set on a pathway of lowered self expectations and academic efficacy. Evangelou *et al.* (2008) conducted a study on current transition practices and highlighted what helps and hinders a successful transition. They

found that a turbulent transition can lead to pupils becoming isolated in their peer group resulting in a lack of self esteem and confidence, pupils showing a diminished interest in school and school work, pupils having difficulty with and becoming disorientated with their new routines and school organisation and furthermore pupils experiencing curriculum discontinuity (Evangelou *et al*., 2008).

2.1.1Transition from Primary to Post-Primary School

It is the transition from primary to post-primary school in particular that is regarded as one of the most difficult in pupils' educational careers (Zeedyk *et al*., 2003; Tilleczek and Ferguson, 2007). In a study aimed at evaluating the transition process in the Irish school system, Naughton (1998) presents a picture of young adolescents facing into a period of major change, where the single-teacher primary classroom with broad-based and largely integrated curriculum often gives way to multi-teacher, subject-based learning content at second level. At the end of first year, pupils had lost some of their enthusiasm for the new subjects and teachers, as according to O'Brien (2004), excitement diminished for most students as they realised they had to conform to new rules and expectations while having to comply with the rigours of a competitive system. Evangelou *et al.* (2008) found that while 84% of primary pupils were prepared for the transition to post-primary education, a note-worthy minority of 16% were unprepared and 3% were anxious or scared in relation to the transfer to post-primary school.

While this literature review would suggest that it is not solely the physical transition per se that impacts significantly on pupils attitudes towards science, it is essential to first frame the primary – post-primary transition in science education in terms of structural considerations; school size, social change, pupil achievement and streaming and transition initiatives. Schools on both sides of the divide face major challenges in restructuring organisational, pedagogical and assessment practices that lessen discontinuity within the transition from primary to post-primary science.

2.1.1.1 School Organisation

School Size

Bronfenbrenner (2004) suggests that students making the transition from primary to post-primary school must confront an 'ecological transition', that is, the adaption to both the

role and setting changes which can impede or facilitate the transfer divide in multiple ways. Much research (Speering and Rennie, 1996; Ferguson and Fraser, 1998) has focused on problems associated with school organisation in the transition from primary to post-primary school and some studies have highlighted the degree of change which children must undertake in terms of school size. As Ferguson and Fraser (1998) note, as post-primary schools tend to be much larger than primary schools in the majority of cases, school programs devised to support students during the transition from primary to post-primary school need to take into account the degree of change that students undergo in terms of school size.

Social Change and Development

Many researchers (e.g. Seidman *et al.*, 1994) have found that developmentally, early adolescence is an inopportune time to move from safe and well-known support structures. Students are both excited and anxious, both doubtful and hopeful. As studies by Naughton (1998) have demonstrated, a noteworthy 47% of Irish primary pupils feel an equal mix of worry and expectation at transfer to post-primary school. Tilleczek (2004) suggests that an emotional paradox exists at this transition point.

Status changes also accompany this rite of passage from primary to post-primary school and such changes provide both opportunities and constraints for young people (Tilleczek and Ferguson, 2007). In a detailed examination of pupils' experience of status change in the transition from primary to post-primary school, O'Brien (2004) showed that in their last year at primary school, students were regarded as responsible and grown up but following transition to first-year post-primary school were now at the bottom of the school social ladder and experiencing less control and freedom over their movements (O'Brien, 2004).

Pupil Achievement

Galton, Gray and Ruddock (1999) maintain that since transfer always occurs at the end of the academic year, the long summer break can cause a dip in performance for certain groups of pupils. Essentially, pupils experience a hiatus in progress after transition. It is estimated that approximately two thirds of pupils fail to make expected progress in the years following transition (Galton, Gray and Ruddock, 1999). Beauchamp and Parkinson (2008) acknowledge that the problem of continuity in standards of pupils' achievement as they transfer from primary school to post-primary school has led to many agencies in the UK, government and school based, exploring current practice to identify possible causes.

However, Speering (1995) has noted that where schools are putting energy and money into efforts at smoothing the physical transition to post-primary school, they are not ensuring that pupils' commitment to learning is sustained and their progress enhanced following transition.

Pupil Streaming

Data indicates that upon transition to post-primary school, allocation of students to classes on the basis of ability grouping on transfer is emotionally, academically and socially risky (Lynch and Lodge, 2002). While it is uncommon in the Irish primary school system for schools to stream students according to ability, streaming can and does occur and was found in one large primary school in a study conducted by O'Brien (2001). Students in lower streams in their new second-level schools frequently expressed feelings of low-esteem and a sense of academic and social exclusion from their schools (O'Brien, 2001). This in turn would have huge impact on achievement in all academic subjects including the learning of science, since students tend to internalise such constructions of their abilities (Tilleczek and Ferguson, 2007).

Transition and In-School Initiatives

In order to retain more youth in-school and to provide opportunities for student success, greater attention must be paid to pathways and transition from primary to post-primary school through appropriate transition planning initiatives (Tilleczek and Ferguson, 2007).Despite this, there is currently no national policy in Ireland relating to the transfer of information between primary and post-primary (O'Brien, 2001; Varley *et al*., 2008b). Studies such as that conducted by O'Brien (2001) have shown that an absence of meaningful dialogue between first and second-level schools, a lack of clarity and understanding of each other's roles, and lack of information about the operation of the two school systems can lead to an incoherent transition being experienced by pupils. This is confirmed by Varley *et al.* (2008b) who found that one third of post-primary teachers indicated they had received no information at all about first year students prior to entry. Despite both national and international concern, little attention has been paid to the issue of transfer as complex process in the academic and educational discourse in Ireland (O'Brien, 2001).

2.2 Transition in Science Education

In a longitudinal study of first-year students' experiences upon 'moving-up' to post-primary school, Smyth *et al.* (2004) found that there are gaps and differences between

primary and post-primary schools in terms of information transfer, understanding of curricula and approaches to teaching and learning. Failure to establish a real continuum between primary and post-primary schooling is having an impact on the success or otherwise of students' successful transition (Smyth *et al.*, 2004). Furthermore, in a leading study on science education in the United Kingdom, Murphy and Beggs (2005) have revealed the significance of the transition period from primary to post-primary education and the problems that arise particularly in the area of science.

Science, as a school subject, seeks to promote the acquisition of new knowledge through observation and investigation with phenomena in the world around us. Through science education, children construct, modify and develop a broad range of scientific concepts and ideas. Thus;

> 'Science education equips children to live in a world that is increasingly scientifically and technologically orientated'
>
> (DES, 1999a).

> 'In an era of rapid scientific and technological change the study of science is fundamental to the development of the confidence required to deal with the opportunities and challenges that such change presents in a wide variety of personal and social contexts'
>
> (DES, 2003a).

However, there can be substantial discontinuities between what young people experience in their school science lessons and in the rest of their lives. Aikenhead (1996) argued that school science expects young people to cross this border which is more forbidding for some students than others. School science education can only succeed when students believe that the science they are being taught is of personal worth to themselves. Thus, unless school science explicitly engages with the enthusiasms and concerns of the many groupings that make up today's students, it will lose their interest.

Past studies (Hadden and Johnstone, 1983) have pointed to an erosion of interest towards science education occurring predominantly between the ages of nine to fourteen years. More recently, Murphy and Beggs (2005) have identified that children are 'turned off' science at school when they are quite young and in particular, it is the aforementioned period of transition from primary to secondary school that is one of the deciding factors in the current declining interest in science. Campbell (2001) also identifies the transition from primary to post-primary school as a time when commitment and enthusiasm for science built

up in primary school decreases on transfer to post-primary school. It is thus appropriate to review the literatures dealing with how pupils' attitudes to science may be affected by the transition from primary to post-primary school.

2.2.1 Pupils' Attitudes to Science across the Transition

Pupil's perceptions of learning science are important to their future interest and attainment in the subject. When a child reaches post-primary school in Ireland she or he will already typically have experienced eight years of schooling and by this stage will have developed particular attitudes to science (Varley *et al*., 2008a). Though pupils continue to come to post-primary science with high expectations that it will be both interesting and challenging, many studies demonstrate that pupils' enthusiasm for school science can lessen following transfer to post-primary school (Hendley *et al.*, 1995).

Murphy and Beggs (2003) carried out an extensive survey of primary children's attitudes to science and found that most of the older pupils (10-11 years) had significantly *less* positive attitudes than younger pupils (8-9 years) towards science enjoyment, even though the older pupils were more confident about their ability to do science. Murphy and Beggs (2003) question if a lack of motivating and enhancing experiences in science that is causing pupil disengagement with science at senior cycle primary school level. As the continuing decline in numbers of students taking science subjects in the Leaving Certificate indicates, many young people may feel indifferent towards science or believe it is beyond their understanding. Notably therefore, Varley *et al.* (2008a) document one issue of concern relating to primary pupils' attitudes to science; that is the relatively few comments from pupils about the '*relevance'* of the science they are learning, either in relation to their everyday lives or to their future aspirations. This is of concern in relation to Primary Science Curriculum implementation, as it indicates that pupils may not be fully appreciating one of its key aims namely, '*the contribution of science and technology to the social, economic, cultural and other dimensions of society*' (DES, 1999a, p. 11). If pupils are not given the opportunity to distinguish the relevance of the science they are learning, they are less likely to have a continued interest in studying science.

2.2.1.1 Primary Pupil Attitudes to Science

It has been found within the Irish context that primary pupils are generally enthusiastic about primary school science. The majority are well disposed towards learning about

virtually all the content areas of the primary school curriculum and are very positive about hands on science, appearing to have opportunities to engage in it, applying a range of scientific skills as a result (Varley *et al.*, 2008a). In particular, a number of researchers have sensed a great enthusiasm on the part of pupils when engaged in hands-on activities in science lessons (Bricheno, 2001; Campbell, 2001; Ponchaud, 2001).

The frequency of hands-on experiences in primary school science is more a matter of debate. Children are telling us how important practical, experimental science is for their learning yet numerous researchers question if it is the lack of investigative work that is turning them off science even before transition to post-primary school (Ponchaud, 2001; Murphy and Beggs, 2005; Varley *et al.*, 2008a). Ponchaud (2001) was concerned that scientific enquiry had diminished in many primary schools in the United Kingdom. He pointed out that teachers should capitalise on the flexibility of the primary curriculum to carry out longer-term investigations, which would be more difficult to do in the timetable constrained post-primary school. Concerns about the prescribed nature and lack of pupils' science activities were also raised in a study of primary science in England and Wales (de Boo and Randall, 2001). In the Irish context, the relative infrequency of child-led investigations is a particular concern in relation to the Primary Science Curriculum's stated aim of fostering children's natural curiosity, so encouraging independent enquiry through well-planned, practical investigations (DES, 1999a). This raises questions about experiences that pupils are having at upper primary level and whether there are differences evolving between the prescribed curriculum and the taught curriculum in the classroom.

2.2.1.2 Primary Pupils' Expectations of Science

It is postulated by Campbell (2001) that a factor in the aforementioned decrease in pupil commitment and enthusiasm for science at transition to post-primary school is that primary pupils' expectations of post-primary science are not being met. While pupils reported an enjoyment of science generally, Campbell's study raises concerns about the image, status and academic challenge of school science following transition (Campbell, 2000). It is widely recognised in the United Kingdom and further afield that pupils enter their post-primary schooling with very high expectations of science and positive attitudes towards it. Moreover in Ireland, the vast majority of senior cycle primary pupils look forward to studying science at secondary level (Varley *et al.*, 2008a).

Pupils leave primary school with a perception that the most important learning activity was practical investigation and experimentation. Activities other than hands-on tasks were seen as boring and as 'barriers' to real learning (Osborne *et al*., 1998). Pupils thus expect greater continuity between primary and post-primary science through content and experimentation (Campbell, 2001). Pupils expect learning to be more difficult but in turn they also expect to be given more responsibility. Pupils expect to be in laboratories with specialised equipment and facilities contrasting with the classroom science of primary science and with simple apparatus. The frequent mention of the Bunsen burner suggests its symbolic significance as apparatus that characterises doing post-primary school science (Varley *et al*., 2008a).

According to Galton (2002), pre-transfer induction visits to post-primary schools often provide primary pupils with unreasonably high expectation of what post-primary science will entail. Braund and Driver (2002) further highlight the issue of these 'taster' experiences forming high expectations of post-primary science prior to transition. They demonstrated that visiting laboratories and observing dramatic and exciting experiments' appeared to be typical of the experiences encountered by primary pupils on their pre-transfer visit. Unsurprisingly, as seen above, primary pupils expected to use more sophisticated equipment and dangerous chemicals in secondary school science (Braund and Driver, 2002). There seems to be little doubt that pupils' expectations of post-primary science and its practical application in the classroom are heightened by pre-transition visits to the new post-primary school.

2.2.1.3 Post-Primary Pupil Attitudes to Science

Science as a subject has a relatively positive profile at post-primary school, when students' general interest in school is taken into account (Varley *et al.*, 2008b). First year students appear to regard post-primary science in a positive light in comparison with the science they encountered at primary school. Varley *et al.* (2008b) report that when asked following transition to post-primary school, the vast majority of students claim to prefer post-primary science.

Campbell (2001) however has revealed serious concerns regarding the image and status of primary science. Primary science is not seen as 'real' science following transition leading to first-year post-primary pupils undervaluing their primary science curriculum. Many pupils

also claim that science at post-primary level is more interesting than primary science, although the precise reasons for this are unclear (Varley *et al.*, 2008b). In particular, Campbell (2001) was concerned that students' views of their primary science experiences were so negative and that some pupils either stated or implied that at primary level, science had been a rare occurrence involving few, if any hands on activities. Therefore, it would seem from the research that students are forming positive attitudes to post-primary science in spite of, rather than because of, their primary experiences (Varley *et al.*, 2008b). Varley *et al.* (2008b) also added that it may also be the case that an overly negative view of primary science was conveyed by students in an effort to distance themselves from the experience of primary school science in general and certainly, some students appeared to show distain for science at primary level.

The principle reasons, according to a number of sources, for pupils' preference towards post-primary science are the emphasis on practical activities and the increased time devoted to science (Kirkpatrick, 1992; Mullins and Irvin, 2000). In their study on post-primary pupils' attitudes to science, Varley *et al.* (2008b) demonstrated that many students spoke enthusiastically about the greater quantity and frequency of experiments, some mentioning the more impressive nature of equipment for practical activities and having the chance to conduct experiments for themselves. Overall it would appear that students reported post-primary science in very positive terms in comparison with primary science.

Contrary to this however, British, American and Australian studies (Kirkpatrick, 1992; Mizell and Mullins, 1997; Mullins and Irvin, 2000) have reported student disillusionment with studying science in their early post-primary school experiences due to a lack of academic challenge. They conclude that many young adolescents become more negative about schools and themselves in general in the period after transition because they are moving into a more competitive environment and many, uncertain of their strengths relative to others, lose self-esteem and can disengage (Galton, Gray and Ruddock, 1999). Results by Gilbert (2006) further contradict those of Varley *et al.* (2008b) above by suggesting that while children are generally positive about science following transition to post-primary school, they are less interested in science than other subjects (Gilbert, 2006). Murphy and Beggs' (2005) study in Northern Ireland found that children tended to change their views about science because of having to carry out repetitive tests and training to recall facts. Older children felt that they do too much written work in science (Murphy and Beggs, 2005). In

comparison with primary school pupils, first year students also appear to be rather unenthusiastic about teacher demonstrations of science experiments (Varley *et al.*, 2008b).

2.3 Science Curricula

2.3.1 Primary Science

The introduction of the new Primary School Curriculum (DES, 1999a) in the year 1999 heralded a change in the content of science to be taught and the approaches to primary science teaching. The previous primary curriculum *Curaclam na mBunscoile* (DES, 1971) had first seen a shift towards a new, child-centred approach in Irish education. The *Curaclam na mBunscoile* (1971) placed a great emphasis on biological and environmental science, while science that incorporated physical and elemental topics was only a significant component of the programme for fifth and sixth classes. However, according to Smyth *et al.* (2004), concerns were raised about the extent to which the 1971 curriculum philosophy was fully reflected in classroom practice. International studies conducted at a time when the *Curaclam na mBunscoile* was in operation also highlighted concerns about the teaching and learning of science in Irish primary schools (IAEP, 1989; DES, 1999a).

The new Primary Science Curriculum (DES, 1999a) was seen as incorporating the key principles of the 1971 curriculum while also taking account of current educational thinking and wider societal change. From this perspective, the child is seen as an active agent in their own learning, in keeping with constructivist philosophy which regards education as a process in which the child constructs knowledge in interaction with others (Muijs and Reynolds, 2011). Therefore according to the Primary Science Curriculum;

> 'Primary science involves helping children develop basic scientific ideas and understanding, which will enable them to explore and investigate their world. In well-planned, practical investigations children's natural curiosity is channelled and they are equipped with the strategies and processes to develop scientific ideas and concepts'
>
> (DES, 1999a: p.6).

Adhering to a constructivist learning methodology, children's ideas as the starting points for science activities and education are now considered essential (DES, 1999a). This adaption of a constructivist approach aligns the Irish primary curriculum with primary science curricula

across the western world. Children's existing ideas in science are challenged to develop scientific understanding through constructing new knowledge for themselves (Varley *et al*., 2008a). It follows thus in the Primary Science Curriculum that;

> 'Meaningful learning occurs when the pupils construct their understanding by modifying their existing ideas in the light of new insights gained from scientific investigations. Thus, science may be seen as the active process of the personal construction of meaning and understanding' (DES, 1999a: p.7).

Many researchers have criticised the lack of continuity between the promoted and delivered science curricula (Ponchaud, 2001; Murphy and Beggs, 2005). Ponchaud (2001) was concerned that scientific enquiry had diminished in many primary schools and that current primary science curricula tended to constrain children's science learning as a body of facts rather than a method of enquiry. Murphy and Beggs (2005) note the lack of opportunity for children in the primary science classroom to explore, investigate their own questions or further their own intellectual development. In the Irish context Varley *et al*. (2008a) maintain that, despite the Primary Science Curriculum's aspiration to '*help children develop basic scientific ideas and understanding through...well-planned, practical investigations at channel children's natural curiosity'*, they found that many pupils are not afforded regular opportunities to engage in hands on science, are not applying certain scientific skills and are experiencing teaching demonstration and explanation as a dominant feature of their primary science education (DES, 1999a: p.6).

In addition, it has been suggested by Murphy and Beggs (2005) that the introduction of increased focus on English and Mathematics with the implementation of the Literacy hour and Numeracy hour strategies in England and Wales caused science education to be marginalised. It remains to be seen if the emphasis on Literacy and Numeracy as promoted by the Department of Education and Skills in Circular 0056/2011 (DES, 2011) will result in a similar exclusion of science in Irish Primary Schools. It is interesting to note that while the NCCA is the statutory body for curriculum issue, the instruction to schools regarding the emphasis on Literacy and Numeracy comes from the DES. The primary school curriculum in Ireland is made up of six general subject areas comprising eleven individual subjects. From first class onwards, a minimum of 4 hours 10 minutes per day should be devoted to 'secular instruction' with 30 minutes per day spent on 'religious instruction'. The government

document ‘Literacy and Numeracy for Learning and Life’ (DES, 2011) indicates that schools will be required to increase the amount of time spent on literacy and numeracy to 90 minutes and50 minutes per day respectively. The implications for the classroom timetable will very much depend on how narrowly ‘literacy’ and ‘numeracy’ are interpreted within the broader curriculum. According to this strategy document it must be acknowledged that;

> ‘understanding and using literacy and numeracy are such core skills that time for their development must be safeguarded, sometimes by delaying the introduction of some curriculum areas and always by ensuring that the teaching literacy and numeracy is integrated across the curriculum’
>
> (DES, 2011).

However, unlike the English and Mathematics curricula, many science curricula does not present an obvious sequence for the development of concepts and skills (Murphy and Beggs, 2005). Therefore, it remains to be seen if science education at primary level in Ireland will be marginalised at the point of implementation, in turn affecting pupil engagement in a continued study of science into post-primary education.

2.3.2 Post-Primary Science

In 2003, the Junior Certificate Science Syllabus was revised and implemented in order to counter act the deficiencies of its predecessor. In the previous curriculum models there was a complete under-emphasis of Chemistry and Physics (Varley *et al.*, 2008a). Prior to the introduction of the revised Junior Cycle Science Syllabus, pupils studied either Science (with Local Studies) or Science (without Local Studies) which were introduced in 1989. Material was presented as a list of content (facts, definitions, laws, lists of properties, etc.) which it was intended would be taught and learned with an emphasis on student experience of science as a practical activity. However, there was no explicit indication of the desired learning outcomes to be associated with this content. More significantly in the context of this study, the 1989 Science Syllabus did not maintain any coherence with the primary science curriculum (Curaclam na mBunscoile, 1971).

Therefore, while much of the content of the previous syllabus has been retained, the revised Junior Cycle Science Syllabus (2006) deviates from its predecessor in three significant ways. First, the revised syllabus has a different structure when compared to the previous syllabus. The revised Junior Cycle Science Syllabus now incorporates the three

main areas of science: Biology, Chemistry and the study of Physics (DES, 2006a). Secondly, the revised syllabus places student learning in the context of science activities by developing students' understanding of science concepts, as well as allowing them to acquire the necessary scientific process skills. This syllabus signals a shift away from an emphasis on learning content and towards '*hands on engagement'* with practical activities and development of appropriate relevant process skills (DES, 2006: p.6). Thirdly, topics in the revised Junior Cycle Science Syllabus (DES, 2006a) are accompanied by a set of learning outcomes, which encompass the knowledge, understanding and skills that students can be expected to attain through their study of science. It would fundamentally link scientific concepts to everyday life – a key aim of the Primary School Science Curriculum. It was also the aim of the revised Junior Cycle Science Syllabus (2006a) that arising out of their experience in the junior cycle, many students would be encouraged to study one or more of the science subjects in the senior cycle, thus preparing them for further study or work in this area.

Another guiding factor in the design of the revised Junior Cycle Science Syllabus was to align the science encountered by students at Junior Cycle with the science they would have experienced within the Primary Science Curriculum (DES, 1999a).Current NCCA work aimed at rebalancing the Junior Certificate subject syllabi to a common template has identified the need for a 'statement of links' to be included (Smyth *et al.*, 2006). There are many similarities between the types of science content envisaged at primary and early post-primary level. The revised Junior Cycle Science Syllabus acknowledges this fact (DES, 2006a). **Table 2.1** below outlines the topics from both primary and junior cycle science syllabus suitable for linking.

Table 2.1: Primary and Junior Cycle Science Curricular Links

Primary Science Curriculum (DES, 1999a)	Junior Cycle Science Syllabus (DES, 2006a)
Living things • Human life • Plants and animals	**Biology** • Human Biology food, digestion and associated body systems • Human Biology the skeletal/muscular system, the senses and human reproduction • Animals, plants and micro-organisms
Energy and forces • Light • Sound • Heat • Magnetism and electricity • Forces	**Physics** • Force and energy • Heat, light and sound • Magnetism, electricity and electronics
Materials • Properties and characteristics of materials • Materials and change	**Chemistry** • Classification of substances • Air, oxygen, carbon dioxide and water • Atomic structure, reactions and compounds
Environmental awareness and care • Environmental awareness • Science and the environment • Caring for the environment	

The primary school curriculum therefore presents an opportunity to prepare pupils for their future study of science at post-primary level, and conversely, the Junior Cycle Science syllabus allows teachers to build on students' earlier experiences at primary school. The linkage between primary and post-primary education is clear, but according to Smyth *et al.* (2004), an understanding of this may not have permeated the system in a meaningful way. The extent to which this curriculum linkage and continuity has been recognised by primary and post primary teachers, who are focussed on coming to terms with the implementation of the respective science curricula, remains to be seem.

2.4 Science Curricular Continuity

Studies by Galton, Gray and Ruddock (1999), Smyth *et al.* (2004) and Varley *et al.* (2008a) have drawn attention to the fact that despite the introduction both nationally and internationally of new science curricula aimed at smoothing the move to post-primary school, there are still problems at transition with curriculum continuity. Continuity has been defined as an uninterrupted succession, a state almost impossible to achieve in education (Gorwood, 1986). In comparing the science curricula at primary level and junior cycle post-primary, it would appear that there are many commonalities of experience envisaged for students within the two school settings, with a development of progression of experience would also be inherent in documents (**Table 2.1**). Beyond the exhortation to 'build on' earlier experience, there is relatively little in the literature to indicate or illustrate what primary –post-primary curricular continuity in science might actually look like in the classroom (Sears and Sorenson, 2000). Smyth *et al.* (2004) report a substantial group of first year pupils experiencing discontinuity in learning experiences between primary and post-primary school. Pupils indicate that the curriculum does not follow on naturally from primary level. The majority also see teaching methodologies as quite different.

In the Irish context, Smyth *et al.* (2004) and Varley *et al.* (2008a) highlight that since the breadth and depth of understanding of science content is greater at post-primary level than at primary level, this should represent a progression from the material that pupils should have experienced in primary school (**Table 2.1**). Contrary to this however, Murphy and Beggs (2005) report that in the United Kingdom, primary science, unlike many other of the primary subjects, does not present an obvious sequence for the development of concepts and skills. Varley *et al.* (2008b) have demonstrated that some overlaps exist in the earlier points of each topic or sub-topic in the Junior Cycle Science syllabus, however, when compared with the curriculum for fifth and six class at primary level. Examples of these include; '*the structure, function and care of teeth'* (DES, 1999a, p.83) compared with 'identify *molars, premolars, canines and incisors and described their functions*' (DES 2003a, p.11) and '*recognise that materials can be in solid, liquid or gas form*' (DES, 1999a; p.88) compared with '*name the 3 states of matter and know their characteristics'*(DES, 2003a, p19). Murphy and Beggs (2005) have also indicated that few teachers feel curriculum links are satisfactory and believe that perhaps science curriculum planning at post-primary level in particular has not been modified to allow for children's achievement in primary school.

Other authors in the past have alluded to the notion by post-primary science teachers that they are giving pupils a fresh start and are starting from scratch (Hadden and Johnstone, 1983; Shrigley, 1990; Spector and Gibson, 1991). In a study conducted in Northern Ireland, Jarman (1993) surveyed post-primary teachers regarding their planning for primary/post-primary curricular continuity. It found that the main source of post-primary teachers' knowledge of primary science practices was teachers who talked to their pupils about their earlier science experiences. While one third of teachers indicated they had taken some cognisance of their pupils' earlier experiences in only a few cases did this amount to any material change in their practices. Jarman (1993) also found that almost half the post-primary teachers interviewed asserted that though their pupils had 'done things' in primary school, they did not 'know' them or they 'knew' them but did not 'understand' them. Therefore, it was impossible to take account of their earlier experiences.

There is also discontinuity in the methods of teaching and learning between primary and post-primary science schooling due to lack of familiarity with current science curricula. In a study conducted by Varley *et al.* (2008a), a slight majority 69% of Irish post-primary science teachers were unfamiliar with science processes in primary science. Furthermore, in a survey conducted by the INTO (2008), just under 19% of post-primary teachers stated they were familiar with the primary school curriculum at all. 62% disagreed or strongly disagreed with the statement that teaching methodologies and approaches at second level are broadly similar to those at primary level (INTO, 2008). Smyth *et al.* (2004) reveal that this lack of awareness of the thrust of the Primary School Curriculum can lead to much repetition of subject matter in 1st year post-primary school. From the perspective of the post-primary school and the teaching of science across the transition, it is important that subject teachers familiarise themselves with the teaching and learning approaches that characterise pupils' experiences in primary school (Smyth *et al*., 2004).

2.5 Primary – Secondary Science Teacher Liaison

Galton *et al.* (1999) found that promoting dialogue between primary and post-primary teachers on science content, assessment and pedagogy was critical to a positive transition. There is a widespread consensus by researchers (Galton, Gray and Ruddock, 1999; Sears and Sorenson, 2000; Smyth *et al.*, 2004) that the introduction of 'national' curricular frameworks had potential to improve primary – post-primary curricular continuity in science. Many

features of the current education system and school organisation sometimes frustrate the best efforts of teachers to promote continuity through improved liaison (Nicholls and Gardner, 1999). Sears and Sorenson (2000) state that, post-primary teacher's knowledge of primary science in their associate schools derives not from formal attempts to learn about their pupils' earlier experiences but from informal discussion with the children. Thus, teachers are relying on their pupils' ability to describe their understandings. This can be problematic as children tend to underplay their primary science education, as noted above, and therefore the circumstance of post-primary science, with its unfamiliar laboratories and its sophisticated equipment is so different from primary science that pupils simply fail to see the connection (Jarman, 1993). The level of communication in relation to academic matters at the time of transfer would appear to be of concern. Therefore, Smyth *et al.* (2004*)* advocates increased amounts of communication regarding science curricular planning and implementation and pupils' expectations of science across the primary- post-primary divide.

2.6 Teachers' knowledge and confidence in teaching Science

Although few teachers would regard themselves as scientists, they all have a view of what science is, and this is conveyed through their teaching (Harlen, 2000). The work of Appleton (2003) highlights the importance of the teachers' content knowledge of science in order to stimulate students' interest and learning processes. Studies by Gilbert (2006) have found that part of the explanation for pupils' negative attitudes towards school science may be the shortage of well qualified science teachers capable of providing a positive experience. Moreover, many science teachers are required to teach sciences outside their own specialisation. This undermines their confidence, leading them to offer a significantly more closed and less stimulating experience.

A recurring theme in much literature about primary science and the subsequent transition to post-primary science has been the lack of preparedness and apparent reluctance of many primary teachers to teach science (Appleton, 2003). According to Psillos, Spyrtou and Kariotoglou (2005) primary teachers hold perceptions about physical phenomena and scientific concepts similar to those of school children, although to a lesser degree and expressed in a more sophisticated language. It is known from numerous pieces of research (Harlen, 2000; Nilsson, 2008) that primary school teachers have limited scientific knowledge which results in low confidence in teaching science. While a small minority of primary

teachers may undertake scientific studies, significantly fewer specialise in the teaching of science (Nilsson and Driel, 2010). The Task Force on Physical Sciences in Ireland found that a minority of Irish primary teachers have taken a physical science subject to upper post-primary level (Task Force on Physical Sciences, 2002). According to Murphy and McCloughlin (2003) Irish students on Bachelor of Education programmes are not required to take a science subject. Furthermore, Childs and McNicholl (2007) have investigated the disjointed relationship between post-primary science teachers' subject matter knowledge and their teaching practice. When a teacher felt confident with their subject matter knowledge, he or she was better able to match the content of science teaching explanation (Nilsson and Driel, 2010).

Harlen *et al.* (1995) have probed the coping strategies that are adopted by teachers if and when knowledge was limited. Low confidence often results in teaching that is limited to 'scientific activities that work' which the teacher feels comfortable and familiar with (Appleton, 2003). These strategies include teachings as little of the 'low-confidence aspects' of science as possible i.e., relying heavily on work cards, underplaying questioning and discussion and avoiding all but the simplest practical work (Appleton, 2003).

2.7 Summary

The concern that fewer school leavers opt for scientific based careers can be supported in the existing literature on science education. The majority of authors agree that pupils' expectations of science, curriculum continuity, teacher confidence and liaison have an impact on students' interest in and attitude to learning science particularly in the transition from primary to post-primary school.

Studies have shown how pupils' expectations of entering the post-primary science classroom are not being met. Student's perceptions of post-primary science are often not what they expected and this experience may have long term implications for their subject and career choices in the field of science. There is also evidence to suggest post-primary teachers underestimate the abilities and capabilities of entering pupils.

The provision of science education in Ireland has changed with the introduction of the Primary School Curriculum in 1999 and a revised Junior Cycle Science Syllabus in 2006. These curricula have altered what science and how science is taught in both Irish primary and

post-primary schools. However, various researchers report a substantial group of first year post-primary pupils experiencing discontinuity in learning experiences between primary and post-primary school and that the curriculum does not follow on naturally from primary level. The majority also see teaching methodologies as quite different. Studies in the Irish context have reported that there are significant numbers of junior cycle teachers unfamiliar with the Primary School Science Curriculum.

In the final analysis of literature, collaboration between Irish primary and post-primary science teachers was discussed. International studies have reported that in considerable numbers of primary and post-primary schools, planning to promote continuity from primary to post-primary science is largely under developed. It has been found that a lack of curricular linkage and integration between most primary and post-primary science teachers may contribute to a lack of interest and engagement in science by their pupils. Studies emphasise the need in science education of giving students a voice, allowing them to express their views and opinion, or their likes and dislikes and in doing so, supports the aspirations of improving accessibility in learning science and scientific literacy.

Chapter 3

Research Methodology

3.0 Introduction

This chapter will present the research design and methods utilized in this study. Firstly, the aims and objectives of the study are outlined. Following this, the selection, design and suitability of the data collection tools used in this research will be discussed. A rationale will also be provided as to why these methods were selected. The piloting and sampling of these methods of data collection and analysis of data will be presented and finally ethics and limitations of the study will also be discussed.

3.1 Data Collection Methods

A variety of data collection methods have been drawn on in this research in order to investigate the research questions. Combining evidence from more than one source should lead to more substantial conclusions (Creswell, 2009). Both qualitative and quantitative methods of data collection were utilised and through corroboration between the two methods, triangulation of data was accomplished. Triangulation is necessary for contrasting and comparing different accounts and perspectives of the same situation, thus providing a more detailed and balanced picture (Altrichter *et al*., 1993). By utilising a variety of data-collection methods, results in this study provide depth and validity to research findings and conclusions. While the data collection methods were primarily qualitative, a quantitative approach was also taken in the analysis of some data.

3.2 Overview of the Research Strategy

Following a review of qualitative research literatures (Lincoln and Guba, 1985; McMillian and Schumacher, 2001; Creswell, 2008) it was determined that both questionnaire and interview would be the most appropriate data collection tools for this study. **Table 3.1** below illustrates the aims and data collection methods of this research study. In order for information to be collected from respondents in their natural environs, interactive and in-depth exploratory modes of inquiry must be employed (McMillian and Schumacher, 2001). Through such personal interaction, the researcher developed further insight and meaning from the results. This also makes the research method logically inductive as the researcher builds on meaning from data collection in the field (Creswell, 2008). Thus, the final written study includes the voices of the participants, the innate response of the researcher, a multifaceted interpretation of the problem, extending the current literature and/or signals a

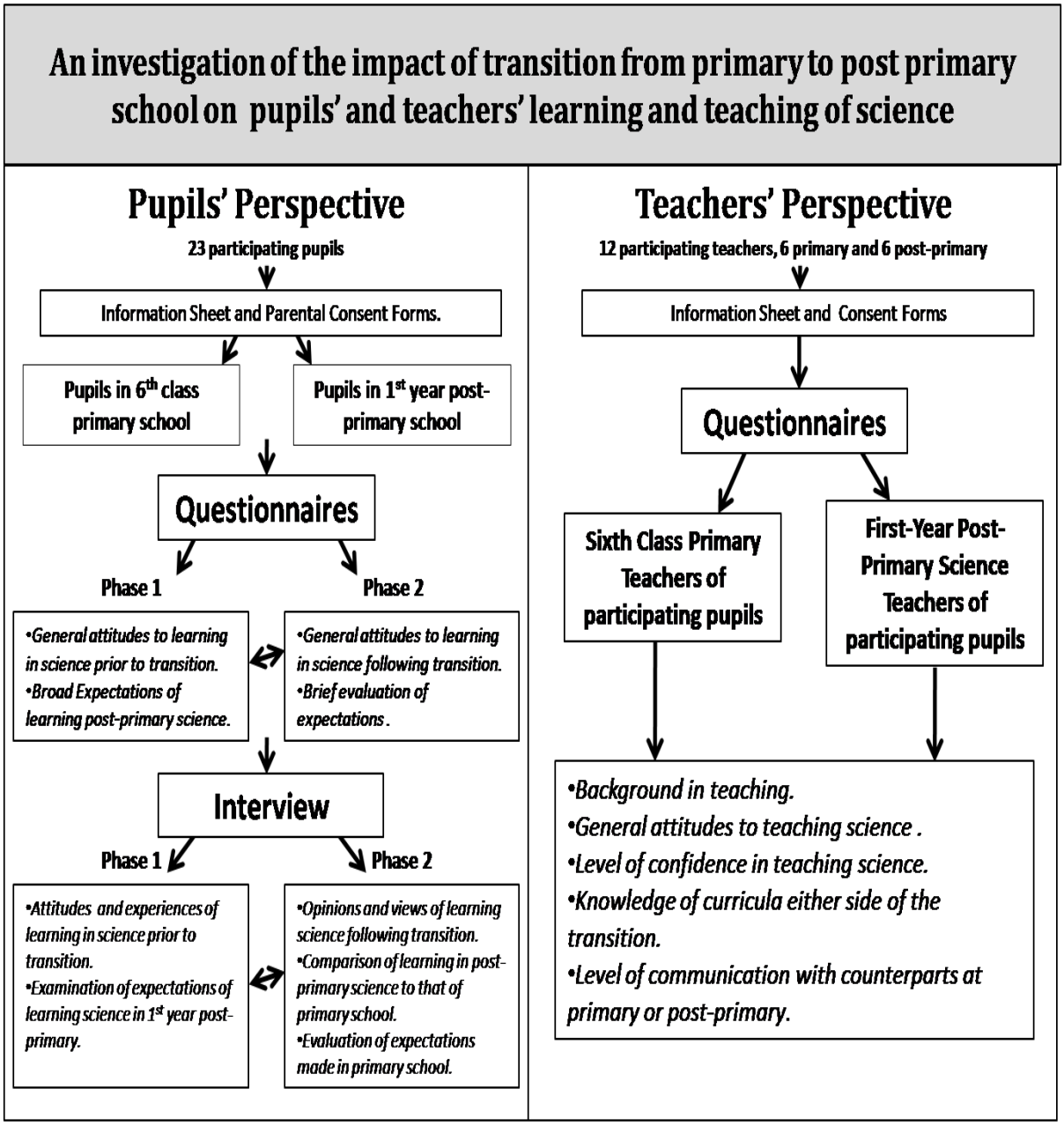
call for action (Creswell, 2008). **Figure 3.1** clearly demonstrates the research design employed in this research. It essentially aims to documents changes in pupils' and teachers' attitudes at the transitional phase, explores the consequences and makes recommendations relevant at local and national level.

Table 3.1 Overview of the Aims of Research and Methods of Data Collection Used.

Phase 1 of Research	
Aims	**Data Collection Methods**
• **What are participating primary pupils' attitudes to and expectations of learning science prior to the transition to post-primary school?**	Initial Pupil Questionnaire Initial Pupil Group Interview
• **What are the general attitudes of participating primary teachers' regarding their teaching of science in the final stages of primary school?**	Teacher Questionnaire

Phase 2 of Research	
Aims	**Data Collection Methods**
• **How are participating pupils' attitudes to and interest in science affected following transition to post-primary school?**	Follow-up Pupil Questionnaire Follow up Pupil Group Interview
• **What are the issues arising upon pupils' transition from primary to post-primary science which are of concern to participating post-primary teachers?**	Teacher Questionnaire

Figure 3.1: Overview of Research Design



3.4 Characteristics of Research Types

3.4.1 Quantitative Research

A quantitative study, as defined by Creswell (2009), is an investigation into a social or human problem, based on testing a theory composed of variables, measured with numbers, and analysed with statistical procedures in order to determine whether the predictive generalisations of the theory hold true. Bryman (2004) states, that quantitative research can be constructed as a research strategy that emphasises quantification in the collection and

analysis of data. It incorporates the practices and norms of the natural scientific model and embodies a view of social reality as an external, objective reality. Quantitative methods of research follow a scientific approach; they allow structure and investigational design, as well as statistical means of analysis. Findings are primarily focused on producing precise and objective figures and statistics (Bryman, 2004).

The quantitative research methods used in this project, as illustrated in **Table 3.1** and **Figure 3.1** above took the format of pupil and teacher questionnaires. More specifically, the utilisation of closed questions in the questionnaires allowed for quantification in the collection of data from pupils and teachers across the transition from primary to post-primary science. This also assisted in the analysis of data. Although the questionnaires mostly contained close questions or Likert-scale questions, open-ended questions were also included to gather more detailed (qualitative) data thus providing the opportunity to pupil (**Appendix A**) and teacher (**Appendix B**) respondents to elaborate further on their answers.

However, it is claimed by a number of researchers (Cloke *et al*., 1991; Smith, 1998) that it is not possible for quantitative research to be free of value and meaning in social research. As researchers are part of society, their values, experiences and motives inevitably influence their research and furthermore, quantification was claimed to give a false sense of objectivity by artificially separating the observer from the observed (Cloke *et al* 1991). Another criticism was the failure of quantitative techniques to appreciate the importance of structure and agency. Quantitative researchers treated people as objects without any consideration of the values and meanings that make individuals human and the capabilities that they possess (Smith, 1998).

3.4.2 Qualitative Research

Unlike quantitative research where frequency is an essential characteristic, qualitative research aims to ascertain the 'how' and 'why' of people's behaviour and attitudes as they interact with the world around them (Yin, 2003). It is the researchers aim to determine the attitudes and opinion of pupils and teachers concerning their experience of science within the primary – post-primary divide. Qualitative research was thus deemed the most appropriate methodology. The key to understanding the use of qualitative research in this particular research study is the idea that meaning is socially constructed by individuals in interaction with their world (Creswell, 2009). It is, as defined by Creswell (2009), an inquiry process

embedded in understanding a social or human problem. It is based on constructing a holistic picture, produced with words, reporting comprehensive views of respondents and conducted in a natural setting.

Learning how both teachers' and pupils' experience teaching and learning in science, how they interact within the science classroom and examining the meaning it has for them, requires an interpretive qualitative approach. **Table 3.1** above clearly demonstrates the qualitative research methods utilised in this study along with the aims of each method of data collection chosen. Pupil group interviews allowed the researcher to gain a more tangible insight into the initial data collected in the questionnaire stage. **Figure 3.1** above further illustrates the rationale and use of qualitative research methods in this study.

There are many criticisms of qualitative research in the available literature (Denzin and Lincoln, 1994; Silverman, 2000). Firstly, this category of research is seen, for the most part, as descriptive and subjective (Silverman, 2000). It aims to collect descriptions of a topic in order to show its importance and significance to people and, as the name suggests, is related to the quality of the data rather than the quantity (MacNaughton *et al*., 2001). This may have implications for the reliability of the study. A further criticism of qualitative research is the matter of validity. Such research can lead to the use of unintended measures 'to define, count and analyse its variables', thus neglecting 'the social and cultural construction of the variables' (Silverman, 2000).

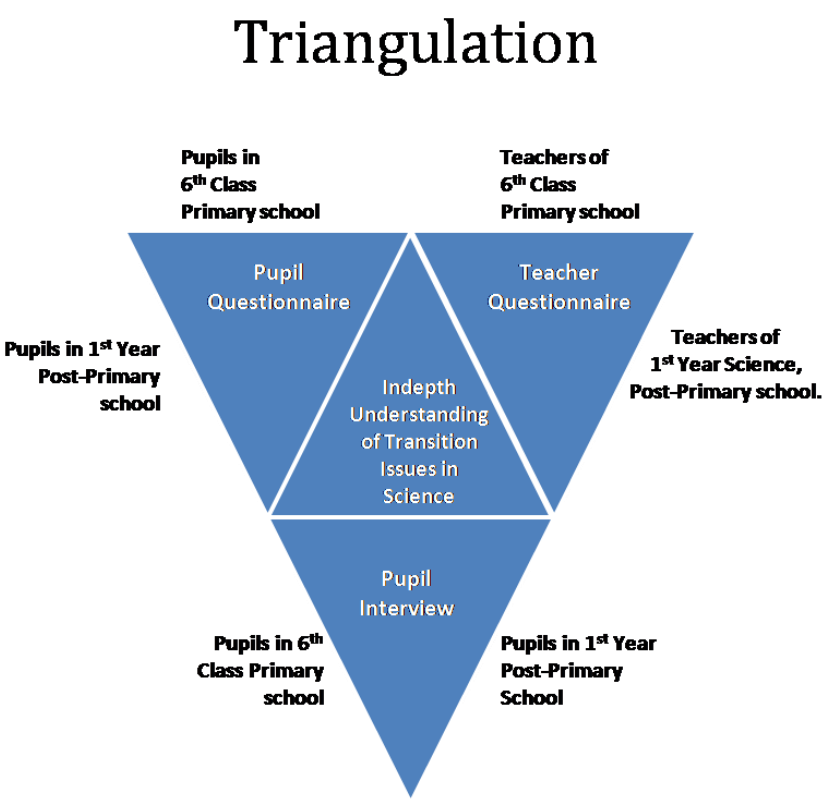
3.4.3 Mixed Methods

It was decided by the researcher to utilise mixed methods in this study in order to acquire statistical and quantitative results from a sample population followed by qualitative data from a number of individuals to help clarify the results in more detail (**Figure 3.2**). Hammersley (1999) highlights a gulf that exists between qualitative and quantitative research, stating that the two methods are frequently used to represent essentially opposing approaches to the study of the social world. Bryman (2008) argues that treating quantitative and qualitative research as compatible neglects the fact that they are based on fundamentally different and irreconcilable foundations. Despite this, Brannen (1992) asserts that while many researchers see themselves as belonging to either qualitative or quantitative, others simply unite the two. However, while faults are seen to be present in both quantitative and

qualitative methods as separate entities, many researchers (Brannen, 1992; Bell, 2005; Slavin, 2008) advocate a mixed-method approach.

Hammersley (1999) proposes the use of triangulation as a particular approach to mixing methodologies. He refers to the use of quantitative research to substantiate qualitative research findings or visa versa. In essence, the first method is used in order to help inform the second method. It is one of the most significant theories in qualitative research is that conclusions are supported with evidence from different sources (Slavin, 2008). Reference to triangulation in this research reflects an effort by the researcher to provide depth and legitimacy to the research findings and conclusions. Bell (2005) points out that, the key to triangulation is considering the same things from different perspectives, and thus, confirming or challenging the findings of one method with that of another. Therefore, the researcher attempted to achieve triangulation by comparing the qualitative and quantitative data collection to examine if there was corroboration between the two and furthermore by reference to the literature (Silverman, 2006).

Figure 3.2: Triangulation Employed in this Research Study.



3.5 Sampling

Defining the population on which the research is to focus, is an important sampling decision that must be made in the preliminary stages of research (Cohen *et al*., 2007).In order to collect data from participants relevant to the transition from primary to post-primary science education in Ireland, a selective sample of practicing primary and post-primary teachers along with pupils in the transition classes (6^{th} class primary and 1^{st} year post-primary) were chosen to partake in this study. A theoretical or purposive strategy of sampling was taken in this study (Bryman, 2008), where participants are chosen for their relevance to the research question, analytical framework and explanation or account being developed in this research (Schwandt, 2007).

3.5.1 Sample Size

In theoretical or purposive sampling, ideal sample size is not quantifiable (Schwandt, 2007). The size of the sample depends on the nature of the study and the research questions and concepts being investigated (Cohen *et al*., 2007). In this study, the sample size was

determined by school type, setting and gender base. The following illustrates the breakdown of the sample.

3.5.1.1 Schools

Schools participating in the study were selected to give a representation of the school types available to pupils and of the teaching community within each school in Ireland. It was first decided to select six participating post-primary schools. These schools were chosen specifically to ensure that all school types were included in the research and thus, were not randomly chosen. Post-primary schools in the Mid-West region of Ireland were examined and six were chosen not just for their representation but were;

- from a rural, suburban and urban setting.
- of secondary, comprehensive and vocational type.
- of all gender types i.e. all male, all female and mixed.

Table 3.2 shows the demographic of post-primary schools participating in this research.

Table 3.2: Post-Primary School Demographic (N=6)

School	Location	Gender	School Type	Class Size (participating 1st year)
G	Rural	Single – Boys	Secondary	24
H	Urban	Mixed	Secondary College	29
I	Urban	Single – Girls	Secondary College	28
J	Rural	Mixed	Vocational	25
K	Rural	Mixed	Community	22
L	Urban	Mixed	Comprehensive	29

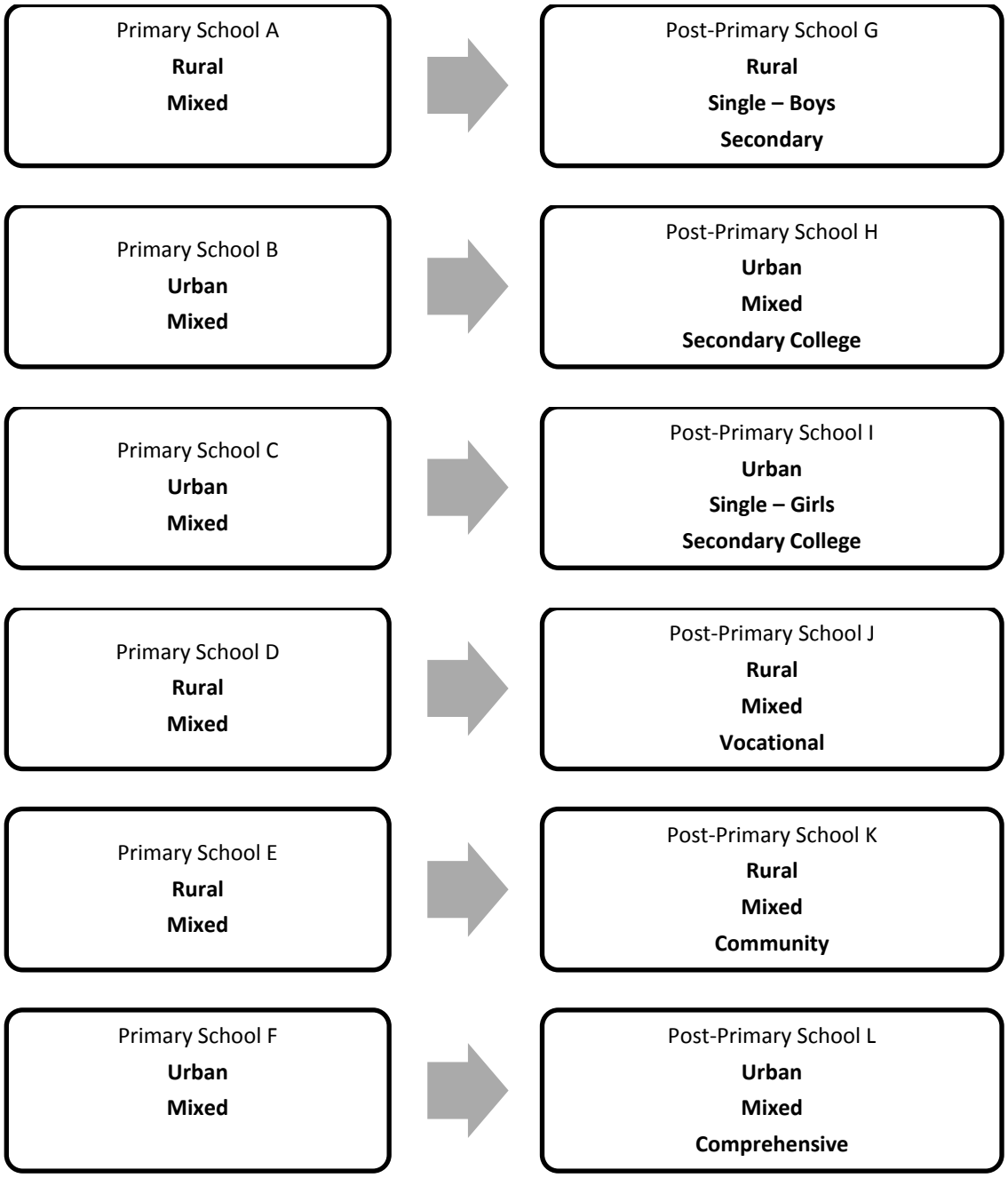
Following this, six primary schools were selected from which 6th class pupils would transfer to each post-primary school already identified above (**Figure 3.4**). This would ensure that a particular group of pupils could effectively be followed through the transition process. All primary schools participating were of mixed sex. This was due to these primary schools being the only "feeder" schools available where a specific group of pupils could be tracked into the above post-primary schools (**Figure 3.3**). All schools were in the Mid-West region of the country.

Table 3.3: Primary School Demographic (N=6)

School	Location	Gender	School Type	Class Size (participating 6th class)	Disadvantage Status
A	Rural	Mixed	JI - 6th	26	No
B	Urban	Mixed	JI – 6th	32	No
C	Urban	Mixed	3rd – 6th	29	Yes
D	Rural	Mixed	JI – 6th	23	Yes
E	Rural	Mixed	JI – 6th	14	No
F	Urban	Mixed	JI – 6th	30	Yes

The following graph presents the transitional relationship between the post-primary and primary school selected for this study.

Figure 3.3 Relationships between Participating Primary and Post-Primary Schools (N=12)



3.5.1.2 Pupils

An approximate number of 23 pupils from the aforementioned six primary schools were first selected to partake. Through consultation with the class teacher, pupils transferring to first year classes in the previously identified post-primary schools were selected. Three to four pupils in each primary school group were targeted as this number was considered appropriate in when conducting pupil group interviews (Cohen *et al.*, 2007).

Pupils involved had to;

- be from a 6th class setting, either a single 6th class group or a mixed class setting (5th and 6th or 3rd to 6th class inclusive).
- be moving to first year post-primary school in the following school year (**Figure 3.2**).

The researcher considers the above sample to be satisfactory as 6th class primary pupils in the process of transition to 1st year post-primary are not only the most likely to be competent in competing the questionnaire but are the most likely population to be experiencing this transitional phase. Thus one can be reasonably confident of the validity of what generalizations are made (Coleman and Briggs, 2002).

Just over half the pupils (13 out of 23) participating were male and thus ten (of the 23) were female. The vast majority of the pupils participating (16 out of 23) were 12 years of age while a further 5 (of the 23) were 11 years of age at the end of their 6th class in primary school. **Figure 3.4** and **Figure 3.5** below show the gender ratio and range of ages of the participants.

Figure 3.4.: Gender of Participating Sixth Class Pupils in this study (N=23)

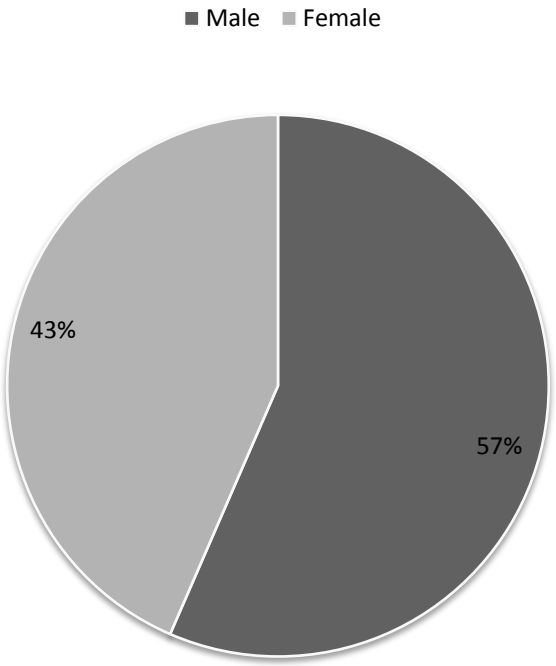
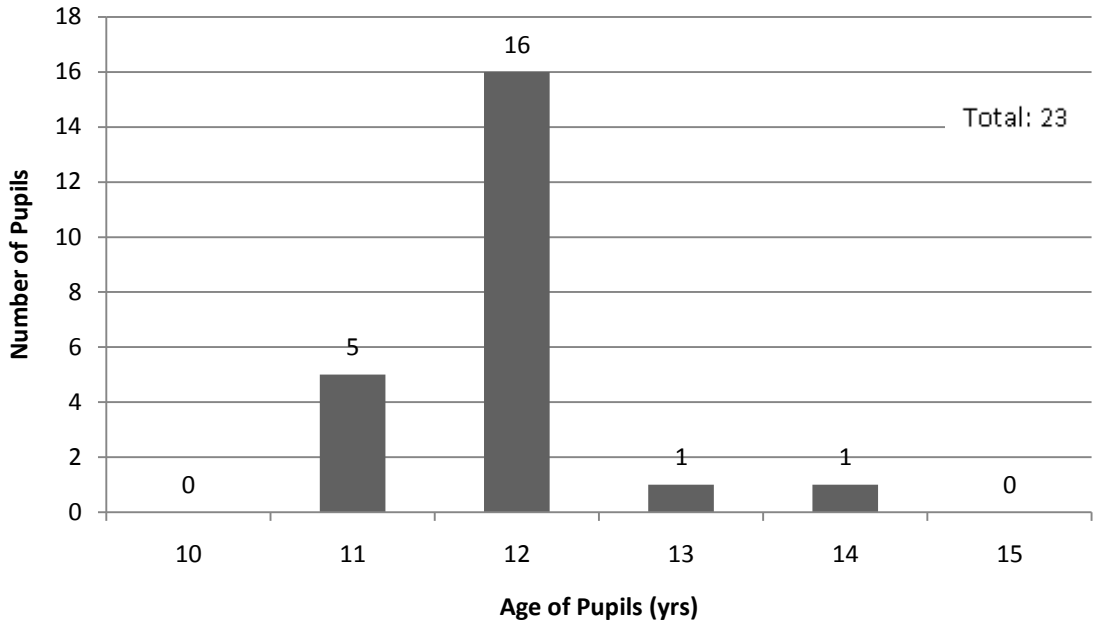


Figure 3.5: Age of Participating Sixth Class Pupils (N=23)



3.5.1.3 Teachers

Twelve teachers (six primary and six post primary) were selected to partake.

Teachers involved had to;

- have considerable or sufficient i.e. probated experience in teaching at primary /post-primary level.
- teach in the participating pupils in question i.e. 6th class primary and junior cycle post-primary 1st year class groups.
- have relevant teacher qualifications.
- teach science and another subject, or science only (applicable to post-primary teachers).

This smaller number of teacher respondents was preferable in this study. A small sample free of bias is preferable to a large sample that is biased and unrepresentative or whose lack of bias cannot be proved (Fogleman, 2002).

A quarter of the teachers participating (i.e. 4 out of 12) were male and thus 8 of the total twelve were female. Of the 4 males, 1 was teaching in primary school with the remaining 3 in post-primary school. In contrast, 5 females taught in primary school and 3 in post-primary. Teachers in both sectors held a wide range of teaching experience. **Table 3.4**

and Figures 3.6 to 3.8 below, show the gender ratio, range of teaching experience and class type of the participating teachers in this study.

Table 3.4 – Teaching Experience of the Participating Primary (N=6) and Post-Primary Teachers (N=6)

Teacher	**School Level**	**Sex**	**Teaching Experience** (years)	**Class**
1	Primary	Female	1	Mixed
2	Primary	Male	21	Single
3	Primary	Female	8	Single
4	Primary	Female	25	Single
5	Primary	Female	14	Mixed
6	Primary	Female	9	Single
7	Post-primary	Male	7	Junior-Senior Cycle
8	Post-primary	Female	12	Junior Cycle
9	Post-primary	Female	18	Junior Cycle
10	Post-primary	Male	22	Junior-Senior Cycle
11	Post-primary	Male	7	Junior-Senior Cycle
12	Post-primary	Male	9	Junior Cycle

Figure 3.6 Gender of Primary and Post-Primary Teachers (N=12)

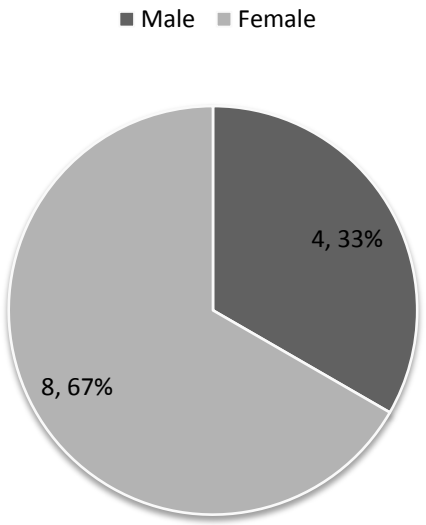


Figure 3.7 Gender of Primary Teachers (N=6)

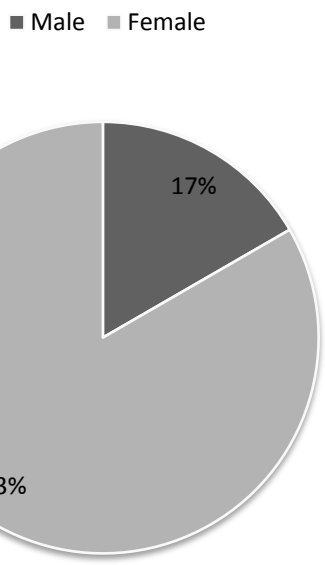
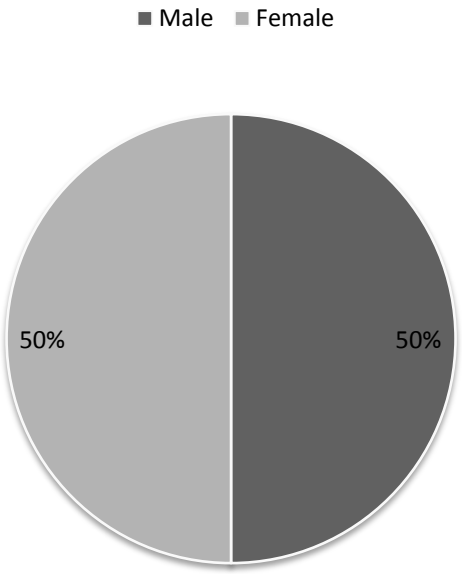


Figure 3.8 Gender of Post-Primary Teachers (N=6)



3.6 Questionnaire

The questionnaire is a highly valuable method of data collection, providing information about the distribution of a wide array of 'people characteristics' and the relationship between these characteristics (Bryman, 2004). This kind of descriptive information has value in this study by helping to gauge both pupils' and teachers' opinions and, in effect, illuminate the research questions being considered. It is also possible to go further than the descriptive with the questionnaire, and use it to understand the phenomena being studied and clarify patterns

of results obtained (Robson, 2002). Therefore questionnaire, in particular a self-completion or self-administered questionnaire, was considered to be a most appropriate method of data collection for this research study.

3.6.1 Pupil Questionnaire

The pupil questionnaires, as seen in **Appendix A,** aim to expand upon how the transition from primary to post-primary school effects pupils' attitudes to science and interest in science. Twenty three pupil questionnaires in total were completed by pupils first at the end of their final year (6^{th} class) primary school and again after a twelve month interval at the end of their first year in post-primary school (**Appendix A**). The primary pupil questionnaire documents pupils' attitude to primary science, experiences of learning science prior to transition and their expectations of post-primary science. The post-primary questionnaire investigates pupils' attitudes to science following transition to post-primary school and the factors influencing pupils continued study of science at post-primary level. Primary pupil questionnaires were administered in June of 2010 and post-primary pupil questionnaires in May of 2011**.**

3.6.2 Teacher Questionnaire

The teacher questionnaire allows teachers, both primary and post-primary, to indicate their concerns in the teaching of science across the transition from primary to post primary (**Appendix B**). It examines teaching practices in both primary and post-primary science classrooms and investigates these in the context of a coherent transition. It also examines the opportunities available to teachers within the transitional phase for interchanging ideas. Twelve teacher questionnaires were completed, six primary and six post-primary (**Appendix B**). These questionnaires were specifically administered to 6^{th} class primary teachers and 1^{st} year post-primary teachers at the end of their respective school calendars; to primary teachers in June 2010 and post-primary teachers in May 2011.

3.6.3 Questionnaire Design

Questions were designed specifically to help achieve the goals of the research and, in particular, to answer the research questions. A good questionnaire not only provides a valid measure of the research questions, but also gets the co-operation of respondents and elicits

accurate information. The subsequent issues were considered when designing the questionnaire for pupils and teachers, based on a variety of literature in this area (Cohen and Manion., 2000; Wellington, 2000; Bell, 2005; Slavin, 2008).

3.6.3.1 Self-completion Questionnaire

The self-completion or self-administered questionnaire allows the respondent to answer questions and complete the questionnaire themselves. Bryman (2004) presents both advantages and disadvantages to the use of a self-completion questionnaire. Firstly, this category of questionnaire is more economical and is simply quicker to administer. Self-completed questionnaires are very efficient in terms of researcher time and effort (Robson, 2002). Secondly, characteristics such as gender, ethnicity and social background of the researcher are not obvious and thus do not bias the answers given by the respondents (Bryman, 2004). Furthermore, there is no variability in questions asked and also it is convenient for respondents.

The self completion questionnaire also presents a number of disadvantages. Firstly, there is often no one present to help or prompt the respondent during completion, thus there is a greater risk of omitting data. Also, there is a limit to the number of questions that can be asked by the researcher and with postal questionnaires in particular, there can be a lower response rate (Bryman, 2004). In overcoming these, the self-completion questionnaire provides a relatively simple and straightforward approach to the study of attitudes, values and motives (Robson, 2002). It was deemed a highly useful and effective means of data collection in this particular research study (**Appendix A, Appendix B**).

3.6.3.2 Questionnaire Layout

Cohen *et al*. (2007) informed us that the layout of the questionnaire is vitally important. It is essential that it looks easy, attractive and appealing to the respondents and as De Vaus (2002) reminds us, a questionnaire that is not always administered by the researcher should be easy to follow and self-explanatory. As this research required both pupil and teacher respondents to complete a questionnaire the researcher felt it was vital to ensure the layout of the questionnaire facilitated both these groups equally (**Appendix A, Appendix B**). The language used and phrasing of questions were made appropriate for the sample that would

receive it, i.e. the varying language in the teacher questionnaire versus the pupil questionnaire. For example, pupils were asked to rate their enjoyment of learning about 'Materials such as wood, plastic and metal' whereas teachers were asked to rate their confidence in teaching about 'Materials and their Properties' (**Appendix A, Appendix B**). As DeMarrais and Lapan (2004) state, item wording and formats that may be suitable for college graduates may not be suitable for children or others with little formal education.

Taking into account the above points and suggestions, the researcher divided the research themes into a number of sectional headings (see **Appendix A**). The pupil questionnaire was divided into the following headings:

- School in general
- Science in general
- Science Learning
- In our science lesson...
- In science class...
- In secondary school ...

These headings sought responses aimed at determining pupils' level of interest in their study of science and their attitudes to the science they are taught and how it is taught. Following this the teacher questionnaire was divided into the following headings:

- General Information
- Length of teaching experience
- Class profile
- School profile
- Children with special needs
- Time teaching
- Time planning
- Confidence in teaching Science Curricula
- Pedagogy of science
- Contact with primary /post-primary colleagues
- Benefits of contact with primary /post-primary colleagues

The above headings allow the researcher to determine the teaching situations of both teachers and the issues arising for teachers in teaching science. It must also be noted that there are more open-ended questions included in the teacher questionnaires. This is due to the researcher utilising the teacher questionnaire to gain information that pupils would not necessarily have access to or have the ability to answer.

3.6.3.3 Question Style

A key aspect to producing a questionnaire is writing it in such a way that while the questions remain faithful to the research task, respondents understand what you want from them and are happy to give it to you (Robson, 2002). Thus in this research study, a combination of closed (list, quantity, grid, category, contingency, Likert scale) and open ended questions were used in the development of both pupil and teacher questionnaires (see **Appendix A, Appendix B**). Likert scales can be used to discover strength of feeling or attitude towards a given statement, such as attitudes to science education. The implication is the higher the category chosen, the greater the strength of the agreement (Bell, 2005). An example of a Likert scale question used in this study may be the pupil being asked to rate their opinion on the statement '*I enjoy science'* by indicating – '*I agree, I am not sure or I do not agree*' (**Appendix A**).

While open questions allow people to freely respond and also enable the researcher to get a closer insight to the personal attitudes and beliefs of the participant. Closed questions allow for responses of participants to be questioned in a more analytical way. A large number of the questions used in the development of this research questionnaire were closed, or forced choice questions requiring a 'Yes' or 'No' answer (see **Appendix A, Appendix B**). Such closed questions in this study include '*Have you ever had contact with a primary/post-primary teacher regarding the teaching of science in your class?'* However, there were also a number of open-ended questions at the conclusion which took the form of loosely structured and sentence completion questions for example, *'Do you think the science you are now studying in secondary school is different to the science you learned in primary school and if so, how is it different*?' (see **Appendix A**).

In order to avoid problems with the reading of questions by participants, the researcher aimed at all times to keep the language simple and the questions short, particularly in the pupil questionnaire. Double-barrel questions and leading questions which may confuse

and/or influence to respondents were also avoided. The researcher also avoided asking questions in the negative and tried to ensure that the questions meant the same to each of the respondents. Furthermore, questions were limited to those which respondents are likely to have the knowledge to answer. The researcher also ensured that questions were devoid of ambiguity and also avoided direct questions on sensitive topics (Robson, 2002).

3.6.3.4 Piloting the Questionnaire

It is widely acknowledged by researchers (Cohen and Manion., 2000; Wellington, 2000)that all data-collection techniques should be piloted in order to (a) gauge the length it takes recipients to complete them, (b) test that all questions and instructions are comprehensible and (c) enable the researcher to remove any items that do not yield usable data (Bell, 2005). It is a vital phase in the design and creation of a questionnaire and it is crucial to its success (Oppenheim, 1998).

Therefore, in March 2010, the initial pupil and teacher questionnaires were tested by a teaching colleague of the researcher with a younger class grouping of 4th and 5thclass. The reason for this pilot was two-fold. Firstly for convenience; this class grouping and teacher were in the researchers own school and were not going to be completing the questionnaire for the purpose of the actual research. Bryman (2004) supports this type of piloting and emphasises that the pilot should not be carried out on people who might be members of the sample employed in the full study. Secondly it was believed by the researcher that if the children in a younger class were able to fully comprehend and complete the questionnaire, then 6th class primary and 1st year post-primary pupils most certainly would. 'Pilot studies allow the researcher to determine the adequacy of instructions to respondents completing the questionnaire' (Bryman, 2004: 160). The researcher also asked a number of 6th class teachers, not part-taking in the study to evaluate and assess the questionnaire in order to ensure that the instructions and questions were suitable for both pupil and teacher participants.

Following piloting of the questionnaires, it was noted that the time taken to fully complete the questionnaire varied from 5 to 20 minutes in both pupil and teacher groups. Instructions were understood overall and it was noted by a number of teachers that the questionnaires appeared to be professional and attractive. It was noted by the researcher during the pilot that the final section of open-ended questions was not being fully filled-in by

either pupils or teachers. After due consideration, both questionnaires were edited accordingly following suggestions arising from the pilot.

Firstly, it was decided to change the typeface of the pupil questionnaire to Comic Sans MS, as it was more legible and deemed more attractive to pupils (**Appendix A**). It was also pointed out during the piloting that when individual questions continued onto a new page, both pupils and teachers were more likely to leave those questions unanswered. Therefore, the researcher ensured that any question located at the end of a page did not carry on to the next (**Appendix A, Appendix B**). Also, a number of questions were rewritten for clarity and ease of answering e.g. in the pupil questionnaire, pupils were asked if they enjoy learning about '*What happens to things when you heat or cool the*m?'Following piloting, the wording of this question was adjusted to *'I enjoy learning about what happens when you heat things up and cool them down?'* (**Appendix A**). It was also recommended that teachers may need to monitor pupils during completion of the questionnaire or the questionnaire would be administered where possible by the researcher.

3.6.3.4 Administration of Questionnaires

With the support of the researcher's principal teacher, the researcher made herself available, to distributed and administer the questionnaires. The researcher both delivered and collected pupil questionnaires with the assistance of class teachers. This served as an advantage as, despite the piloting of the questionnaires, a small number of both pupils and teachers in the different class groups/schools had minor issues with a number of the questions.

The questionnaires were administered within school hours on different dates to primary schools in June 2010 and post-primary schools in May 2011. The questionnaires were completed by all pupils within school hours, and in the case of post-primary pupils, in their specific science lesson. Pupils were given ten minutes to complete the questionnaire and were encouraged to ask for assistance if necessary. As with the pupil questionnaires, the researcher made herself available to distribute and administer the teacher questionnaires. They were administered within school hours to all participating teachers. In all but two of the primary schools and two of the post-primary school, the researcher was present to administer the questionnaires. In the case where the researcher was not present the pupil and teacher questionnaires were administered by the class teachers involved. The researcher provided a

contact number to the teachers in question in the event of an issue arising during administration of the questionnaires. Two weeks were allowed for these schools to return the questionnaires. All questionnaires not administered by the researcher were returned within the time period.

3.7 Interviews

According to Lichtman (2006), the research interview is the most common form of data collection in qualitative research. It can simply be described as 'a conversation between the interviewer and the respondent with the purpose of eliciting certain information from the respondent' (Bell 2005; 157). Silverman (2000) remarks that the primary issue (in conducting interviews) is to generate data which gives an authentic insight into people's experiences. Therefore, for the purpose of this research, it was felt interviewing pupils would give further insight and elaborate upon the responses given in the questionnaires. 'Interview enable participants...to discuss their interpretations of the world in which they live and to express how they regard their interpretations , of the world in which they live, and to express how they regard situations from their own points of view' (Cohen and Manion, 2000: 267). It was hoped the interview would therefore explore concepts in greater detail that were not afforded by a questionnaire.

3.7.1 Interviews – Advantages and Disadvantages

An advantage of the research interview as a data collection tool is that it allows greater depth than other methods of data collection. Thus, it was utilised in this research as it allowed the researcher to ask more detailed questions of pupils, hear their responses and seek explanation from them (Cohen *et al*., 2007). For example when Pupil 16 and 17 (Primary Pupil Interview) stated '*I like doing the experiments with the explosions, stuff like that because it's much more fun and sort of active....like when we made the volcano'*. The researcher was able to ask '*Tell me about that'* (**Appendix C**)**.**

Furthermore, it allows the researcher to fully comprehend what the participants were trying to say and enabled them to obtain a clearer picture of the opinions and thoughts of the participant (Worthern *et al*., 1997). When pupils in this research were asked '*What do you not like learning about in science class?*' Pupil 11 (Primary Pupil Interview) stated '*Everything, most of all the body.*' This researcher was able to gain more insight into the negative attitudes of pupils towards science by simply asking '*Why do you not learning about the*

body?' (**Appendix C**). Another significant advantage of the interview in this study is its ease of adaptability; however, it must be noted that topics were selected prior to the interviews, questions were devised and methods of recording decided upon.

The fact that interviewing is time-consuming is a notable disadvantage, as Robson (2002) notes that when undertaking an interview, one must remember that anything under half an hour is unlikely to be valuable; anything going much over an hour may be making unreasonable demands on busy interviewees, and could have the effect of reducing the number of persons willing to partake, which may in turn lead to biases in the sample you are trying to achieve. Thus, the researcher strove to keep all interviews to within the half hour limit. Another disadvantage to the use of interviews is that they require precise and organised preparation – the researcher having to make arrangements to visit schools and teachers, securing necessary permissions from boards of management, principals, parents etc and this also takes time.

Despite the difficulties involved, interview was deemed a most purposeful tool for collecting data in this study as it allows both pupils and teachers to express how they regard situations from their own point of view (Cohen *et al*., 2007). Thus the interview completes the triangulation approach taken in this research. It can shape the data collected first through questionnaire. Therefore, interviews, in accordance with the view of Bell (2005), can put flesh on the bones of responses gathered in questionnaires.

3.7.2 Interview Types

Robson (2002) outlines certain types of interview – fully structured, semi-structured and unstructured. Semi-structured interviews were used to obtain the second set of data in this research study. The selection of this strategy depended solely on the interview purpose, for example, to obtain the present perceptions of pupils, to obtain future expectations of pupils and to verify and extend information gathered during the questionnaire phase (McMillan and Schumacher, 2001). Thus, the semi-structured interview involves the development of a broad set of questions and format, which are followed and used on all participants (**Appendix C**). While the general structure is the same for all individuals being interviewed, according to Lichtman (2006) the interviewer can vary the questions as the situation demands and the respondent is allowed a considerable degree of freedom within the framework (Bell, 2005). Semi-structured interviews were hence selected as a further data

collection method in this research and consisted of open-ended questions intended to verify and elaborate upon answers to questions previously asked in the questionnaires.

Furthermore, it was deemed appropriate to conduct the above semi-structured interviews using a group of pupils rather than individual interviews. The data produced in group interviews can reveal the social and cultural context of people's understandings and beliefs (Cohen *et al*., 2007). Blumer (1969) was among the first few sociologists who used group discussion and interview methods with key informants in their research. He believed strongly that 'a small number of individuals brought together as a discussion or resource group, is more valuable many times over than any representative sample' (Blumer, 1969: 41). In focus group interviews, researchers can see directly how the participants take part in discussion, share ideas, views and experiences, and may even argue with others in the group (Liamputtong, 2011). The number of participants involved in focus groups leads to a more dynamic discussion process and hence facilitates the social construction of meaning (Holstein and Gubrium, 1995). It was noted in this research however, that it is access to interviewing children that is perhaps most challenging, as while it is relatively easy to arrange interviews once access to a school has been achieved, it is access to children's' understanding that is more difficult.

Thus the researcher took a number of steps to ensure essential data was collected when dealing with both primary and post-primary pupils in the group interviews. Firstly, it was decided to have a group size of 3-4 pupils as, according to Cohen *et al.* (2007), too few and it can put pressure on individuals; too large and the group fragments and loses focus. Also, as the researcher was dealing with children, it was essential to keep the duration of each group interview no longer than fifteen minutes and keep distractions to a minimum. Lastly, the researcher kept the language simple, to the point and without ambiguity throughout the interview (**Appendix C**).

3.7.3 Interview Techniques

Moser and Kalton (1971: 271) describe the interview as a 'conversation between the interviewer and the respondent with the purpose of eliciting certain information from the respondent'. According to Roberts-Holmes (2005), the interviewer must be empathic, respectful, sensitive and able to understand social situations, in order to develop the skill of knowing how and when to probe for information. Therefore, the researcher aimed to build a

good rapport with the interviewees from the outset, putting them at ease and building their confidence through simple closed questions at the start (**Appendix C**). Notably however, the researcher ensured that throughout the interview phase, pupils were not guided or coerced into answering questions in a particular way thus avoiding interviewer bias.

According to Marshall and Rossman (2006), the interviewer must have excellent listening skills, be skilful at interacting with people, be able to frame questions accurately and probe responses for additional information. In taking this on-board, the researcher decided to record the interviews in order to listen more intently to the pupils being interviewed. Robert-Holmes (2005) concurs with this and believes recording, rather than writing the interview down, is an important research interview habit to develop because it allows you to do your main job, that is, active listening. In order to carry out recordings of the pupils interviews, both pupil and teacher participants received parental and participant consent forms respectively in order to take part in the study (**Appendix C**). Furthermore, an undertaking was given that the names of participating schools, teachers and pupils, being confidential, were not revealed or identified in any publications. Data collection took place during school hours on school premises at times appropriate to each participating school and in conjunction with school principal and class teacher. The researcher at all times adhered to each participating school's policy on child protection and conformed to any procedures put in place while collecting the data i.e. collecting data from either pupils or teachers in the presence of another member of school staff. To ensure confidentiality of the collected data is maintained, recordings are held securely on the PC of the researcher and are protected by password. The researcher alone will have custody of, and access to, the data. As per the Mary Immaculate College Record Retention Schedule, the research recordings will be held for three years after the conclusion thus allowing validation of the research.

3.7.4 Piloting the Interviews

In order to identify any problems with the interview schedules, questioning style and recording procedures, pilot interviews were carried out in advance with a sample number of pupils in the researchers own school. In May 2010 the initial interview schedule was tested with a group of 3 pupils from 5th class. As with the questionnaire piloting referred to above, the reason from this was two-fold. Firstly, as this class were in the researchers own school, they were an easily accessible group and more importantly, were not going to be interviewed for the purpose of the actual research. Secondly if pupils in a younger class are capable of

understanding and responding competently the questions asked of them in the interview, it stands to reason that 6th class primary and 1st year post-primary pupils would also. Following piloting, a number of issues such as the elimination of background noise, the wording of questions and overlapping of responses by interviewees became apparent. As a result of the above considerations arising from the pilot interviews, the pupil interview schedules and recording equipment were revised accordingly.

3.7.5 Interview Schedule

According to Roberts-Holmes, 2005, the researcher should employ a research guide in semi-structured interviews as it enables the research to remain focused with a list of points to be covered during the interview, without the fixed and predetermined interview schedule. Thus an interview schedule was drawn up by the researcher based on themes and topics explored in the previous pupil and teacher questionnaires. For example, pupils were asked to elaborate on their opinion of 'writing in the science class' in the group interview as during the questionnaire, significant numbers of pupils responded negatively to the statements '*I enjoy copying from the board'* and '*I enjoy doing worksheets'*. The interview schedule for this study can be seen in at **Appendix C.** According to Marshall and Rossman (2006) the researcher explores a number of wide-ranging topics to help reveal the participant's views, but otherwise respects how the participant frames and structures the responses. Thus, the role of the researcher is one of facilitator and enabler, encouraging the interviewee to 'speak their mind' on the topic (Roberts-Holmes 2005, 109).

3.7.6 Question Structure

Following the interview schedule, questions should be structured in a systematic way (Roberts-Holmes, 2005). In this study the researcher used a planned and controlled approach to devising the questions to be asked. It was noted by the researcher that as specific questions had to be put to the pupil respondents regarding the different aspects of the transition phase, e.g. topic area, expectations, it was felt that the opinions of the pupils would not be fully established if the interview took a largely unstructured approach. Therefore, a number of closed questions were included at the start to establish a rapport between the researcher and interviewees and in doing so, make them more comfortable with the interview process (see **Appendix C**). These included;

- How old are you?
- What class are you in?
- What is you teacher's name?
- Do you like science?

Following this, questions were for the most part open-ended (see **Appendix C**). Such open-ended questioning was deemed appropriate for the purpose of this research as the opinions and perspectives of the pupils were sought after. Open-ended questions consisted of;

- What kinds of things do you like doing in science?
- What would a typical lesson be like in your class?
- Describe what you think science will be like in secondary school

According to Cohen *et al.* (2000), they are flexible and allow the interviewer to investigate and go in to more depth if necessary. For instance, if a point was made by a pupil that was relevant to this study but more information was needed, the interview schedule was briefly set aside to investigate further, taking care to get back on track as soon as possible.

3.8 Ethics

Research involving humans is an invasive process (Lindsay, 2000), as it deals with what should be done and should not be done when collecting data in research and calls for a moral perspective on things, rather than a practical perspective (Denscombe 2003). Hammersley and Atkinson (1995) raise their concerns regarding ethics when research involves collecting data from individuals and in the case of this research, pupils and teachers. They hold the view that it is clearly not enough just to request permission but that the participants has the right to a full explanation of the research process and what will happen to the data especially if it possibly may be published. Therefore, at all times throughout this research process, strict ethical standards were fully upheld.

Firstly, informed consent was engaged in this research study (**Appendix D to H**). It was felt appropriate for this research as it ensured both pupil and teacher participants were informed of the purpose of the research in hand, were made aware of the expected duration of the project, the procedures involved and especially of their right to decline and withdraw

from the research once participation has begun (Cohen *et al.*, 2007). It was also found by the researcher that informed consent also provides an opportunity for prospective participants to ask further questions and receive answers in order to clarify any issues and concerns they may have outstanding.

Permission to conduct research from the class groupings and teachers in question was initially sought and gained from school principals. Having discussed with them the significance of the research and received approval, permission was then sought from the Board of Management. It was emphasised to both principal and Board of Management that the confidentiality and anonymity of the school, its staff and students involved was guaranteed. Informed consent (Silverman, 2006) from parents/guardians was then sought for the pupils to participate and also from participating individual teachers. Children and young people are rarely deemed free to decide entirely for themselves whether or not to participate in research (Silverman, 2006) and therefore it was deemed necessary to seek permission from parents and/or guardians for the purpose of this research project. Firstly, a general letter and information sheet was sent to all parents/guardians in the class informing them of the research taking place (see **Appendices D and F**). Parents and guardians were firstly assured that their child's anonymity would be fully respected, they were made aware of what was involved for their child at each stage of the research and that they could withdraw from the study at any time.

Also, informed consent was sought from the participating teachers in each class involved. A letter and information sheet was therefore sent to each teacher involved and they were made aware of the purpose of the study, exactly what was expected of them, any possible risks and how they could voluntarily pull out if necessary from the research at any stage (**Appendices G and H**). A research proposal was furthermore passed through Mary Immaculate College Ethics Board.

3.8.1 Ethical Issues relating to the completion of the questionnaires

According to Cohen *et al.* (2007), the questionnaire is an invasion into the life, professional or otherwise, of the respondent. Therefore, certain things were made apparent to both the pupil and teacher respondents in the questionnaire phase of the research; including the guarantee of their confidentiality and anonymity; the promise that the research would not

damage them in any way and their rights to withdraw from the research at any stage. The researcher was mindful of these issues throughout the questionnaire phase of the study.

Another ethical matter than must be taken into account is the issue of methodological rigour and fairness (Cohen *et al.*, 2007), thus the researcher aimed to avoid bias and to treat any data collected consistently and truthfully. Furthermore, the researcher ensured that the questionnaire items were not offensive, intrusive or biased (**Appendices A and B**).

3.8.2 Ethical issues relating to interview

According to Cohen *et al.* (2007), interviews have an ethical dimension as they are concerned with interpersonal interaction and produce information about the human condition. Furthermore, Bell (2005) points out that the researcher has a responsibility to explain to respondents as fully as possible what the research is about, why they are being interviewed, how they will be involved and what will be done with the information obtained. In the case of this study, pupil respondents' parents and guardians were first informed beforehand in the form of a letter and information sheet and were asked to complete a consent form (**Appendices D to H**). Following this, the pupils were told the nature of the study prior to the interview and were told in words they would understand (MacNaughton *et al*., 2001).

The researcher remained highly conscious of potential biases in relation to issues and attitudes of pupils in relation to their learning of science being explored in interviews. It must be acknowledged that the findings of this research are based solely on the participants, and that any information volunteered, deduced or otherwise throughout the duration of this study were held in the strictest confidentiality.

3.9Validity and reliability

3.9.1 Validity

According to McMillan and Schmacher (2001: 407), the validity of research design is considered 'the degree to which the interpretations and concepts have mutual meanings between the participants and the researcher'. It tells us whether an item measures or describes what it is supposed to measure or describe (Bell, 2005). Cohen *et al.* (2007) state

that validity is an absolute necessity for both quantitative and qualitative research, as invalid research is of no significant value.

The validity of this research design has been enhanced and consolidated through the triangulation of both qualitative and quantitative methodologies. By utilising both questionnaires and interviews in this study, the results provide depth and validity to the research findings and conclusions. Furthermore, a pilot study of each tool was conducted in advance, care was taken to avoid leading questions at all stages of interviews and lastly, all findings were cross checked by the researcher (Cohen *et al.*, 2007). Willig (2003) believes that there are three ways in which qualitative research methods in particular, inherently address issues of validity and these were also taken into account in this research study:

- The data collection generally takes place in a real-life setting i.e. school, classroom.
- The participants can challenge or correct any assumptions the researcher may have made
- The research process and the researcher's role are constantly under review.

3.9.2 Reliability

All researchers, whether they are conducting quantitative research, qualitative research, or a combination of the two, must aim to ensure their research is reliable. Cohen *et al.* (2007) explain that, reliability is achieved if the research were to be carried out on a similar group of respondents, in a similar context, it would produce similar findings. They (Cohen *et al*., 2007) also write it is easier to ensure reliability in quantitative research than it is in qualitative research but stress that it still must be addressed in the qualitative research. Willig (2003: 17) claims that qualitative research investigates individual and experiences in great detail and 'does not aim to measure a particular attribute in large numbers of people'. Thus, she acknowledges that there is disagreement among researchers about the extent to which reliability should be an issue in qualitative research (Willig, 2003).

To ensure reliability in this research the following steps were taken:

- Points made in the literature in relation to the development of the questionnaires were adhered to.

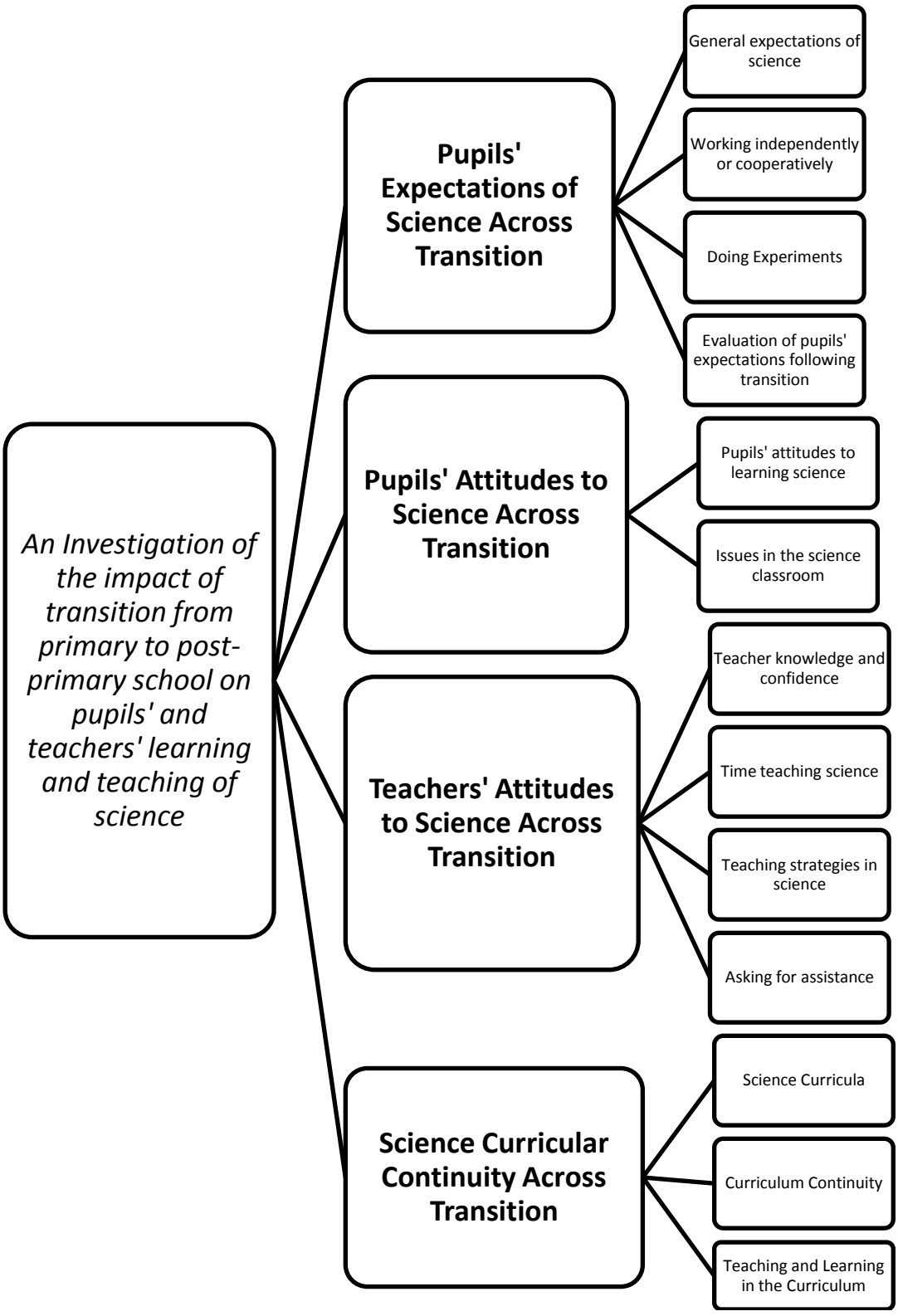
- The instructions for the questionnaire were written clearly on the front and repeated throughout where necessary.
- The interview schedule was pre established and adhered to, and the same topics and themes were explored with each group of respondents.
- All interviews were recorded, which provided material for reliability checks later.
- All interviews were carefully and systematically transcribed.

3.10 Data Analysis

Hitchcock and Hughes (2001) describe data analysis as an attempt to organise, account for and provide explanations of data so that some kind of sense may be made of them. This allows the researcher to move from a description of 'what' is the case to an explanation of 'why' that is the case. According to Hopkins (2008), the analysis of data is an important phase of any research process because it is at this point that the researcher can assume that the results obtained are valid and trustworthy.

First in this study, all the responses from the pupil and teacher questionnaires and pupil interviews were read to ascertain a broad classification into categories to which the data belonged to. Secondly, every question from the four sets of questionnaires (two pupil and two teacher) were entered into the variable view of SPSS (Statistical Package for Social Sciences, Version 18) and the responses from these were coded where applicable. Following this, graphs and other physical representations in the study were generated using Microsoft Office Excel. Specific categories were thus established; for example categories in the theme 'Primary Pupils' High Expectations of Post-Primary Science' may be; more 'real' the expectations developing following pre-transfer induction visits. Next, each response from the open-ended questions and interview were assigned to one of these categories or multiple-categories as described above. This method of analysis is advocated by Bell (2005). Finally, the responses within each category were reflected upon with themes established, permitting a more unified and integrated picture of the data. **Figure 3.9** clearly demonstrates the emergence of themes and sub-themes from the data collected in this research.

Figure 3.9 Themes and Sub-Themes merging in the context of the Transition from Primary to Post-Primary Science Education.



3.11 Summary

The research design and methodology employed in this study have been outlined in this chapter. The data from the relevant sources (pupil questionnaire and interview, teacher questionnaire) was combined to give a holistic portrayal of the experiences and perspectives of pupils and teachers of the teaching and learning in the science classroom, using methodological triangulation.

It was important to acknowledge that the correct sample size depends on the purpose of the study and the nature of population under scrutiny (Cohen *et al*., 2007) and in this study, a total sample size of 23 pupils and 12 teachers was yielded. Furthermore, triangulation was used in this study as it noted that it is one of the most important concepts in qualitative research (Slavin, 2008). It was used to reduce biases and increases the validity and reliability of the conclusions (Schwandt, 2007).

A total of 2 items were designed as collection tools, questionnaire and interview, all of which were piloted in advance. Confidentiality of all participants was assured through the distribution of questionnaires by the researcher, individual schools and class teachers. Data analysis involved the separate analysis and subsequent cross referencing of data from all sources, pupils and teachers. Major themes were then identified and linked to recent research findings in the literature, and the data was then presented in terms of the research questions, which were established at the outset of this study.

By utilising informed consent, research was conducted with the utmost sensitivity for the participants. Geographical spread and small sample size were identified as limitations of the study. It was acknowledged that the findings and results gained in this study are not representative of the entire target population, nor may they be considered statistically reliable but they may be of interest in the area of science education across the transition from primary to post-primary schools.

Chapter 4

Research Analysis, Interpretation and Discussion of Findings

The Transition from Primary to Second-Level Science: The Pupils' Perspective

4.0 Introduction

The following chapters present a discussion of the findings and outcomes which emerged during the course of this research. These findings are based on data derived from the pre-transition and post-transition pupil and teacher questionnaires conducted and also from data obtained in interviews with these pupils on both sides of the transition. Where possible, the researcher attempted to utilise two or more data sources to support findings (**Figure 3.2**). The information gathered was verified and organized thematically to bring out the major issues and concerns among both pupils and teachers regarding the transition. The following chapters will combine the relevant theory and previous findings with the results of the empirical research collected during this research. Although the insight gained with regard to issues in science across the primary - post-primary transition is undoubtedly of major importance and pertinence, other related and inter-related themes of equal importance emerged thus explaining the existence of these secondary themes. The findings, interpreted and discussed here, are organised in terms of a four-fold scheme of themes represented again below (**Figure 3.9**).

What follows in Chapter 4 is a thorough presentation of the findings derived from the pre and post transition pupil questionnaires and interviews. Data derived from these methods is combined with data from other sources, such as teacher questionnaire responses. Themes and sub-themes in this section are presented under the following key headings and will look at the findings in order to provide a multi-faceted overview of the pupils' perspective of the study of science from primary to post-primary school.

- **Theme 1: Pupils' expectations of science across transition.**
    - General expectations of science.
    - Working independently or cooperatively.
    - Doing experiments.
    - Evaluation of pupils' expectations following transition.
- **Theme 2: Pupils' attitudes to science across the transition.**
    - Pupils' Attitudes to Learning Science
        - *Pupil Enjoyment of Science*
        - *Science is Easy*
        - *Importance of Science*
        - *Other Issues Arising*

- Issues in the Science Classroom
    - *Doing Experiments*
    - *Working in Groups*
    - *Writing and Reading*
    - *Questioning in Science Class*

The following chapter, Chapter 5, will present findings derived from the primary and post-primary teacher questionnaires. It will evaluate the concerns of teachers in the teaching of science across the transitional phase and also analyse the continuity that exists between the Primary Science Curriculum and the Junior Cycle Science Syllabus.

4.1 Overview of Themes in Chapter 4

Theme 1: Pupils' Expectations of Science across the Transition

It is postulated that a factor in regression in pupil interest and uptake of science is that pupils' expectations of post-primary science are not being met (Campbell, 2001).It is widely recognised in the United Kingdom and a number of other countries that pupils enter their post-primary schooling with very high expectations of science and positive attitudes towards it. Over the succeeding years though, interest in science generally wanes, especially in chemistry and physics (Osborne *et al*., 1998). This section gives a clear and concise picture of pupils' expectations of science in the final years of primary and initial stages of post-primary school in the Irish context. In developing this theme, other equally important patterns emerged such as pupils expectations of increased investigative work and independent learning. Evaluation of their expectations following transition also yielded significant comparison with Campbell (2001) above.

Theme 2: Pupil Attitudes to Science across the Transition

In a report for the Wellcome Trust, Murphy and Beggs (2005) stated that if the current problem of declining interest in school science is not urgently addressed, it will lead to a reduced number of scientists and science teachers in the future. There have been further international studies (Jarman, 1984; Speering, 1995; Tobell, 2003) which have shown that an incoherent transition to post-primary education in science is detrimental to student interest and uptake of the subject at later stages of education. The pupils' feelings and emotions, behaviours and opinions on the issue of transition in science education were central to the data leading to the findings in this section. While examining the data collected in this

research, other subsequent themes emerged. Pupils' experiences of the science classroom yielded further issues affecting pupil attitude to science across the transition.

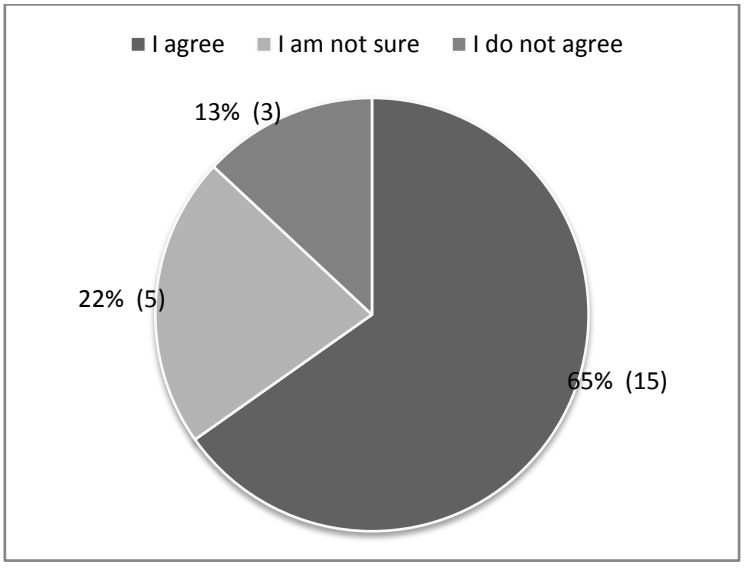
4.2 Theme 1: Pupils' Expectations of Science across Transition

One distinct section of the pupil questionnaire examined the pupils' expectations of science learning prior to transition to post-primary school. The purpose of this was to evaluate how the above pupil attitudes to science curricula affected pupil expectations both before and after transition. It also aimed to examine and find out any issues arising in pupils' expectations following transition to post primary school. It examines primary pupils expectations of post-primary science in general, of working independently and collaboratively, doing experiments in first-year post-primary, working with new equipment and in the laboratory and repetition of learning. It also investigates if expectations are being met following transition to first-year post-primary and if pupils will continue future studies in science once at post-primary school.

4.2.1 Primary pupils' expectations of science in general

Pupils were asked at the end of 6th class primary school to state if they were looking forward to studying science in first-year post-primary school. The following figure (**Figure 4.1**) presents these findings:

Figure 4.1 I Look Forward to Doing Science (N=23)



65% of primary pupils surveyed admitted to looking forward to studying science in post-primary school. Seven pupils commented during the pupil interview on how much better science would be in post-primary school (**Appendix I**). There is an understanding among primary pupils that while learning in science may become more difficult, it will be more interesting and engaging. Pupil 1 (Primary Interview) stated '*It will be a bit harder and there will be lots more things to do, like different things and the experiments will be harder but she'll go through them'*. Another pupil, Pupil 13, also comments on pupils developing ability in science. '*It'll be getting harder but while it's getting harder you'll be getting better'* (Primary Interview). Pupil 12 notes a belief among primary pupils that they will be given more responsibility in post-primary school science (Pupil12, Primary Interview).

Five of the pupils (22%) were unsure at the end of their final year in primary school if they were looking forward to science studies. Pupil 2 (Primary Interview) commented 'In *first year it might be like a small step kind of harder and then up along the years it gets harder, so first year it'd be ok'.* Three pupils, 13%, were not looking forward to the experience. A number of pupils expected to be writing and reading more, and also to be repeating topics already learned in primary school. When questioned in the interview, pupils commented on having to do more writing. Pupil 13 (Primary Interview) expected there to be '*More work writing; well have a lot more writing in secondary school'*. There appears to be a belief that topics would be the same as in primary school but with more detail (Pupil 11, Primary Interview,). Studies by Campbell (2001) point out that the majority of pupils expected content to be the same but that it would be more difficult and more extensive. His studies also found that a number of pupils expressed an expectation that at secondary school, they would be given more responsibility for their learning (Campbell, 2001).

4.2.1.1 Working independently and collaboratively

Pupils were then asked if they believed they would work by themselves and/or with their friends in their first-year science classroom. **Figures 4.2** and **4.3** below present the findings;

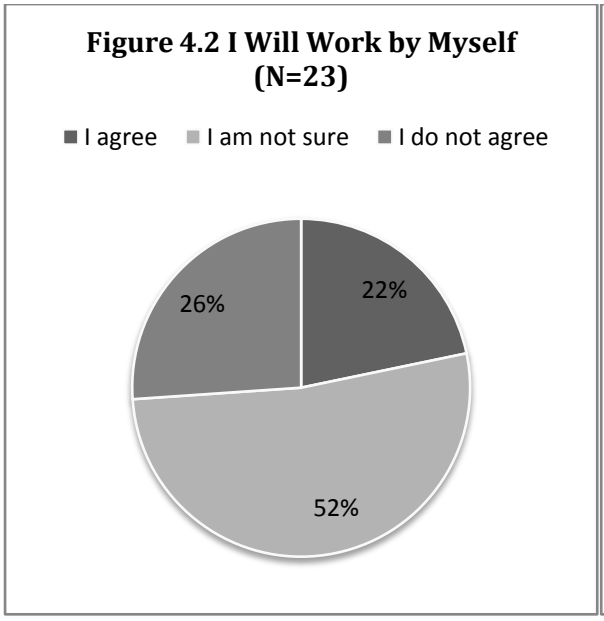


Figure 4.2 I Will Work by Myself (N=23)

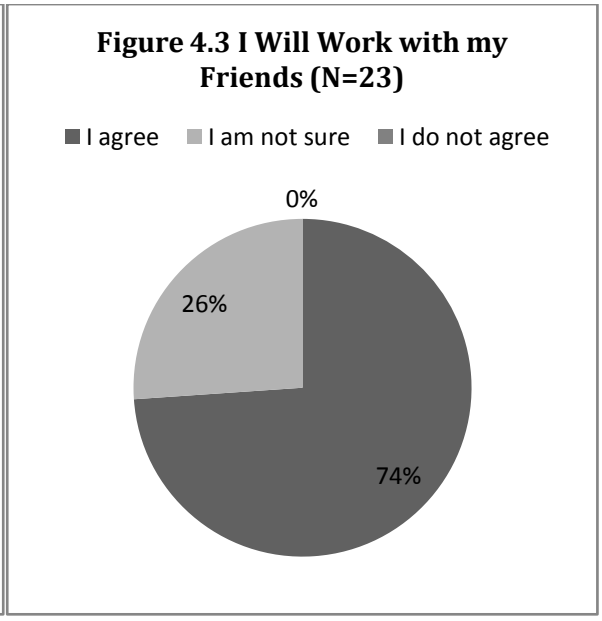


Figure 4.3 I Will Work with my Friends (N=23)

Figure 4.3 clearly indicates that primary pupils expect to work with their friends in post-primary science class. 74% (17 out of 23 pupils) agreed with the statement. However, in contrast, a large number of the respondents (52%) were unsure if they would work by themselves in their first-year post-primary science class. Pupil 12 (Primary Interview) stated *'I think we will do paired work and maybe some group work*'. Pupil 4 (Primary Interview) also stated '*I'm expecting us to be in groups of two and you'll be explaining to someone else, maybe our partner or the teacher but there'll be no explaining to the small people*(younger pupils in the classroom)*'.* Pupil 12 (Primary Interview) pointed out there is '*A couple of table and a few on one – in pairs. Better because you won't have to be disagreeing with more people'*.

4.2.1.2 Doing Experiments

A large majority of the respondents were of the opinion that they would do experiments when in first-year post-primary school. Pupils expected experiments to be more interesting and 'real'. Pupil 11 (Primary Interview) points out '*Experiments will be different they'll be better than in primary school they were only simple experiments'*. **Figure 4.4** indicates that pupils have high expectations of having the opportunity to do experiments themselves and

seeing less teacher demonstration of experiments.

Figure 4.4: I Will Do Experiments Myself (N=23)

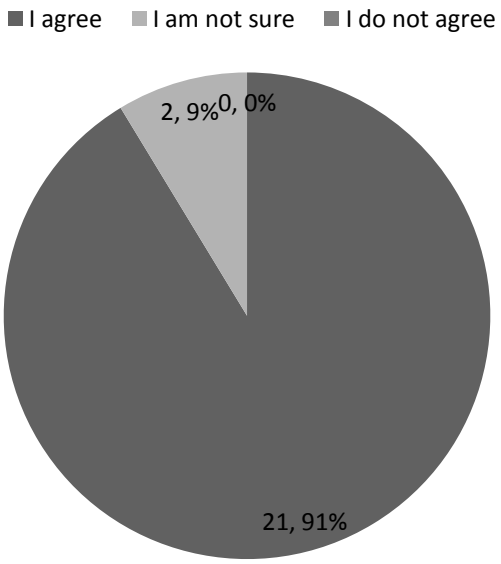
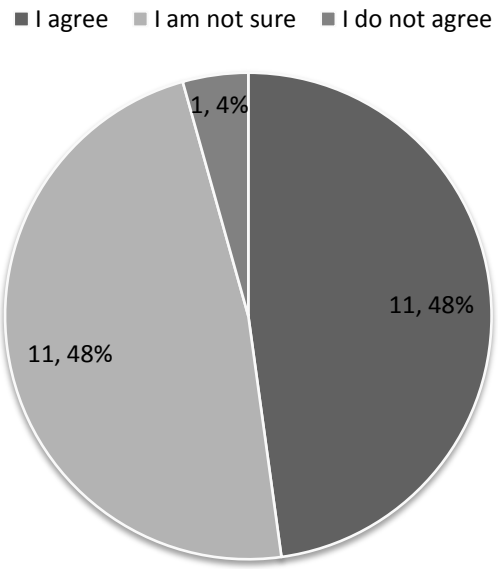


Figure 4.5: My teacher will do experiments (N=23)



Ninety-one percent of pupils (21 out of 23) expected they would do experiments themselves once at post-primary school. There is high expectation among pupils that more responsibility will be given to them upon entry to post-primary school, thus empowering them to do more experiments on their own in science. Pupil 11 (Primary Interview) stated '*I don't think the teacher will be doing the experiments. I think we'll be doing them and she'll be going around'*. In response to this Pupil 12 added "*she'll write the steps on the boards and we'll follow them. We'll have more responsibility*' (Pupil 12, Primary Interview). Pupil 23 (Primary Interview) also states '*I guess we will be able to do more experiments on our own'*. In further studies by Campbell (2001) pupils also had an expectation of continuing personal experimentation. However, eleven pupils were also of the opinion that the teacher would do the experiments. When questioned further in the interview, pupils stated, '*The teacher would do the experiment and we might have to do it afterwards in groups and then write down about it'* (Pupil 3, Primary Interview).

Pupils' expectations of doing more experiments are heightened by visits to their new schools prior to entry. Pupils develop a particular view of their new role in learning science at the open day. Pupil 2 (Primary Interview) states '*I think we'll do lots of experiments because we were down there one night and they had lots of different acids and all these kind of explosions and stuff'*. Pupil 6 (Primary Interview)points out '*We saw the 2nd years doing stuff in the lab with acids, just watching them do it.* Pupil 12 also recalls seeing experiments

on a visit to their new school. '*He showed us a bit of red blue tack and it was bouncy'* (Pupil 12, Primary Interview). Pupils also acquired expectations of the type of topics they would learn about in post-primary science from the open day. Pupil 16 (Primary Interview) commented that they would learn '*more of the human body because in the science rooms there's more of the models'*.

Findings indicate pupils expect to be doing 'real' science experiments, with expectations that they will be in a laboratory and using specialist equipment. Pupil 3 (Primary Interview) states '*We'll be doing our science in the lab every day*'. Pupil 11 (Primary Interview) adds *"Well I hope we do more experiments than this year we'll have like an actual room, a science room for doing experiments".* Pupil 15 (Primary Interview) comments on science being better in post-primary school '*because all the equipment will be in the room and you won't have to be going in and out'*. Another pupil, Pupil 20, specifically mentions new equipment as part of a typical science lesson in post-primary school. They expected to be using '*microscopes and test tubes and the box things'* (Pupil 20, Primary Interview). Campbell (2001) also found that there was a notion that primary science was not genuine and that once at post-primary school, pupils would be doing 'proper' science. Pupils expected to be in laboratories with specialised equipment and facilities which contrasted with the classroom science of primary school and with simple apparatus (Campbell, 2001).

4.1.2.3 Evaluation of Pupils Expectations Following Transition

Following the transition to post-primary school, pupils were questioned further the realisation of the above stated expectations. More pupils commented negatively (10) on their expectations being met than positively (6) (**Appendix J**)**.** Pupils found science was not what they had expected it to be**.** Pupil 18 (Post-Primary Interview) states '*I thought it would be a lot more different'*. Pupils expectations that they would perform large amounts of personal experimentation were not realised. Pupil 6 states (Post-Primary Interview) '*I thought we'd be doing way more experiments'*. Pupil 7 (Post-Primary Interview) points out that science is not what they thought it would be '*because we don't do enough experiments in class, we should do one once a week'*. Another pupil, Pupil 10, also comments on the amount of experimentation and the increase in written work. '*I thought it would be all experiments every second day and that, but it's more writing now'* (Pupil 10, Post-Primary Interview).

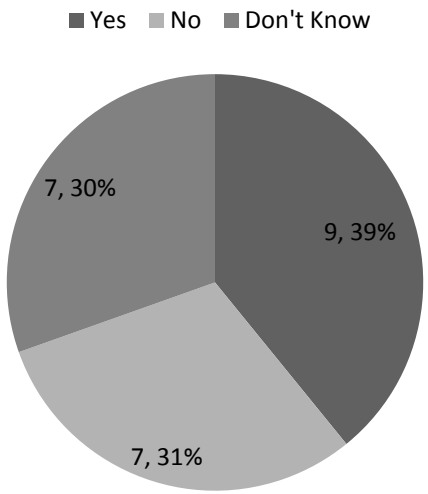
Five pupils commented throughout the interview **(Appendix J)** on the above increased written work load. Pupil 6 (Primary Interview) states '*Ya, like you do a lot of writing...*' Pupil 12 (Primary Interview) adds '*There's a load of writing'*. Pupil 13, while stating an understanding of the expectation of large amounts of writing, expected to be in the laboratory. '*I knew there'd be lots of writing but I thought we'd be in the lab more'* (Pupil 13, Primary Interview).

Three pupils commented in the interview on not being in the laboratory as much as they expected (**Appendix J)**. Pupil 22 consolidates Pupil 13's stance above and states '*... and we only get in the lab every three weeks for the double'* (Pupil 22, Post-Primary Interview,). Pupil 21 (Post-Primary Interview) also states '*but were only in the lab every three weeks and it's not a lot really'.*

Pupils had expected to be doing more, what they presumed to be, 'real' science in post-primary school. Pupils had acquired certain expectations of science from the media and public perceptions. Dissections and explosions were believed to be part of post-primary school science and findings indicate that these expectations had not been realised. Pupil 17 (Primary Interview) states '*We all thought we'd all be doing biology and cutting stuff up'*. Pupil 21 (Primary Interview) expected there to be '*Loads of explosions, it's kind of boring, though, now thinking it wouldn't be my favourite'*. Pupil 20 and 22 both made reference to science on the television and having expectations based on that. Pupil 20 (Post-Primary Interview) states '*I thought it would be like the telly like dangerous and that. But it's not, we only use the Bunsen burner and that was the worst'*. Pupil 22 (Post-Primary Interview) adds they thought it would be '*Like on the telly, dissecting things and stuff*'.

4.2.1.4 Future Studies in Science

Figure 4.6: Will you continue to study science? (N=23)



Nine pupils stated they would continue to study science following their experiences in their first year of post-primary school (**Figure 4.6**). Pupil 11 (Primary Interview) states '*Ya I'd like to keep doing biology it's interesting'*. Pupil 3 (Primary Interview) states '(I*)...probably will pick one of the subjects'*. Many pupils see choosing at least one of the science subjects an advantage to their future studies. The remaining respondents are split evenly, with 7 pupils stated as unsure if they will continue their studies in science and 7 stated as not continuing. Pupil 6 (Interview) states '*No I don't think I'll stick with any of them'*. Pupil 13 (Interview) adds '*It's hard, you have to work at it'*. Pupil 21 (Interview) also states '*No, it gets harder in Leaving Cert'*.

4.3 Theme 2: Pupil Attitudes to Science across the Transition

Pupils were questioned on their attitudes to learning science; first at the end of their primary education and subsequently following their first year in post-primary school. Pupils were asked in both questionnaire and interview to give their view on a number of broad aspects of their learning of science in school; their enjoyment of science, the importance of science in the world around us and the chances of them pursuing a career in science. They were also asked if they found science easy, if it was their favourite subject and if they look forward to doing science in school. Furthermore, the responses of their teachers as regards their confidence in teaching the subject were analysed simultaneously. The researcher was

thus enabled to compare and contrast the learning in science of these pupils across the transitional phase with the responses of their teachers as given above.

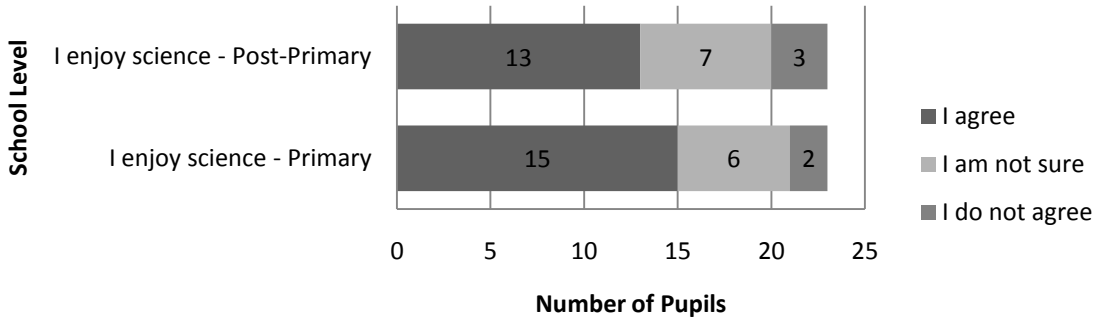
The following are the key findings which emerged in regard the attitudes and experiences of pupils in their learning of science in both primary and post-primary school.

4.3.1Pupil Attitudes to Learning Science

4.3.1.1 Pupil Enjoyment of Science

It is clear from **Figure 4.7** below that most of the pupils (15 out of23) agreed that science is an enjoyable subject to learn in primary school. Just two of the pupils questioned were in disagreement with the statement. **Appendix I** shows that 22 out of 23 pupils responded positively when asked in the primary pupil interview if they enjoy learning science. Of particular note are nine pupils who are cited as having positive opinions on doing experiments and seven pupils who indicated that they found science interesting, fun and exciting (**Appendix I**). Pupil 5 (Primary Interview) noted a high level of interest in learning science in primary school, "*Ya, it's fun. It's interactive because we get to do lots of experiments and stuff like that*". Pupil 10 (Primary Interview) also indicated that they find science interesting *"It's fun and it's good to know stuff when you're older".* **Figure 4.7** shows the overall enjoyment of the subject remains relatively high (13 out of 23) when pupils were re-evaluated at the end of their first year in post-primary school.

Figure 4.7 Pupils' Enjoyment of Science (N=23)



Interestingly, when both primary and post-primary teachers were questioned on their confidence regarding the teaching of science, results show just one primary teacher rated themselves as very confident in their teaching of science. Notably the majority of the primary teachers questioned (4 out of 6) did not rate themselves as in any way confident in

their teaching of science with two primary teachers rating themselves as having limited confidence in teaching science (**Figure 5.1).** In contrast, teachers in post-primary schools were overall more confident in their teaching of science in general than their primary counterparts. The majority of post-primary teachers (4 out of 6), are rated as being very confident in their teaching of the subject (**Figure 5.1).** When compared with the figures above (**Figure 4.7**) it is clear that while primary teachers are less confident in teaching science, more primary pupils (15 out of 23) enjoy learning science. Therefore findings here appear to suggest it may be difficult to link overall pupil enjoyment of science with teacher confidence levels with just an increase of 2 pupils in such a small sample size.

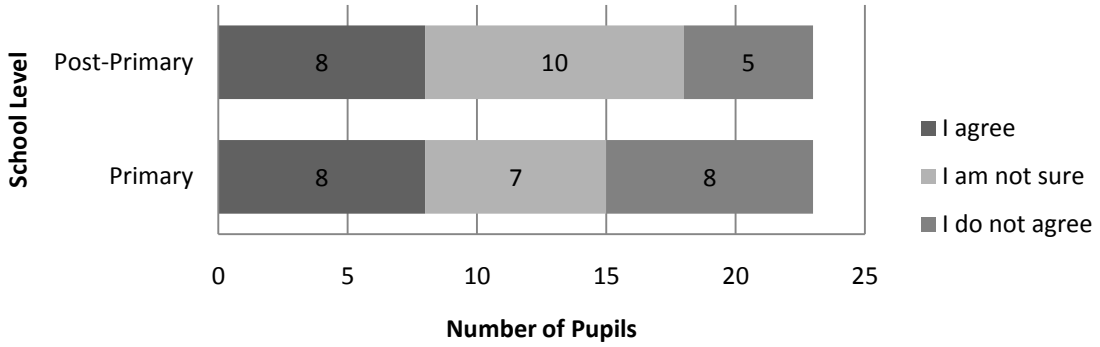
However, findings in this study also indicate that a noteworthy number of the pupil respondents, 8 out of 23, do not enjoy learning science (including those not sure). As shown in **Figure 4.7** six pupils were unsure how they felt about learning science at the end of primary school. Two pupils responded negatively when questioned further in the interview (**Appendix I).** A statement by Pupil 18 (Primary Interview) points to the falling interest in school science. "*Well it's ok, I kind of like it and I don't as well. I just like the way some of the things are very interesting and then I think some things are boring*". Further comments by Pupils 11 and 23 indicate a lack of interest in primary school science "*It's good most of the time, but a lot of the time you're taking stuff down from the board into your copy and you're not doing the experiments* (Pupil 11, Primary Interview). "*I don't think there's any part of science I like doing, well anything I've learned anyway... I don't even understand science properly* (Pupil 23, Primary Interview). Furthermore, when questioned at the end of their first year in post-primary school, there are a still a number of pupils who responded negatively to learning science (**Figure 4.7**). Seven pupils responded as unsure about their attitude to learning science and three rated themselves as not enjoying science. Pupil 2 (Post-Primary Interview) stated *"Not really. I didn't like learning about water and ice and just didn't think it was* (enjoyable)**.**Therefore 10 out of 23 pupils responded negatively at the end of their first-year in post-primary school compared to 8 out of 23 at primary level thus it would appear from these findings that pupil engagement and interest in science can be seen to diminish following transition to post-primary school.

4.3.1.2 Science is easy

A further aspect of pupils' attitude to their learning in science across the transition is how they compare their ease of learning from primary to post-primary school. According to **Figure 4.8** there is uncertainty among pupils when asked how easy they view learning in

science in both primary and post-primary. Results are spread quite evenly throughout the three categories. Eight pupils feel science is an easy subject, seven were unsure about the statement and eight did not feel learning in science was straightforward (**Figure 4.8**). Pupil 8 indicated that while at certain times it can be comparatively difficult in primary school, there are times when it can easy such as carrying out experiments (Pupil 8, Primary Interview). Pupil 10 also indicated in the primary pupil interview (**Appendix I) ,** "Y*a, I think it's fairly easy, like some parts are hard alright, like when you're learning about the heart and you have to learn all that, that's kind of hard remembering all that".* In their first year of post-primary school, while, there is an increase in uncertainty among pupils with (10 out of 23) unsure if science is an easy subject (**Figure 4.8**), there is a decrease in the number of pupils who do not consider science an easy subject.

Figure 4.8 Science is Easy (N=23)



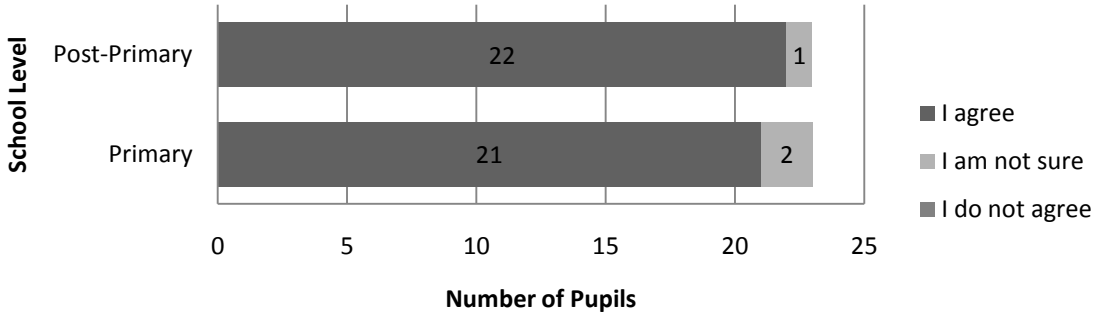
This would appear to contradict the findings of Jarvis and Pell (2005) and Osbourne and Simon (1996) who concluded that there is a relationship between teacher's subject matter confidence and their pupils understanding and attitude. In this instance, with an increase in post-primary teachers confidence levels in teaching science and while pupils found science less difficult following transition, this did not equate to an increase in the number of pupils stated as finding science easy (**Figure 4.8**).

4.3.1.3 Importance of Science

Figure 4.9 below indicates that pupils (in both primary and post-primary) show a positive attitude to the importance of science in the world around us. Twenty-one primary and twenty –two post-primary (**Figure 4.9**) pupils agree with the above statement. Further evidence confirms this understanding among pupils of the advantage of learning about how things work and also the benefits of learning science (**Appendix I).** Pupil 7 and Pupil 8 (Primary Interview) explain *"You learn about the world and how things work and it's*

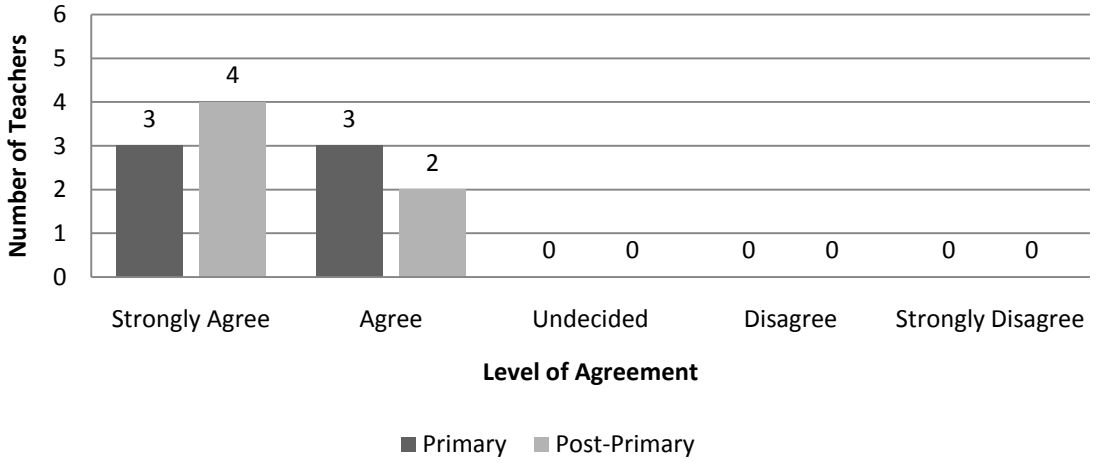
important... ya, well some of them invented cars and made it easier then walking like, it's easier to drive then walk" (**Appendix I).** Pupil 10 (Primary Interview) also stated "*It's fun and it's good to know stuff when your older*" (**Appendix I).** Only two (out of 23) pupils in primary school and one (out of 23) in post-primary school were unsure about the above statement (**Figure 4.9**). No pupil questioned in either primary or post-primary school disagreed that 'science is important in the world around us'.

Figure 4.9 Science is Important in the World Around Us (N=23)



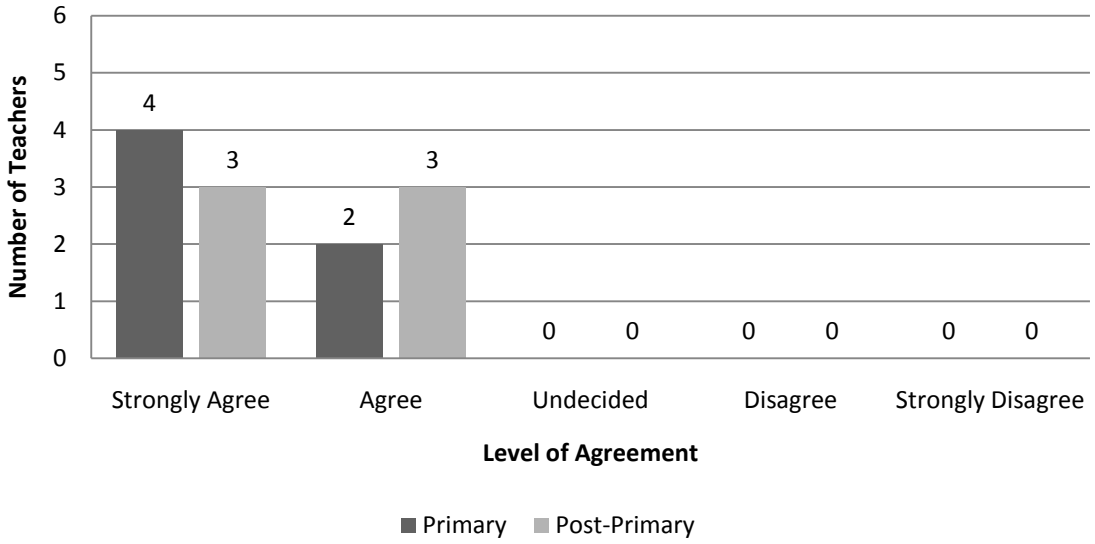
The positive opinion of pupils to the importance of science is heightened by the obvious significance placed on this concept by teachers. Half the primary teachers surveyed (3 out of 6) strongly agreed that they should make their pupils aware of the importance of science with four post-primary teachers also strongly agreeing with the statement **(Figure 4.10).** Furthermore, the remaining three primary and two post-primary teachers are cited as agreeing with the statement.

Figure 4.10 Pupils Should Be Made Aware of the Importance of Science in Their Lives (N=12)



Four primary teachers and three post-primary teachers strongly agree that pupils should be enabled to recognise how their learning in the classroom relates to the world around them. The remaining two primary teachers and three post-primary teachers agree.

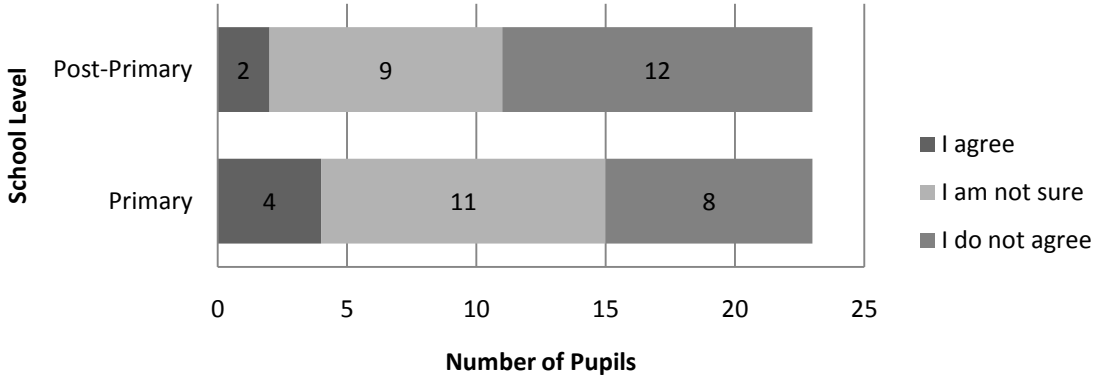
Figure 4.11 Pupils Should Recognise How Classroom Learning Relates to the Outside World (N=12)



4.3.1.4 Other issues arising

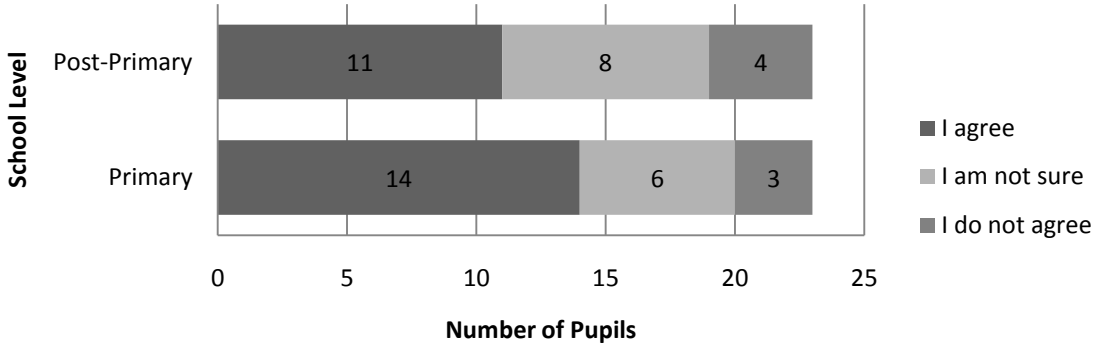
It is noted from **Figure 4.12** that just four (out of 23) of the pupils in primary school and just two (out of 23) of the pupils in post-primary school indicated that science was their favourite subject, a decrease of 2 pupils. When compared with **Figure 4.7** it is notable thus that the number of post-primary pupils who are stated as enjoying science also decreased by 2 pupils. Therefore, pupils' opinion of learning science once at post-primary school may be compared to their level of enjoyment at post-primary level. There are more subject areas to choose from once at post-primary school and it would appear from this research and other studies (Kirkpatrick, 1992; Mullins and Irvin, 2000) that post-primary pupils reported disillusionment with their learning in science in their early secondary school experiences due to increased awareness of other subject areas.

Figure 4.12 Science is My Favourite Subject (N=23)



Furthermore, **Figure 5.6 and Figure 5.7** also indicates that where there is an increase in post-primary teachers' confidence in teaching science, it does not appear to affect pupils' attitudes to their learning in science. When asked if they look forward to doing science, just 11 (out of 23) pupils at post-primary level agreed with the statement, compared to 14 (out of 23) at primary school. This again can be related to **Figure 4.7** and **Figure 4.12** where a decrease in post-primary pupils' level of enjoyment and attitude to learning science was recorded. Therefore, there appears to be obvious inconsistencies and contradictions to the findings of Osbourne and Simon (1996) and Jarvis and Pell (2005) who stated that there is a relationship between teachers' subject knowledge and their attitudes to teaching science which in turn can affect pupils' understanding and attitudes to science. Findings in this research study clearly indicate that while post-primary teachers responded to having higher levels of confidence in teaching science (**Figure 5.1**), fewer pupils enjoy learning science, fewer pupils rate science as their favourite subject and fewer pupils look forward to doing science once at post-primary school.

Figure 4.13 I Look Forward to Doing Science in School (N=23)



4.3.2 Pupil Issues in the Science Classroom

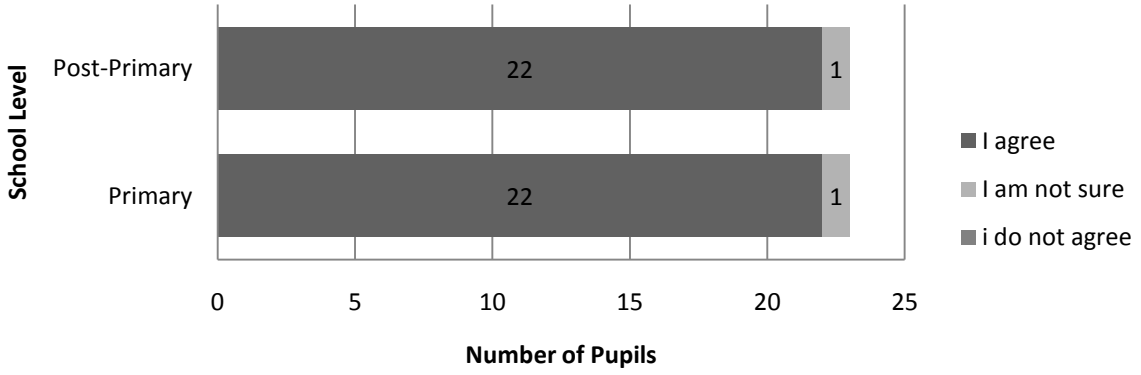
One distinct section of the pupil questionnaire and interview examined the pupils' attitudes to aspects of how they learn in the science classroom. As stated above, the purpose of this study was to investigate the issues and concerns of pupils in their everyday experiences of science at both primary and post-primary level. This section is presented under the following themes; doing experiments, working in groups, writing and reading and questioning.

4.3.2.1 Doing Experiments

According to the Primary Science Curriculum (DES, 1999), learning science should enable the child to develop the skills of working scientifically, which emphasis an approach to investigations and to designing and making. As children use and apply these skills they will learn to deal with more complex concepts and scientific knowledge. These science skills are component parts of an investigative approach to science (DES, 1999). Throughout most stages of a scientific investigation children will observe, predict, attempt to explain and communicate. Therefore, pupils were questioned about their level of enjoyment in doing experiments, the role of the teacher in carrying out investigations and furthermore, working with their friends on investigations.

Firstly, pupils were asked to rate their level of enjoyment in doing 'experiments' in their science lesson. The findings are presented in **Figure 4.14.** No pupil, in either primary or post-primary school, is cited as not enjoying experimentation in science and furthermore, findings below indicate that self-experimentation is most popular with an overwhelming majority of pupils (**Figure 4.14**).

Figure 4.14: I enjoy doing experiments (N=23)



Twenty two pupils in primary and an unchanged number (22 out of 23) of post-primary pupils were stated as enjoying doing investigations in their science class with just one pupil unsure in each class level. These figures correspond with findings by Varley *et al.* (2008a) which state that Irish primary children are very positive about hands-on science and appear to have opportunities to engage in it. It is also clear from these figures that the interest developed during the primary school years in investigation does not fall on transition to post-primary school.

Out of a total of 21 positive comments on science in general, '"doing experiments"' was cited 9 times by pupils at the end of primary school (**Appendix I**) and 8 times at the end of post-primary school (**Appendix J**). **Appendix I and Appendix J** clearly show the positive attitudes pupils on both side of the transition have towards doing investigations in science. When asked at the end of primary school if they like science Pupil 3 (Primary Interview) stated '*Ya, because you get to do experiments'*. Another pupil cited the reason for liking science was how interactive it is and getting to do experiments (Pupil 5, Primary Interview). When asked what topics in particular stand out as being enjoyable, 9 pupils stated '*doing experiments'* (**Appendix I).** Many pupils cited doing experiments as '*easie*r' than other aspects of their science lesson such as reading, writing and learning off. Pupil 5 (Primary Interview) also stated that it is more interesting and engaging for pupils to be engaged in experimentation. They state '*It's alright, if its stuff on the board it's not that great but if its stuff like experiments I like that*. Pupil 2 (Primary Interview) pointed out advantage of being active while learning science. '*I don't like all the writing. You have to write a description of all the stuff, it's just easier to just do the experiment*. Pupil 6 (Primary Interview), also, noted a more positive attitude towards carrying out investigations compared to written activities. '*It's when we do work like experiments in groups and get to talk about it rather than doing worksheets like'*. Pupil 11 (Interview) stated '*I like experiments, and, I don't really like reading, because I find it like hard enough to learn'*. Pupil 1 (Post-Primary Interview), upon studying science in post-primary school, noted an increase in interest in doing investigations due to the wider range of activity involved. '(I like learning about)*...chemicals and that, because we get to do loads of experiments and the chemical part of it*). Pupil 9, also cited being in the laboratory as a further positive aspect of doing experiments. '*Doing all the different experiments in the lab*' (Pupil 9, Post-Primary Interview).

Further information on pupils' attitude to carrying out their own experiments was obtained from their responses to the statement 'I enjoy planning my own investigations'. Their teachers were first asked if they believed their pupils should plan and carry out their own investigations. The following **Figure 4.15** and **Figure 4.16** presents these findings.

Figure 4.15 Pupils Should Plan and Carry Out Their Own Investigations (N=12)

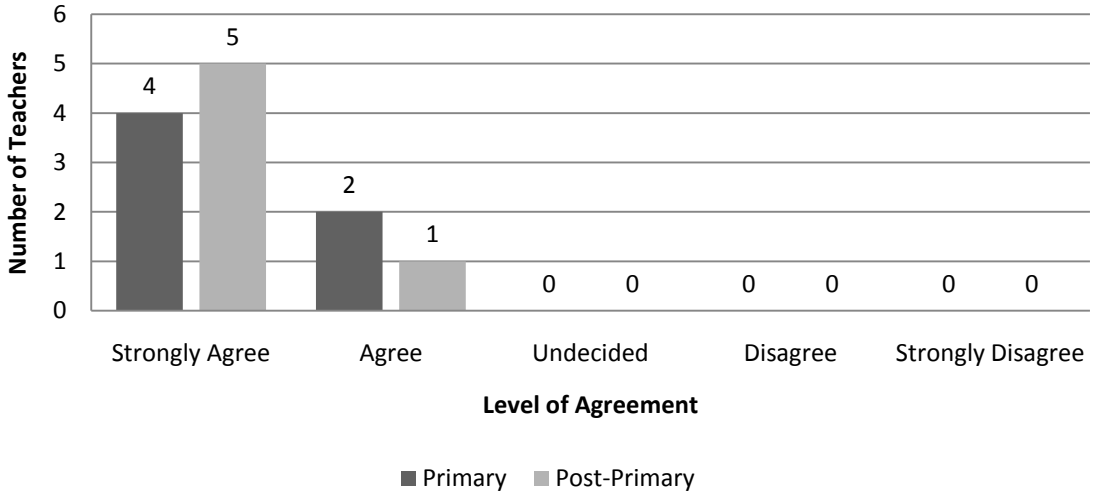
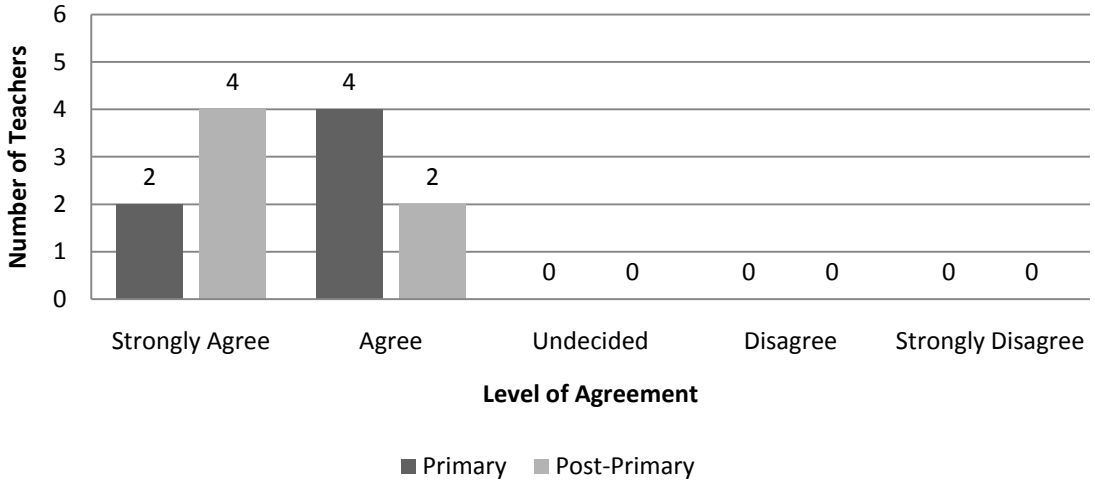


Figure 4.16 Pupils should Make Predictions, Obsevations, Recordings and Presentations (N=12)

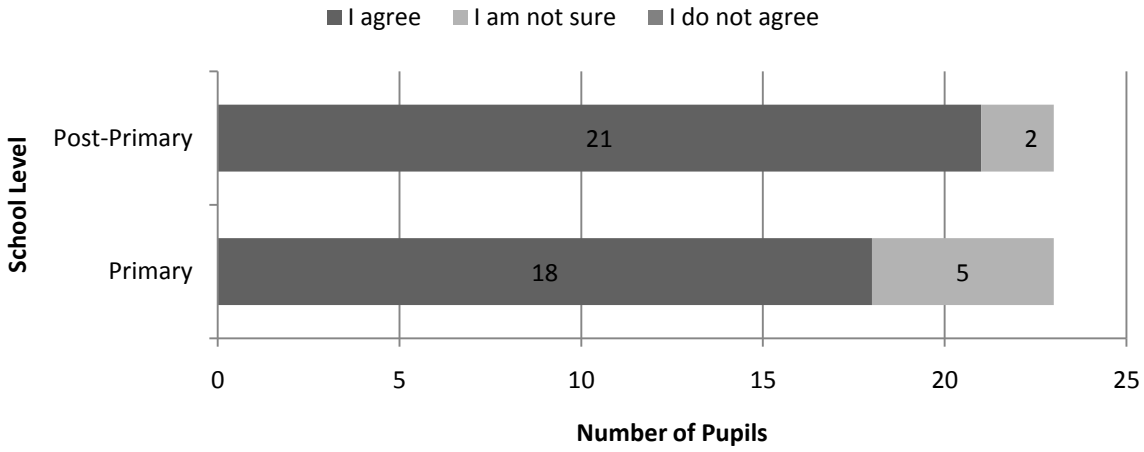


The majority of teachers (4 out of 6 primary and 5 out of 6 post-primary) were in strong agreement that pupils should have the opportunity to plan their own investigation and furthermore carry out these investigations themselves. Although two primary teachers strongly agreed that pupils should make predictions, observations, recordings and presentations when completing investigations, in comparison, a small increase to four post-

primary teachers were in strong agreement with the statement. While this research indicates that teachers are overall positive about the use of pupil-led investigations as a teaching methodology in their classroom, findings by Jarvis and Pell (2005) show that initially teachers may feel themselves apprehensive about providing open-ended practical activities. It was deemed necessary therefore to question if pupils experience of personal experimentation matched the enthusiasm of their teachers.

The following figure and section thus illustrated the pupil's responses to the statement (**Figure 4.17).**

Figure 4.17 I Enjoy Planning My Own Investigation (N=23)



A significant majority of pupils when questioned at the end of their first year of post-primary school (21 out of 23) stated they enjoyed planning their own investigation, an increase of 3 pupils in comparison to results from the previous year in primary school. While pupils enjoy the notion of planning their own investigations, further questioning indicated that pupils do not get much opportunity for planning their own investigations in primary school, with many commenting on having to listen to the teacher and follow instructions before carrying out any experiment. When asked if they plan their own investigations Pupil 9 stated '*No because Miss **** has us already told what to just go and do the planning thing'* (Pupil 9, Primary Interview). Pupil 13 also noted this issue. '*Ya, the teacher would put up on the board the steps of what we have to do'* (Pupil 13, Primary Interview). Another pupil, Pupil 4, believes that not planning your own investigations is a significant issue and can affect learning in science. '*Well like sometimes if she's doing them then we kind of know what to do, so it's basically like were following her orders, but sometimes you're better off just doing it yourself that way you'll find out more'* (Pupil 4, Primary Interview).

When pupils were further asked to respond to a number of statements based on 'who' is doing the experiments in primary and post-primary science classrooms, **Figure 4.18** to **Figure 4.20** clearly indicate that pupils across the transition prefer to do the experiments themselves and/or with their friends.

Figure 4.18 I Like Watching the Teacher Doing the Experiments (N=23)

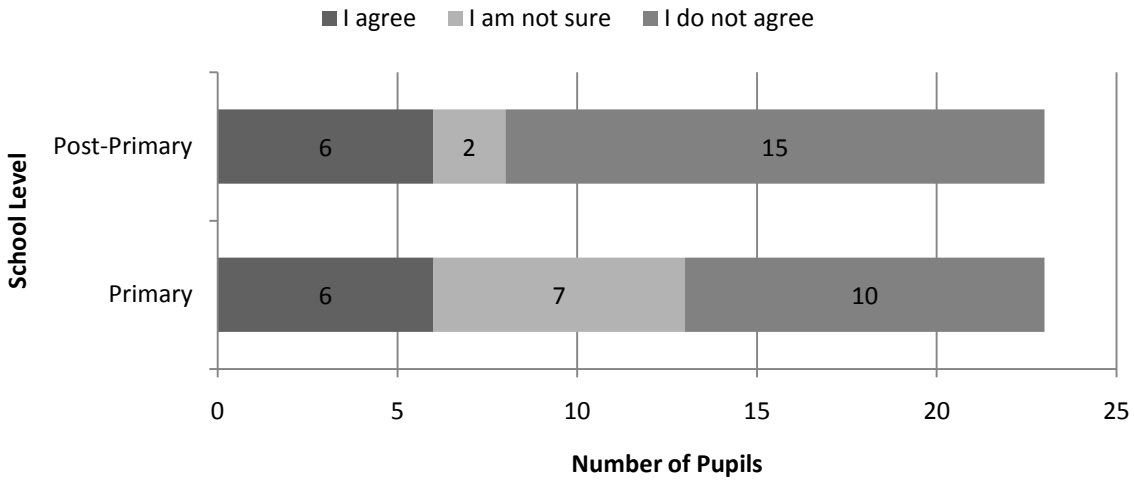


Figure 4.19 I Like Doing the Experiments Myself (N=23)

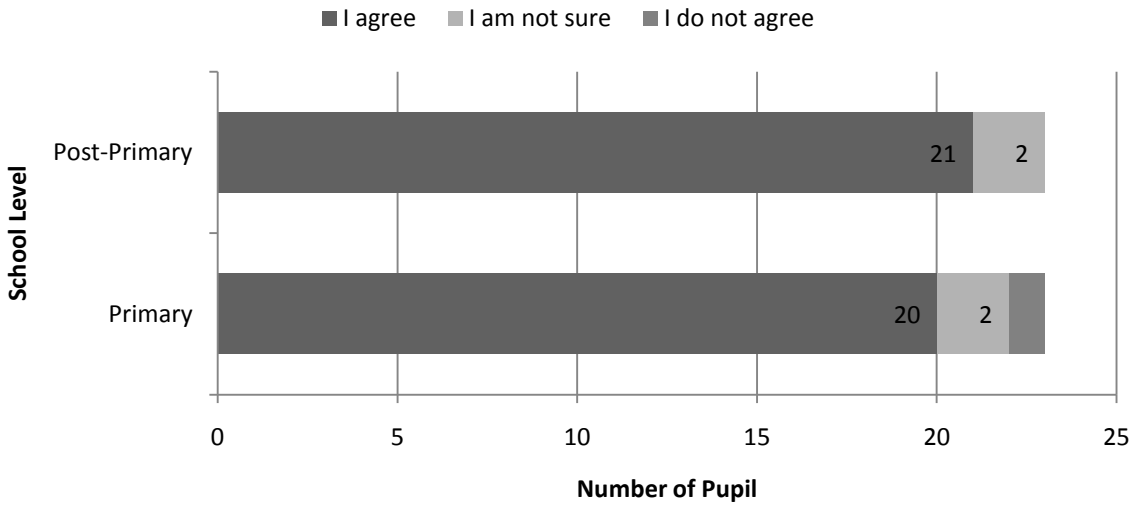
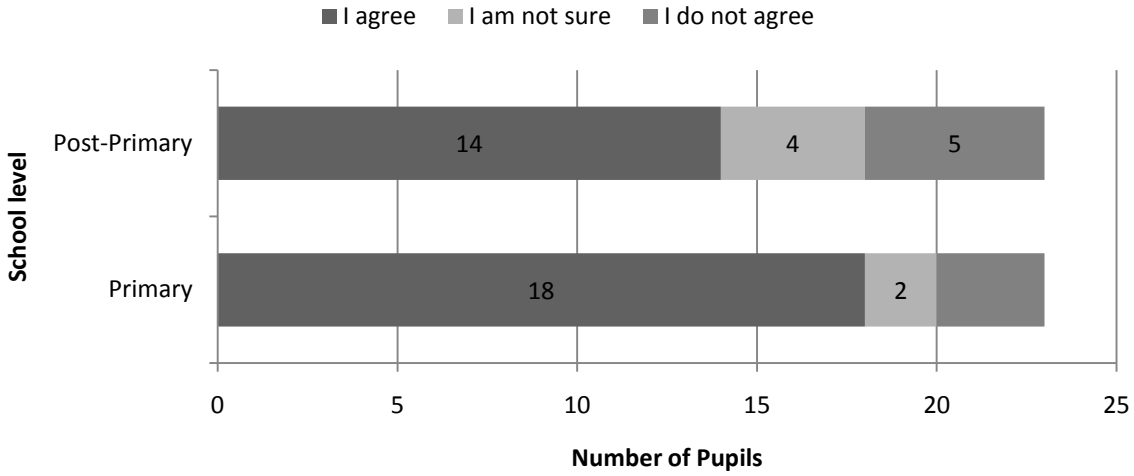
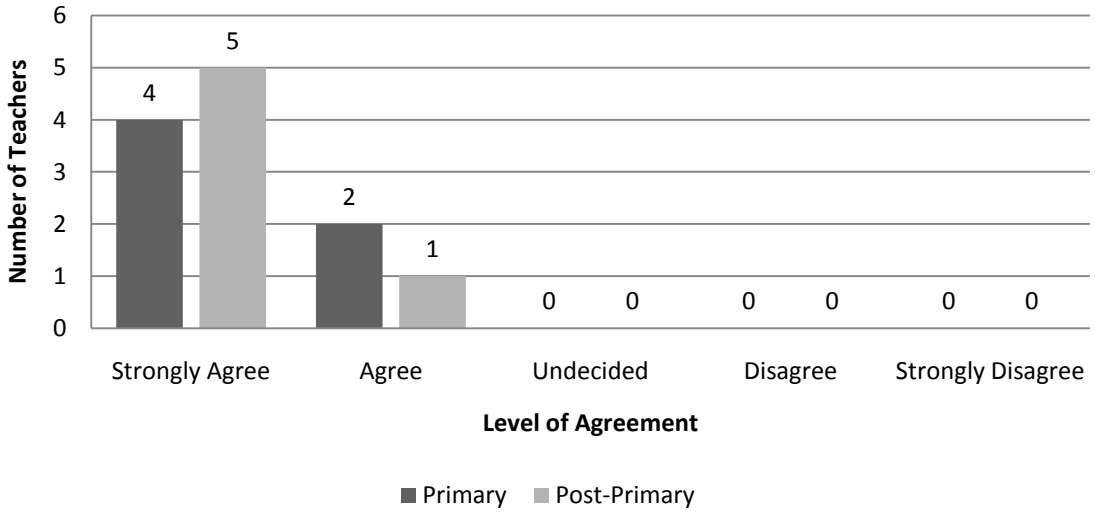


Figure 4.20 I Like Doing the Experiments With My Friends (N=23)



When asked further if they liked watching their teacher doing the experiments, the majority of pupils in both primary (10 out of 23) and post-primary (15 out of 23) did not agree with the statement. **Figure 4.18** clearly indicates that with the number of pupils in disagreement clearly increased across the transition. Further studies by Varley *et al.* (2008b) show that in comparison with primary school pupils, first year students appear to be more unenthusiastic about teacher demonstration of science experiments. Findings in this study indicate that both primary and post-primary teachers agree that pupils should think for themselves in science class (**Figure 4.21**). The majority of teachers from both school levels strongly agree with the statement.

Figure 4.21 Pupils Should Think For Themselves (N=12)



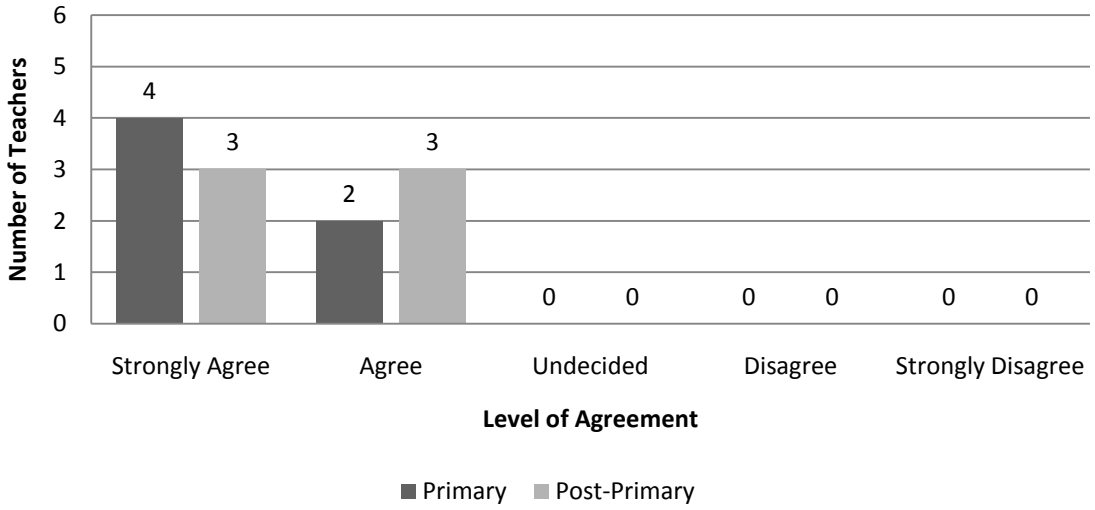
However, Speering (1995) notes that the change between primary and post-primary science is especially striking; as science in primary school is usually activity based and student centred providing strong contrast with post-primary science which is teacher centred and content driven. This researcher questions if the positive opinions of teachers regarding pupil-personal experimentation displayed in **Figure 4.15** above are carried through to the teaching methodologies utilised to promote interest and engagement among pupils in the science classroom.

Just six primary and six post-primary pupils stated they liked watching the teacher doing this aspect of the lesson (**Figure 4.18**). A number of pupils did indicate during the interview that they liked when the teacher explained and demonstrated the experiment before they did it themselves. Pupil 2 (Primary Interview) state ' *We mostly do* (the experiments) *the teacher would do it first on the board, she'd label it first on the whiteboard and then she'd tell you to connect the wire to this and that and then we'd go off and maybe have to change things'.* Pupil 6 (Primary Interview) points out: '*First our teacher shows us what we have to do in the experiment and then we do it. He does it first so we can see what to do'.* This trend continues into first year post-primary with 3 pupils commenting on their teacher doing the experiment in the science lesson (**Appendix J).** Pupil 2 (Post-Primary Interview) states '*He does them first and then he shows us and then we go and get the equipment and we do it'.* Another pupil, Pupil 12, comments on how their teacher carries out the experiment at the same time as the pupils '*She does it while we're doing it, at the same time'* (Pupil 12, Post-Primary). It should be noted however, that as Speering (1995) stated above, post-primary school is a more teacher centred and content driven learning experience and thus, it must be noted in this research that a certain amount of teacher demonstration is recommended at this point of science education.

4.3.2.2 Working in Groups

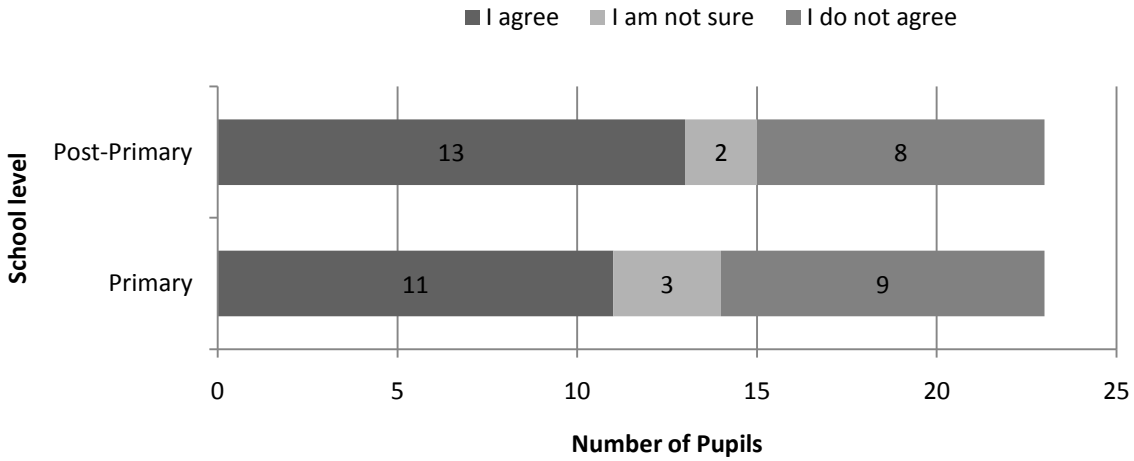
Teachers were questioned on their attitude to their pupils working together in science class. The following figure presents the findings (**Figure 4.22).**

Figure 4.22 Pupils Should Learn From One Another (N=23)



The research clearly shows that both primary and post-primary teachers in this study strongly agree that their pupils should learn from one another in science class. While teachers appear to understand the benefits to pupil learning attributed to the use of peer support in the science classroom, pupils' attitude to group-work in this study is split between both positive and negative opinion.

Figure 4.23 I Like Working in a Group to Talk About Things in Science (N=23)



When asked their opinion on working in groups in their science class there were similar responses from pupils across the transition, with 11 out of 23 pupils in primary school stating they liked working in groups. This number increases to 13 by the end of their first year in post-primary school (**Figure 4.23)**. Eight pupils commented at the end of first year that working with their friends was a positive and worthwhile experience (**Appendix J**)**.** They

felt their learning was being supported when working in either pairs or groups. Pupil 1 (Primary Interview) stated '*I like it, it might be a bit hard and they can help out with more people'*. Pupil 2 (Primary Interview) also commented on the positive aspect of working in groups '*Well sometimes it's good because it can be hard and maybe someone else would be able to do it*'. Pupil 8 mentioned '*if any of your friends are stuck you get to help them'* (Pupil 8, Primary Interview). Pupil 17 clearly explains the use of group-work in their science lesson. '*Usually she gives us a topic, like the last thing was for history and stuff, but like she gives us a topic and you have to go to the computer and find out about your topic and like what happens. And being in a group is kind of better because you don't know what to look for and you don't know what to put down and what not to put down'* (Pupil 17, Primary Interview). Pupil interest and enjoyment in science increased when pupils worked in groups. As Pupil 6 clearly indicates '*I like it because it's more fun and you get to be with your friends'* (Pupil 6, Primary Interview).

However, a significant number of pupils do not like working with their peers in science class. Nine (out of 23) primary and eight (out of 23) post-primary responded negatively as shown in **Figure 4.23.** Seven pupils commented on negative factors influencing group work at the end of their primary science learning (**Appendix I**). These issues included other pupils being bossy, not listening and not having a specific job within the group. Pupil 4 (Primary Interview) states that '*Sometimes people can be a bit bossy and they take over and you'd just be sitting there watching'*. Pupil 12 (Primary Interview) also comments '*Sometimes the people would be talking when you're trying to do it*'.

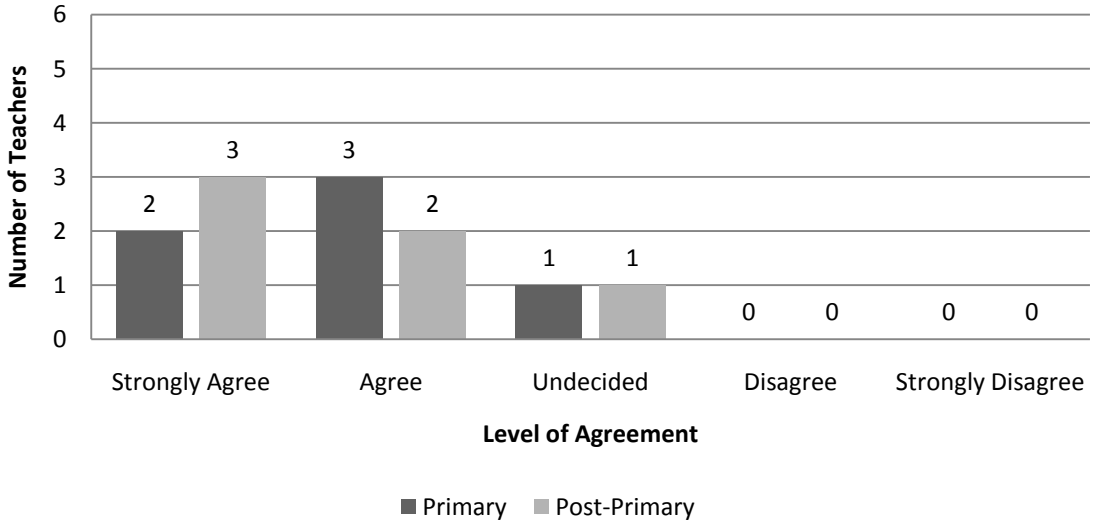
It is clear thus, that pupils continue to seek assistance and support in science from their peers following transition to post-primary school. Though their primary teachers appear more disposed to the use of group-work (**Figure 4.22),** more pupils in post-primary school stated they enjoyed working in groups to talk about things (**Figure 4.23).** There appears to be issues at primary level, however, with the organisation of groups. Pupils in primary lose enthusiasm for learning in science when their ideas and opinions are not being listened to in their peer group. It is in the best interest of pupils continued eagerness in science education if primary pupils' group-work could be better organised to ensure that all pupils are given opportunity for their voice to be heard.

4.3.2.3 Writing and Reading

One specific section of the pupil research examined the pupils' attitude to writing and reading as part of their learning in science across transition. Pupils were questioned about their level of satisfaction with writing and reading activities in their science lessons before and following transition. Writing in science class may consist of completing worksheets, assignments, taking notes and copying from the board. Many studies suggest that pupils do not receive experience of a varied range of possibilities for recording and communicating their work and thus pupil attitudes towards writing in science lessons are not entirely positive (Varley *et al*., 2008a). Findings in this study indicate the issue of large amount of writing and learning as state above, is a reoccurring concern for pupils in experience of learning science.

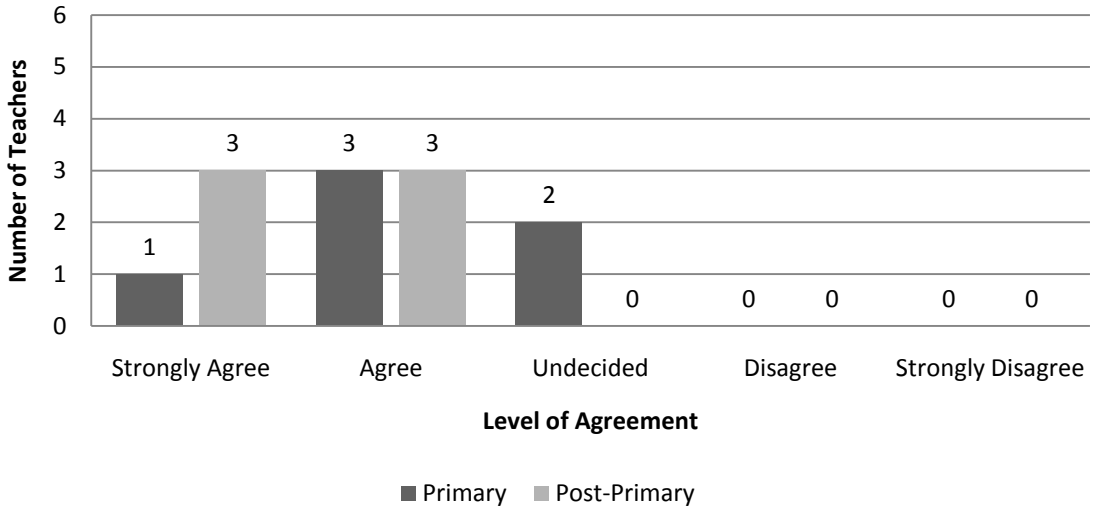
First, however, teachers were questioned on their attitudes to pupil written work in their classroom. The following are the findings.

Figure 4.24 Pupils Should Copy Notes From the Board (N=12)



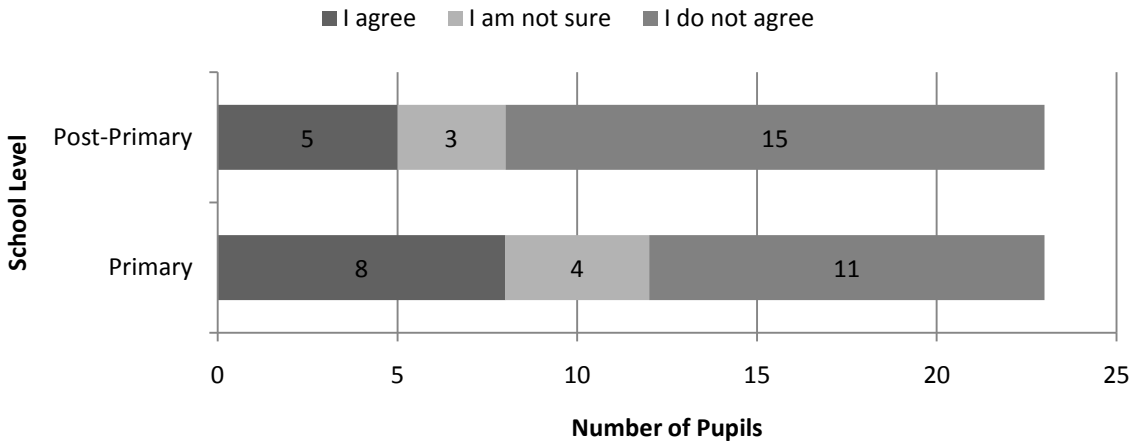
A large majority of both primary and post-primary teachers agree that pupils should copy notes from the board in science class. Two primary teachers and three post-primary teachers are in strong agreement. However, one primary and one post-primary teacher were undecided on this issue. It is notable, that no teacher either primary or post-primary stated they disagreed with pupils copying from the board.

Figure 4.25 Pupils Should Choose to Take Their Own Notes (N=12)



Thus, looking at the evidence collected above, it would appear that post-primary teachers in particular are contradictory in their approach to pupil note-taking. While half of the post-primary teachers strongly agree that pupils should copy notes from the board, half also strongly agree that pupils should have freedom of choice to take their own notes in class (**Figure 4.25**). Could such an inconsistency in teaching methodologies at post-primary school affect pupil attitude to learning in science. It was therefore deemed necessary to ask pupils, before and after transition, to rate their level of enjoyment while writing in their science lesson. These findings are presented below in **Figure 4.26.**

Figure 4.26 I Like Writing About What I Do in My Science Lesson (N=23)



The research clearly indicates that both primary and post-primary pupils feel that they do too much written work in science (Murphy and Beggs, 2005). While eleven (out of 23)

pupils in primary school above (**Figure 4.26**) stated they did not like writing about what they do in science class, this figure increased to fifteen (out of 23) following transition. Similarly, a total of seven comments were recorded during this research pointing to the large amounts of written work in the science classroom as a factor contributing to the development of negative attitudes to science (**Appendix I and Appendix J**). This research confirms the findings of Osborne *et al.* (1998) that any activity other than hands-on experiments, such as written work, are seen as "barriers" to real learning by pupils at both levels. Post-primary teachers focus on large amounts of copying and writing notes is seen in a negative light by pupils upon transition to post-primary school. Furthermore, this study has found that large amounts of written work at post-primary school does not live up to pupils expectations of activities in the post-primary science (Chapter 4, p.71)**.** Pupils had expected there to be more experimentation and less written work upon transition to first year post-primary school consolidating findings by Osborne *et al.* (1998) above. Large amounts of teacher-led, content-driven writing holds no value among pupils at either level. This research has shown that in order to promote enthusiasm across the primary –post-primary divide, teaching strategies must be child-centred and focus on the pupils own learning.

The following **Figures 4.27** and **4.28** clearly indicate that writing through copying from the board and doing worksheets is a contentious issue for pupils, particularly following transition.

Figure 4.27 I Like Copying From the Board (N=23)

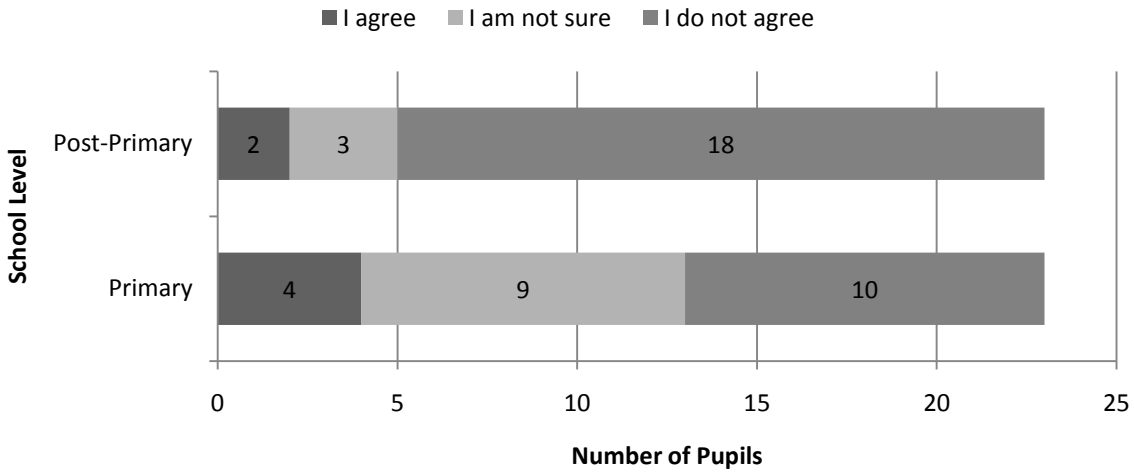


Figure 4.28 I Like Doing Worksheets (N=23)

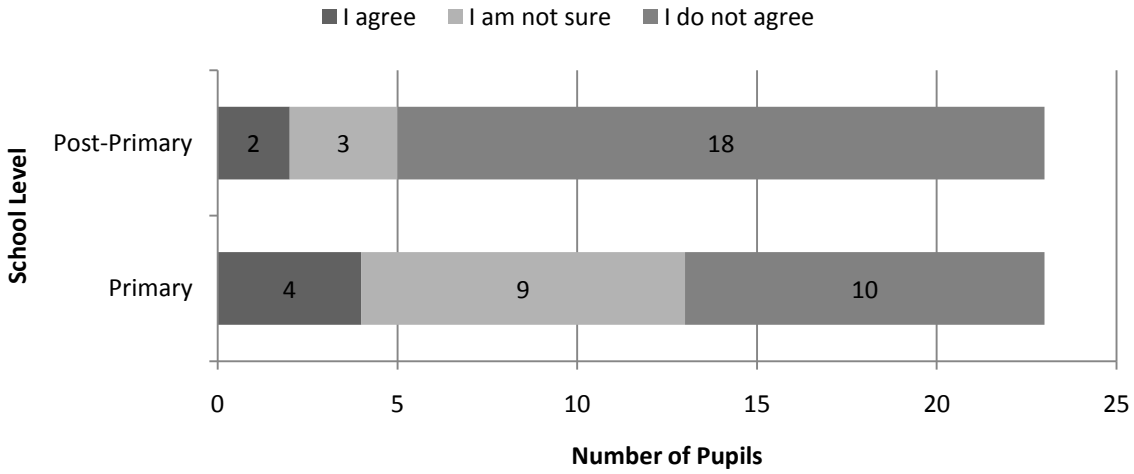


Figure 4.27 plainly shows that while 10 sixth class pupils state they do not like copying from the board. One pupil, in the interview at the end of primary school, clearly indicates that pupils feel writing from the board is a barrier to learning in science. '*We had to take down all the writing from the board after we came in. It's just a waste. I'd rather spend more time doing the experiments'* (Pupil 6, Primary Interview). Pupil 5 (Primary Interview) commented '*Then we have to take down a lot of writing from the board, all the notes about what we did, and our results. It's the worst part, it's so boring'*. Pupils evidently continue to dislike writing from the board well into post-primary school. The number of pupils stated as disliking writing increased from 10 to 18 at the end of first-year in post-primary school. Two pupils in post-primary school commented on an increased amount of writing. Pupil 6 (Post-Primary Interview) stated '*There's more writing after it* (the experiment). Pupil 20 continues the above argument that learning is being impeded by large amounts of writing and copying.

'*I don't like all the writing we have to do. I just want to like do the experiments and not be reading all about them and that like'* (Pupil 20, Post-Primary Interview).

In primary school, pupils experience with written work is often confined to worksheet-type activities. Ten pupils by the end of primary school do not like doing worksheets in their science class (**Figure 4.28**). Such negative opinions may develop among pupils due to the fact that in many of the primary schools in this study, pupils do not have their own science book, but receive photocopies from their teacher. Pupils 1 to 3 state '*No, our teacher she has a science book and she photocopies that and say at the end of the year we might get a test on the sheets we have done. She gives us all the sheets at the end so we can revise and look over them'* (Pupil1-3, Primary Interview). Post-primary pupils, when questioned further appear to prefer writing in their books and copies than doing worksheets. Worksheets are associated with primary school and as Pupil 9 states '*We only had worksheets last year. We didn't really know what we're doing'* (Pupil 9, Post-Primary Interview). There is an opinion among pupils now in post-primary school that writing in worksheets in primary school did not amount to 'real' science. However, as Speering (1995) found post-primary school is a more teacher centred and content driven learning experience. There is a major focus in post-primary school on copying content-driven discussion notes from the board. Pupils thus have little choice in the amount of or the content of their written work in post-primary science class. Results above (**Figure 4.27 -4.28)** show that large amounts of teacher-led written work is leading to cynicism among post-primary pupil regarding the way in which they learn science.

Further investigation into pupil learning in science from primary to post-primary school led to pupils being questioned on their attitude to the use of a science textbook.

Figure 4.29: I like using my science book (N=23)

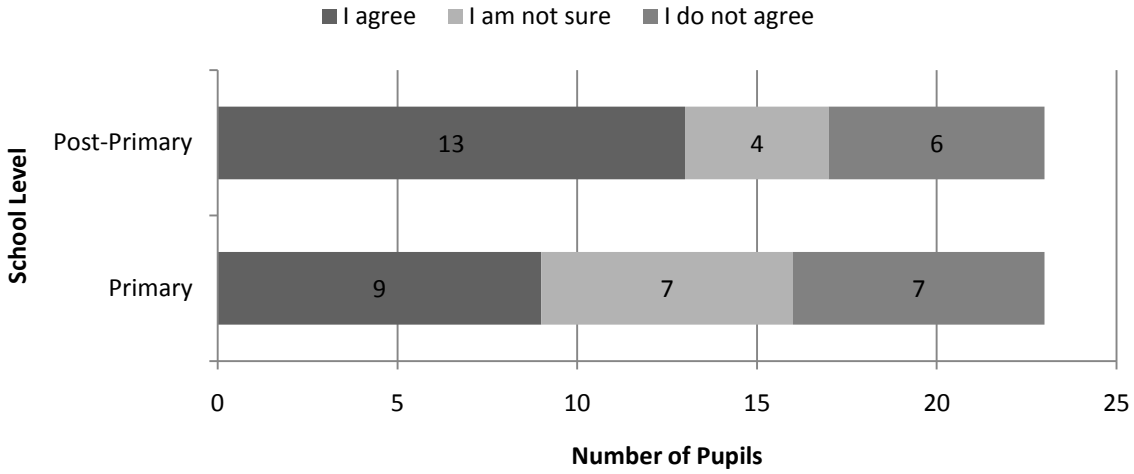


Figure 4.29 clearly shows that pupils' opinions on the use of their science book were spread evenly across all preferences at the end of primary school. It must be noted here that not all participating pupils in this research study have access to a science textbook but utilise photocopies and worksheets provided by their teacher. Thus where nine pupils stated in the questionnaire they liked using their science book at the end of sixth class (**Figure 4.29)** and a further seven pupils responded positively to using their science book when questioned during the interview (**Appendix I),** this increase in positive opinion may be due to the fact that pupils may have a science textbook for the first time in first-year post-primary school**.** *'It's a good book because all the experiments in it are good and real life things and there's questions – real life and experiments'* (Pupil 10, Post-Primary Interview*).*

As noted above by a number of primary pupils, many schools at primary level do not use science textbooks but receive photocopied pages from their teacher. Further investigation indicates that primary schools who do use science books are, in the majority, a combined SESE book, with History, Geography and Science in the one book. Pupils in this study commented on these combination books being more interesting than a singular science textbook. Pupils 8 to 10 stated, when asked if they had a science book '*Ya, we have a book called Earthlinks, for history, geography and science* (Pupil 8, Primary Interview)... *We also have a book called science all around me, but we only used it once, and we had it last year and we didn't use it at all* (Pupil 10, Primary Interview)... *I think Earthlinks is just a better book* (Pupil 9, Primary Interview)...*Ya, its go history and geography in it as well'* (Pupil 10, Primary Interview). The above **Figure 4.29** clearly indicates that attitudes to using their science book improve upon transition to post-primary school. Just over a majority of pupils

(13 out of 23) like using their science book, an increase of 4. Pupils now have a book specifically for science and find it more interesting than a combination book or simply receiving worksheets. Pupil 10 (Post-Primary Interview) consolidates this point "*Ya, it has a lot more interesting points than last year and this one comes with a workbook ".* Pupil 6 (Post-Primary Interview) states '*Ya I like it and you can write it up after you do it and you can look at it after and do diagrams'.* Another pupil, Pupil 11, also comments on the increase in interest in using a science book '*Yes, I like reading it, there's interesting stuff in it'* (Pupil 11, Post-Primary Interview).

This research clearly indicates that pupils' opinion of using a science book improves significantly upon transition to first-year post-primary school. Many pupils commented on not having a specific science book at primary school, a number stated as not having any book at all. Thus, upon transition to post-primary school, pupils view having an explicit book for science with added interest. This point may relate to the issue above (Chapter 4, p. 70) that both primary and post-primary pupils undervalue their primary science curriculum (Campbell 2001). Pupils view not having a specific science textbook in primary school as confirmation that primary science should not be taken seriously as a 'real' subject. As stated above, there are serious concerns regarding the image and status of primary science. Findings above show that once at post-primary level, interest in the use of a science textbook increases significantly (**Figure 4.29).** Therefore, this researcher argues that in order to promote high levels of interest and enthusiasm for science developed at primary level (**Figure 4.7**) onto post-primary level it would be beneficial for primary pupils to have a subject-specific science textbook prior to transition.

4.3.2.4 Questioning in Science Class

A section of this study deals with the issue of questioning and discussion between both pupils and teachers in the science classrooms. Pupils' opinions on talking in science, on being questioned by the teacher and posing questions themselves were examined. **Figure 4.30** indicates that pupils, both in primary and post-primary, view science as a subject where discussion and dialogue is commonplace between pupils themselves and between pupils and their teacher.

Figure 4.30 Science is a subject full of things to talk about (N=23)

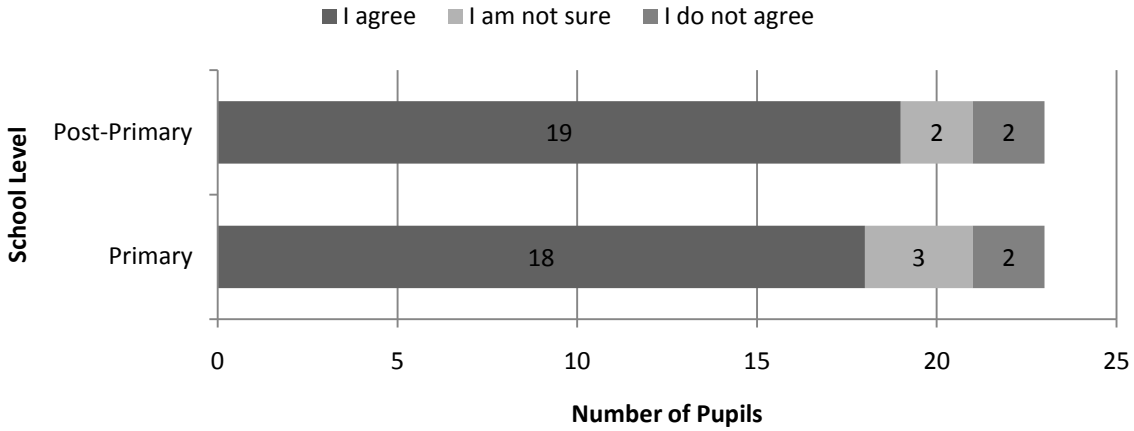
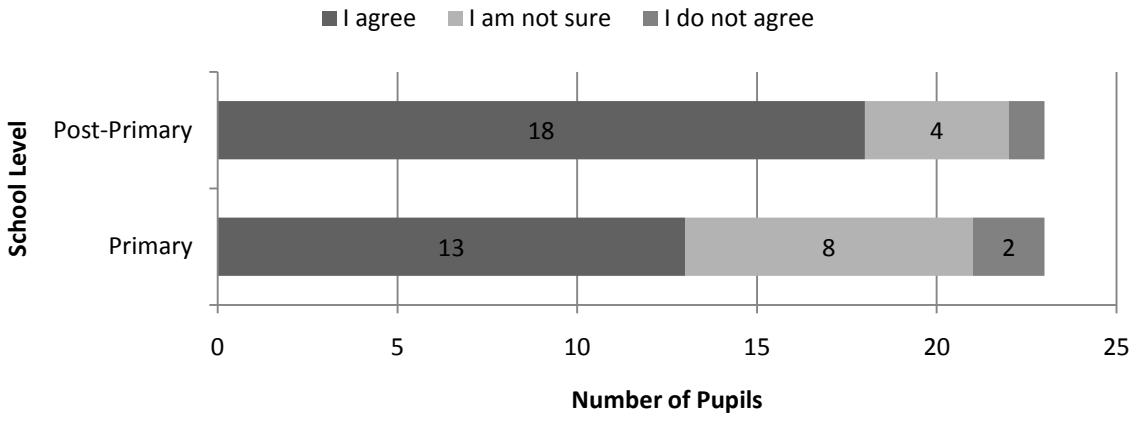


Figure 4.31 below indicates further affirmation of the teacher's role in the science class as stated previously. Pupils are of the opinion that talking in science incorporates teacher questioning. Pupils were asked if 'My teacher often asks us questions about science'. The following are the results.

Figure 4.31 My teacher often asks us questions about science (N=23)

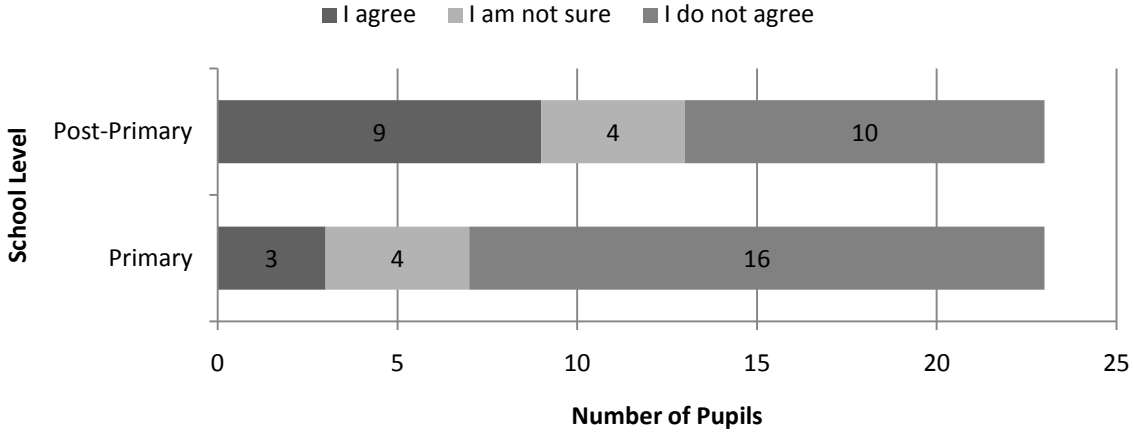


Thirteen (out of 23) pupils in sixth class stated that their teacher often asks questions about science in their lesson. Notably, this number increases to 18 (out of 23) pupils after the first year of post-primary school. Pupil 8 (Primary Interview) at end of sixth class primary stated '*Well you'll either see us listening to Miss **** while she's doing up stuff or us going up and she asking us questions, and doing out projects if we're making them*". Pupil 8 comments on the increased use of teacher questioning at end of first year post-primary. '*It's alright because we don't do too much writing, more of the time he tells us*

stuff and he asks us questions and we talk about it and that"(Pupil 8, Post-Primary Interview).

The number of children discussing and asking questions about science with their friends is shown in the following **Figure 4.32.**

Figure 4.32 I ask my friends questions about science (N=23)



It clearly indicates that primary pupils, generally, do not receive as much opportunity as in post-primary school, to ask questions about science among their peers. A majority of 16 (out of the total 23) did not question their peers about science. This number drops to 10 pupils (out of 23) who did not recall asking questions of their friends in their science class in post-primary school. Pupils in this research have previously shown a positive attitude to working in a group to talk about things in science (**Figure 4.23**). In particular, 11 (out of 23) primary pupils stated they enjoyed working this way in their science lesson, compared to just 3 (out of 23) who stated they ask their friends questions about science. There appears to be a large amount of teacher talking rather than pupil discussion among themselves at primary level. Pupil 3 (Primary Interview) states '*The teacher does most of the talking'*. Pupil 7 (Primary Interview) points out '*We'd usually just listen to the teacher and take notes if you wouldn't think you'd be able to remember'*.

4.4 Further Discussion of Findings from the Pupils' Perspective

It would appear from the results of this study that, in the final stages of primary school, pupil interest in and expectation towards post-primary science is especially high. Seven

pupils commented during the pupil interview on how much better science would be in post-primary school (**Appendix J).** The discussion will be divided into the subsequent headings;

- Pupil High Expectations of Post-Primary Science
- Pupils Changing Attitude to Science from Primary to Post-Primary School

4.4.1 Pupils' High Expectations of Post-Primary Science

As illustrated in this study, primary pupils (Pupil 1, Pupil 5, and Pupil 7, Primary Interview) commented on how science would be '*more interesting*' and how they will '*do much more challenging things'*. These findings clearly indicate the high level of positive opinion pupils hold towards learning science before transition to primary school. However, the above findings have significant implications for this study as this research has found that these high expectations that are not being met upon transition to post-primary school. Evidence suggests that pupils find science is not what they believed it to be. Ten pupils in this research clearly indicated that they felt their expectations had not been met following transition. Pupil 18 (Post-Primary Interview) went so far as to state '*I thought it would be a lot more different'*. Their frustration was evident in a number of their comments; '(Thought we would do) *Loads of explosions, it's kind of boring though now thinking it wouldn't be my favourite'* (Pupil 21, Post-Primary Interview).

Results in this study also consolidate the findings of Varley *et al.* (2008a) who found that prior to transition, primary pupils have high expectations of having the opportunity to do experiments themselves and seeing less teacher demonstration of experiments when in post-primary school. Similar to Varley *et al.* (2008b) it was found that once in post-primary school first year students, found their expectations were not being met and became rather unenthusiastic about teacher demonstrations of science experiments. Findings clearly indicate that pupils had expected to be doing more, what they presumed to be, 'real' science in post-primary school. They consolidate studies by Ferguson and Fraser (1998) that pupils view primary science as not genuine and that once at post-primary school they would be doing proper science (Ferguson and Fraser, 1998).

This researcher found that pupils had acquired certain expectations of science from the media and generic perceptions of science and scientists (Chapter 4, p. 71). Pupil 20 stated, '*I thought it would be like the telly like dangerous and that'* (Pupil 20, Post-Primary Interview).

Pupils expected to see dissections and explosions as part of post-primary school science and findings indicate that these expectations had not been realised. Research findings imply that the expectation of being in the laboratory using various apparatus is largely unfulfilled. Similar to Galton's (2002) view that students' expectations of post-primary science might be unrealistically high due to pre-transfer induction or "taster" experiences, findings in this study indicate that, in particular, pupils' expectations of doing more experiments are heightened by visits to their new schools prior to entry. The research findings imply that primary pupils are shown activities and experiments on open evenings that they may not necessarily partake in themselves once in first-year, which in turn may lead to disappointment and disinterest in post-primary science following transition. This is leading to disillusionment with science at post-primary school and as is postulated by Campbell (2001), a factor in the aforementioned regression is that primary pupils' expectations of post-primary science are simply not being met.

4.4.2 Pupils' Changing Attitudes to Science from Primary to Post-Primary School

4.4.2.1 General Attitudes to Science

The pupils' feelings and emotions, behaviours and opinions on the issue of transition in science education were central to the data leading to the findings in this section. It is clear from the findings in this study that pupils in both 6th class primary and 1st year post-primary generally enjoy learning science. Pupils at both levels find it an appealing, enjoyable and exciting subject to learn. Pupils, particularly at primary level, appreciate the interactivity of science as a school subject. In well-planned, practical investigations, children's natural curiosity is channelled and they are equipped with the strategies and processes to develop scientific ideas and concepts (DES, 1999a: p.6). Findings here have shown that the objectives of personal, child-led active learning in the Primary Science Curriculum are being accomplished in the science classroom. It would appear that findings from this study are, to some extent, contrast with the assumptions by Murphy and Beggs (2005) that enjoyment and interest of science decreases following transition. It does however concur with studies by Varley *et al.* (2008a) that in the Irish context, pupils at primary and post-primary are well disposed to science. Furthermore, pupils' display largely positive attitudes to the importance of science in the world around them. As Pupil 7 states '*You learn about the world and how things work and it's important'* (Primary Pupil Interview). It is the aim of the Primary

Science Curriculum (1999a) specifically to help the child to appreciate the contribution of science and technology to the social, economic and cultural dimensions of society. It would appear therefore that this particular aim has been mostly achieved in this research.

However, a significant number of pupils, 8 (out of 23) primary and 10 (out of 23) post-primary, have developed negative attitudes to learning science either before or after the transition. This researcher believes that primary teachers' knowledge and confidence in teaching the content and skills of the science curriculum has implications across transition, leading to the formation of certain attitudes towards science by pupils even prior to transition. Firstly, an increase in uncertainty among pupils as to the ease of studying science was recorded. Pupils note that non-investigative activities such as learning large amounts of information and complicated vocabulary are comparably more difficult, particularly in primary school. As Pupil 10 indicated doubt about the ease of learning science by stating (**Appendix I)** "*Ya, I think it's fairly easy, like some parts are hard alright, like when you're learning about the heart and you have to learn all that, that's kind of hard remembering all that".* While Jarvis and Pell (2005) found that science should become less difficult following transition, this study established that though there is an increase in teacher confidence and instruction level at post-primary school, this did not lead to an increase in pupils' belief that science is 'easy'. Secondly, just two pupils at the end of their first-year in post-primary indicated that science was their favourite subject. Furthermore, the number of pupils in first-year who look forward to studying science decreased to fewer than half the pupil participants (11 out of 23). Findings in this study suggest that it is due to an increase in awareness of and participation in new subject areas, that student interest in learning science is being marginalised.

4.4.2.2 Issues in the Science Classroom

Pupils in this study were highly positive about 'hands-on' science and appear to have many opportunities to engage in it. It is clear from the findings in this research that the interest developed during the primary school years in investigation does not decrease as a significant majority of pupils (21 out of 23) when questioned at the end of their first-year of post-primary school stated they enjoyed planning their own investigation. While teachers are overall positive about the use of pupil-led investigations, this research questions if such affirmative attitudes to pupils' personal investigative work is carried through to their classroom learning. Pupils indicated in this study that there is little opportunity for planning their own investigations in science with many commenting on large amounts of teacher talk

and demonstration. Further studies by Varley *et al.* (2008b) show that in comparison with primary school pupils, first year students appear to be more unenthusiastic about teacher demonstration of science experiments. Findings in this study here concur with this as the number of pupils stated as not enjoying teacher demonstration of investigations increased upon transition (Chapter 4, p.83). However, it must be noted that a certain amount of teacher demonstration is expected at post-primary level and, as according to Speering (1995), the change between primary and post-primary science is especially striking as science in primary school is mainly activity based and student centred in comparison to post-primary science that is content-driven and teacher-led.

Further issues emerging in this research indicate that a significant number of pupils across the primary - post-primary transition do not enjoy working with their peers in science. Pupils in primary school in particular were found to lose enthusiasm for learning in science when their ideas and opinions are not being listened to in their peer groups. Many pupils commented on the negative factors influencing group-work such as people being bossy, not listening and not having a designated job (Chapter 4, p.87). Moreover, findings in this study indicate that of large amount of writing and reading in science class is a reoccurring concern for pupils in experience of learning science (Chapter 4, p.88). Writing in science class may consist of completing worksheets and work-cards, taking notes, written tasks and copying from the board. Many studies suggest that pupils do not receive experience of a varied range of possibilities for recording and communicating their work and thus pupil attitudes towards reading and writing in science lessons are not entirely positive (Varley *et al.*, 2008a). Contrastingly, upon transition to post-primary school, pupils in this study found having an explicit book for science with added interest. Pupils view not having a specific science textbook at primary school as confirmation that primary science should not be taken seriously as a 'real' subject and that there are serious concerns regarding the image and status of primary science. Large amounts of teacher-led, content-driven hold no value among pupils at either school level. This research has shown that in order to promote enthusiasm across the primary –post-primary divide, teaching strategies must be child-centred and activity-based, as according to the Primary Science Curriculum 'science may be seen as the active process of the personal construction of meaning and understanding' (DES, 1999: p.7).

4.5 Summary

This chapter discussed the findings of the research from the pupils' perspective. Through the emergent themes and sub-themes, it sought to provide an insight into these findings by direct comparison of pupils' experiences of learning science in the final year of primary school and first year of post-primary school.

Chapter 5

Research Analysis, Interpretation and Discussion of Findings

The Transition from Primary to Second-Level Science: The Teachers' Perspective and Science Curricular Issues

5.0 Introduction

Having dealt with the first two themes of this research study '*Pupils' Attitudes to Learning Science'* and '*Issues in the Science Classroom'*, this chapter presents a discussion of the findings and outcomes which emerged during the course of this research from the teachers' perspective and from issues surrounding science curricula. These findings are based on data derived from the primary and post-primary teacher questionnaires conducted. The researcher attempted to also utilise data collected from the participating pupils (see Chapter 4) in order to support teacher findings in this section. The data gathered was then organized thematically to bring out the major issues affecting teachers involved in the transition from primary to post-primary school. Furthermore other related and inter-related themes of equal consequence emerged in the teachers' findings. These themes and sub-themes are presented under the following key headings and will provide a multi-faceted overview of the teachers' perspective of teaching science from primary to post-primary school.

- **Theme 3: Teachers' Attitudes to Science Across the Transition**
    - Teacher Knowledge and Confidence
    - Time Teaching Science
    - Teaching Strategies in Science
    - Asking for Assistance
- **Theme 4: Science Curricula Across the Transition**
    - Science Curricula
        - *Primary Science Curriculum*
        - *Junior Cycle Science Syllabus*
    - Curriculum Continuity
        - *Repetition of Learning*
    - Teaching and Learning in the Curriculum
        - *The Human Body*
        - *Plants and Animals*
        - *Light, Sound and Heat*
        - *Magnetism and Electricity*
        - *Forces and Motion*
        - *Materials and their Properties*
        - *The Environment*

5.1 Overview of Findings in Chapter 5

Theme 3: Teacher Attitudes and Concerns in Teaching Science across Transition

A recurring theme in much literature about primary science education has been the preparedness and apparent reluctance of many teachers to teach science (Appleton, 2003).The essence is that a significant number of primary teachers avoid teaching science due to the fact that they are not knowledgeable about science and thus lack the confidence to teach it (Appleton, 2003). Furthermore Childs and McNicholl (2007) have investigated further the relationship between post-primary science teachers' subject matter knowledge and their teaching practice. The section provides an insight into the issues facing teachers when teaching science in the final years of primary school and the first year of post-primary school. The teacher's opinions and stance on the issue of transition in science education were central to the further analysis of the pupils' findings. While examining the data collected from teachers in this research, other sub-themes emerged of consequence to main findings in this study. These sub-themes included teachers' subject knowledge and confidence, the time spent teaching science, teaching strategies in science and the confidence of teachers to ask for help.

Theme 4: The Science Curriculum across Transition

Recent research has raised concerns about the overall levels of scientific literacy amongst Irish post-primary students (Varley *et al*., 2008b). On a PISA (OECD, 2003e) assessment of scientific literacy, Irish students were found to rank 13th when compared to participants from 29 countries. Concern has also been expressed in Ireland about the declining uptake of science subjects both in the later stages of post-primary school and at tertiary level (Task Force on the Physical Science, 2002). In an effort to address the concerns related to subject uptake and scientific literacy, recent changes have been made to curricula at both primary and early post-primary level. In this section, the relevant curricular documents were studied to compare and contrast continuity across the transition. Furthermore, both pupils and teachers were questioned regarding their teaching and learning within the curricula.

5.2 Theme 3: Teacher Attitudes to Science across the Transition

Both primary and post-primary teachers of the participating pupils were questioned on their attitudes to teaching science. Six primary and six post-primary teachers were asked through a detailed questionnaire to give their view on a number of broad aspects of their teaching of science in their respective school levels; their confidence subject knowledge level

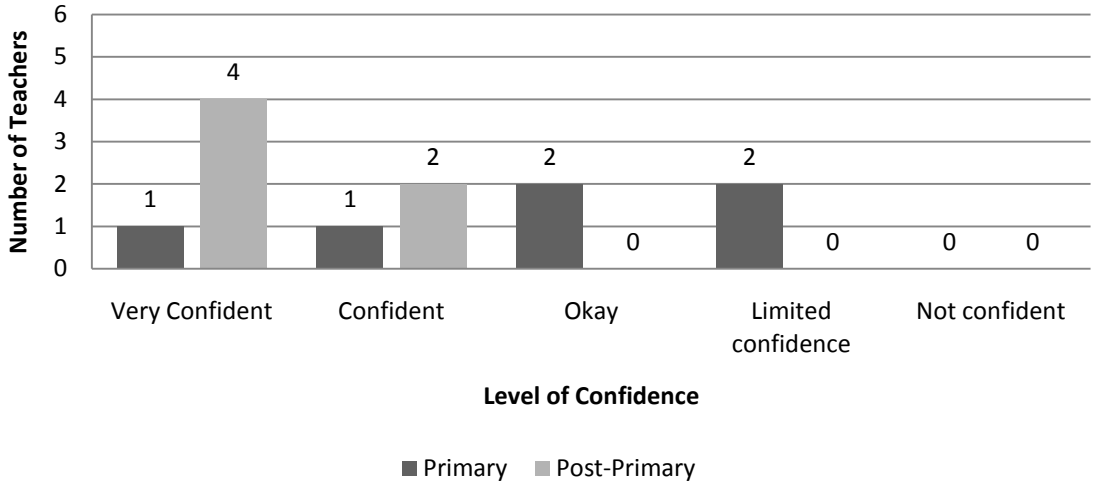
in teaching science and the amount of time spent teaching science. They were also asked their opinion on a range of teaching strategies specific to the science classroom. Questions were also put to the teachers about asking for help and in-service training in their field of teaching. Furthermore, the responses of their pupils were analysed simultaneously and the results collated. The researcher was thus enabled to evaluate and differentiate the issues arising in the teaching of science according to the teachers across the transitional phase with the responses of their pupils.

The following are the key findings which emerged in regard the attitudes and experiences of teachers in their teaching of science at both primary and post-primary school level.

5.2.1 Teacher knowledge and confidence

The work of Appleton (2003) in Swedish primary schools highlighted the importance of the teachers' knowledge of science in order to stimulate students' interest and learning processes. The aforementioned evidence makes a strong case for agreement with Sears and Sorenson (2000) that one of the most difficult problems facing primary teachers is the considerable amount of subject knowledge they are expected to possess. This can clearly be seen in the responses to the teacher questionnaire in this study.

Figure 5.1 Teacher Confidence in Teaching Science (N=12)



When primary teachers were questioned on their confidence regarding the teaching of science, results show just one teacher is rated as very confident (**Figure 5.1).** A majority (4 out of 6) of participating primary teachers did not rate themselves as either very confident or

confident in this study. In contrast, teachers in post-primary schools were overall more confident in their teaching of science in general than their primary counterparts. The majority of post-primary teachers (4 out of 6), are stated as being very confident in their teaching of science and the remaining two confident. Therefore, significant differences in teacher confidence levels are recorded in this research across the primary – post-primary school divide. Such a variation in confidence may lead to a range of teaching styles and practices experienced by pupils transitioning from 6th class primary to 1st year post-primary. Speering (1995) noted that while primary teachers made curriculum decisions based on subject integration, post-primary teachers were content driven. Childs and McNicholl (2007) have investigated further the relationship between post-primary science teachers' subject matter knowledge and their teaching practice. When a teacher felt confident with their subject matter knowledge, she was better able to match the content of science teaching explanation. Thus, it is interesting to note that in the sections following, where teacher confidence in teaching a particular topic area significantly increased from primary to post-primary level, pupils' enjoyment of the topic in question increases.

5.2.2 Time Teaching Science

Further studies by Appleton (2003) suggest a significant number of primary teachers avoid teaching science due to the fact that they are not knowledgeable about science and thus lack the confidence to teach it. A recurring theme in much literature about primary science education has been the preparedness and apparent reluctance of many primary teachers to teach science (Varley *et al*., 2008a). However, despite a number of respondents indicating a lack of confidence in their teaching of science, results in this research point to a majority (5 out of 6) teaching the required amount of science (1 hour per week) as laid out in the time allocation framework of the Primary School Science Curriculum (DES, 1999a). One primary teacher did indicate they spent less than the recommended time teaching science in their classroom. Findings also indicate that post-primary teachers, spend more time than their primary teacher colleagues teaching science**.** This of course is an obvious result of the subject specific nature of post-primary education. Post-primary teachers will normally specialise in one or two subjects and will teach these subjects to students from the first year to the sixth year. This means that a teacher can potentially teach up to eight lessons in one day to different classes containing up to 30 students each, often of differing ability levels.

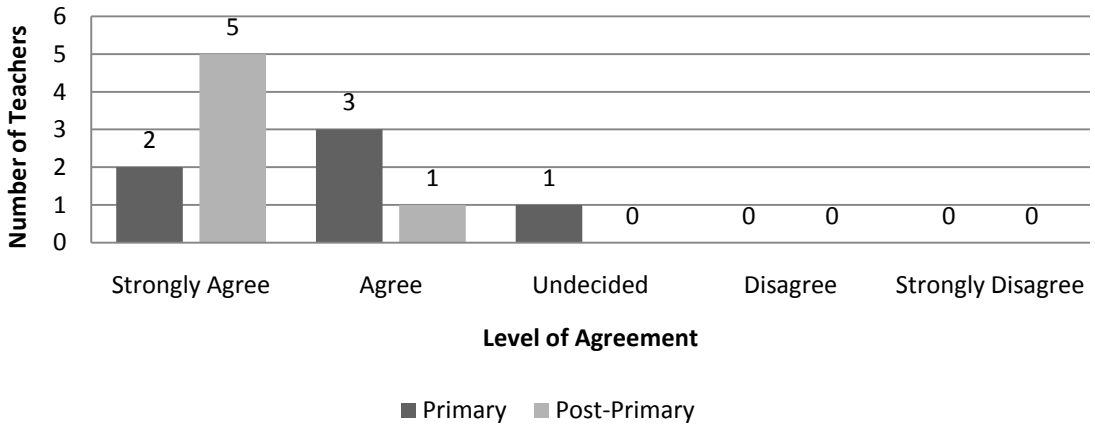
Primary and post-primary teachers were also questioned on how long they typically spend on planning and/or preparing for a science lesson per week. The following were their responses. Findings indicate that 5 out of 6 primary teachers surveyed spend less than an hour planning and preparing for a science lesson. Just one teacher is cited as spending over an hour on planning for their science lessons. In contrast, 6 post-primary teachers state they spend over one hour preparing for their science lessons. Further contrary to the above findings of Varley *et al.* (2008a), primary pupils in particular in this study allude to regular engagement with science in their school (**Appendix I**). Therefore, this researcher considers that it is not the amount of science teaching that is a factor the disengagement with science in the primary to post-primary transition but ineffective and unsuccessful science teaching strategies and methodologies utilised by many teachers.

5.2.3 Teaching Strategies in Science

According to Jarvis and Pell (2005), when teachers lack the confidence to teach science, they tend to use strategies which allow them to maintain control of classroom knowledge flow but, in terms of contemporary science curricula, these strategies are not engaging pupils in active and exploratory science learning. Consolidating this point, this research also found that primary teachers tended to adopt coping strategies if and when knowledge was limited. Similar to Harlen *et al.* (1995) and their study of Scottish primary teachers understanding of scientific concepts, this study found that these strategies include teaching as little of the 'low-confidence aspect' of sciences as possible, relying heavily on worksheets, minimise questioning and discussion and avoiding all but the simplest practical work.

In this study, teachers were questioned on their opinion of a range of teaching strategies in the science classroom, particularly their use of experimentation and investigation. While the majority of primary teachers agreed that teachers should be able to demonstrate an experiment in a science lesson, one primary teacher did respond as undecided on the issue (**Figure 5.2).**

Figure 5.2 Teacher's should be able to demonstrate an experiment. (N=12)



While just two primary teachers strongly agreed that teachers should be able to demonstrate an experiment in the science class, a large majority (5 out of 6) of the post-primary respondents strongly agreed with this statement (**Figure 5.2).** Ponchaud (2001) was concerned that scientific enquiry had diminished in many primary schools. He pointed out that these teachers should capitalize on the flexibility of the primary curriculum to carry-out longer-term experiments, which would be more difficult in a time-table constrained post-primary school (Ponchaud, 2001). This research would appear to add to the work of Ponchaud (2001) and indicates that across the transition, post-primary teachers are also reluctant to partake in new and open-ended investigations.

One primary teacher and just two post-primary teachers stated that they strongly agreed that teachers should do science activities based on children's ideas. It must be pointed out also, that two primary teachers were undecided on the relevance of this issue in their teaching of science and a further one post-primary teacher was also undecided on the use of children's ideas as a starting point for science activities and investigations

Tantamount to the above evidence, there were a number of primary teacher respondents who did not, on the other hand, agree that teachers should be able to use scientific equipment skilfully (**Figure 5.3**).

Figure 5.3 Teachers should be able to use scientific equipment skilfully (N=12)

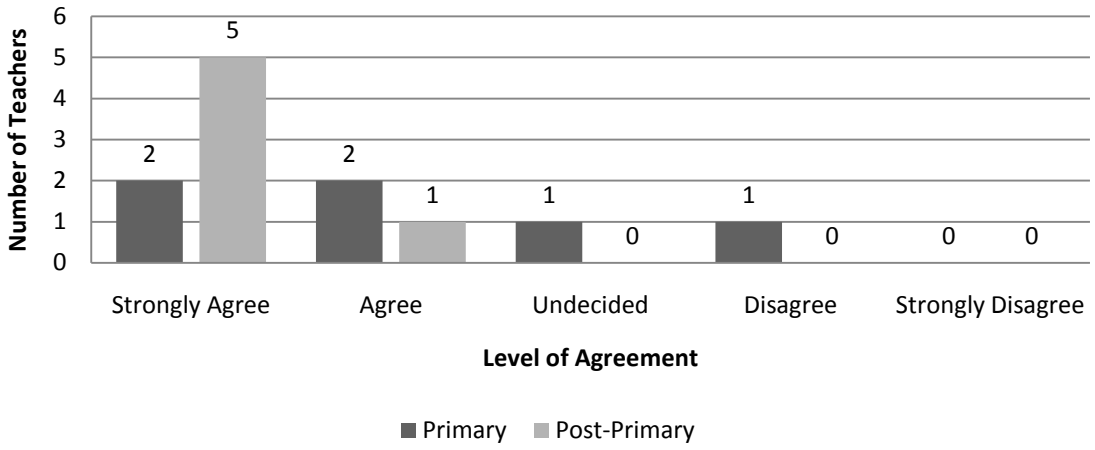


Figure 5.3 clearly indicates that while a large majority of five post-primary teachers strongly agreed that teachers should be able to use scientific equipment skilfully, just two primary teachers stated they strongly agreed they should be able to utilize scientific apparatus in their science lessons. A further one primary teacher was undecided and the remaining one disagreed that teachers should be able to use science equipment. This would again point to the limited confidence of a number of primary teachers in this study in contrast to the enhanced subject knowledge displayed by participating post-primary science teachers.

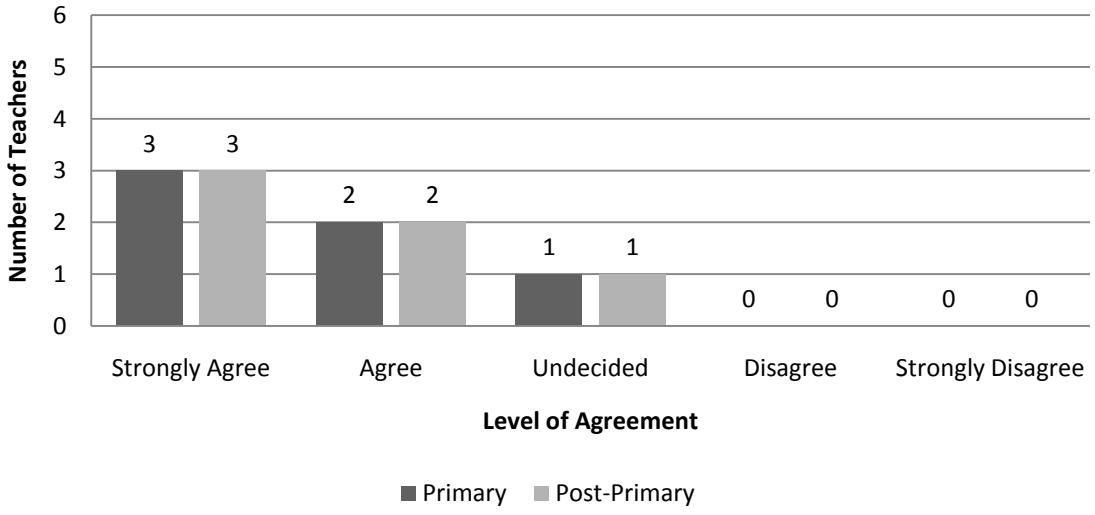
Studies by Murphy and Beggs (2005) found that primary teachers feel they lack the confidence to teach science effectively, particularly in relation to carrying out simple science investigations. Thus, this research assumes that if primary teachers are reluctant to carry out more challenging investigations and use more complex equipment in their science lessons due to a lack of confidence, their pupils gain the perception that primary science investigations lack challenge and purpose. As one pupil noted, '*Experiments will be different* (in post-primary school) *they'll be better than in primary school they were only simple experiments'* (Pupil 11, Post-Primary Interview). There is a notion among pupils that the science studied in primary school is not genuine and that now, at post-primary school, the pupils are doing "proper" science. When asked did they enjoy learning science many first-year post-primary pupils responded "(There's) *more experiments, there's nothing I don't like. It's better than last year, we do more experiments and we do more stuff* (Pupil 18, Post-Primary Interview). A study by Campbell (2001) analysed the views of pupils before

and after transfer to post-primary school. While pupils reported an enjoyment of science overall the study also raised concerns about the image, status and academic challenge of primary school science following transition to post-primary school. Campbell's (2001) claim that primary science is not seen as real science by pupils has significant implications for this study. He argues that pupils, both primary and post-primary pupils undervalue their primary science education (Campbell 2001). Pupils in this study consolidate the argument that teachers' use of with pupils stating '*I think it will be more interesting we will do much more challenging things. It will be hard but I thing that it will be better'* (Pupil 11, Primary Interview).

5.2.4 Asking for assistance

Teachers from both sides of the transition agree that teachers should have the confidence and assurance to ask for help in their teaching of science. Whether it is from a colleague or an outside source, equal numbers of primary and post-primary teachers strongly agree (3 out of 6) (**Figure 5.4**).

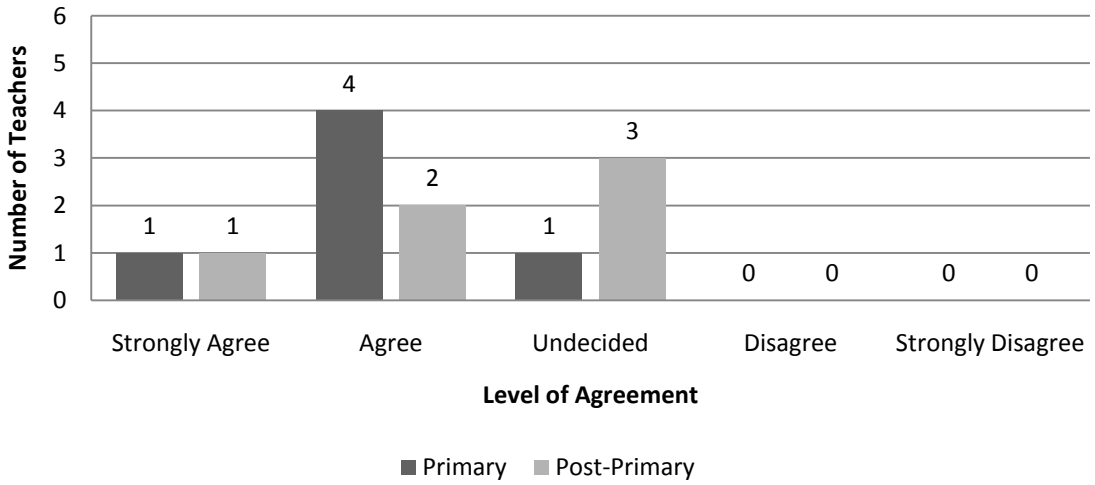
Figure 5.4 Teachers should ask for help from a colleague (N=12)



Surprisingly, when asked if teachers should receive regular in-service training in science, half the post-primary teacher respondents (3 out of 6) were undecided on this issue, with just one in strong agreement (**Figure 5.5).** In contrast, a majority of primary teachers (4 out of 6) agreed that in-service training would be beneficial in their teaching of science. These findings would again confirm that primary teachers lack confidence and knowledge in

their teaching of science in comparison to their post-primary counterparts across the transition and thus feel the need for more frequent and in-depth in-service training in science in order to improve their teaching and in turn, improve pupil learning. Murphy and Beggs (2005) highlighted how problems such as lack of provision for long in-service practical courses for teachers shows the low priority of science in many primary schools. They found that by involvement in primary science professional development activities, teacher confidence increased.

Figure 5.5 Teachers should receive regular inservice training (N=12)



In all topic areas of the science curriculum, post-primary teachers, having specific subject-based training, are more confident than their primary counterparts (Chapter 5, p.131**).** Similar to Osbourne and Simon (1996), findings thus suggest that primary teachers, with having to acquire content knowledge, pedagogical content knowledge and curricular knowledge across a large number of subject areas, cannot feel fully confident teaching all aspects of just one subject area, in this case science. It also consolidates findings by Nilsson and Diel (2010) and The Task Force on Physical Sciences in Ireland (2002) that show significantly few primary teachers specialise in the teaching of science and that a minority of Irish primary teachers have taken a physical science subject to senior cycle post-primary level. This researcher questions if it is lack of teacher confidence and knowledge at primary level that may lead to disinterest and disengagement among pupils even prior to transition to post-primary school.

5.3 Science Curricula across the Transition.

Since the crux of this research is to delve into and examine the transition from primary to post-primary science in the Irish school system it was thus necessary to study the science curricula from both levels. The introduction of the new Primary School Curriculum (DES, 1999a) in 1999 brought around a change in the science subject matter to be taught and the approaches to teaching primary science. Science was to be taught once a week; for at least one hour from 1st to 6th class and forty-five minutes in the infant classes. It would involve more investigative and skill-based experiences. In 2006, the revised Junior Certificate Science Syllabus (DES, 2006a) was implemented in the hope that a new syllabus would place more emphasis on developing students' understanding of science concepts and the development of necessary scientific process skills. It would essentially link to the core of the Primary School Science Curriculum by connecting scientific facts to everyday life. Consequently, it would create a better match between the primary and post-primary science syllabi (Varley *et al*., 2008a).

A direct comparison of the content and skills development of both Primary and Junior Cycle curricula was undertaken in order to examine if indeed the revised Junior Cycle Science Syllabus (DES, 2006a) built on students' earlier experience at primary school and conversely if the Primary School Science Curriculum (DES, 1999a) now presents an opportunity to prepare pupils for future study of science in post-primary level. One distinct section of the 23 pupil questionnaires examined the pupils' attitudes to the various areas of learning within the science curricula. The purpose of this was to evaluate pupil attitudes to science curricula both before and after transition to post-primary school. It also aimed to examine and find out any issues arising in pupils' learning in science from the end of 6th class primary into first year post-primary. In turn, both primary and post-primary teachers were questioned on their confidence levels in teaching the various topic areas of the aforementioned curricula. Therefore, pupils' attitudes to science learning can be compared with their teachers' opinions on teaching it within the transition from primary to post-primary school

The following are the key findings which emerged.

5.3.1 Science Curricula

5.3.1.1 Primary School Science Curriculum

According to the Primary Science Curriculum,

> ‘Science education enhances children's knowledge and understanding of themselves and the world in which they live. It involves children in the active construction of their own understanding. This understanding changes in response to the children's broadening experience’
>
> (DES, 1999a).

The teaching of science in the primary curriculum involves the development of two types of understanding: the understanding of concepts and of procedures. Firstly, children's conceptual understanding is concerned with the development of scientific knowledge and with their deepening understanding of fundamental scientific ideas. The four strands of the primary science programme are;

- **Living things**
- **Materials**
- **Energy and forces and**
- **Environmental awareness and care.**

These outline the knowledge and understanding that children need to acquire and describe the scientific ideas that they will encounter. Secondly, procedural understanding, also referred to as having knowledge of the scientific process is included in the section of the science curriculum entitled 'Working Scientifically'. It outlines how children may engage in scientific enquiry throughout their learning of science. It is a procedural model of how scientists work and includes statements of the various component skills that contribute to this methodology;

- **Questioning**
- **Observing**
- **Predicting**
- **Investigating and experimenting**
- **Estimating and measuring**
- **Analysing**
  Sorting and classifying
  Recognising patterns
  Interpreting
- **Recording and communicating**

Findings in this research suggest that the most popular topics in both primary and post-primary school appear to be those in which the pupils are more actively engaged in their own learning. According to the Primary School Science Curriculum '*A key characteristic of learning within Social Environmental and Scientific Education is the involvement of the child in the active exploration and investigation of all their environments'* (DES, 1999a).When questioned, 20 out of the total 23 primary pupils and 20 out of 23 post-primary pupils agreed to liking learning about 'reactions' in science, hence making it the most popular topic in both primary and post-primary school science. This point was further confirmed within the Primary School Science Curriculum (1999a) and the revised Junior Cycle Science Syllabus (2006a) which states that children's learning by investigating is at the heart of these new and revised curricula.

5.3.1.2 Junior Cycle Science Syllabus

In the post-primary junior cycle, the study of science contributes to a broad and balanced educational experience for students, extending their experiences at primary level (DES, 2006a).Essentially, it is concerned with the development of scientific literacy and its associated science process skills, together with an appreciation of the impact that science has on our lives and environment. In an era of rapid scientific and technological change, the study of science is fundamental to the development of the confidence required to deal with the opportunities and challenges that such change presents in a wide variety of personal and social contexts (DES, 2006a).The syllabus has three major components; biology, chemistry and physics.

Furthermore, the revised Junior Cycle Science Syllabus (2006a) places more emphasis on developing students' understanding of science concepts, as well as allowing them to acquire the necessary scientific process skills. Where the previous curriculum presented the materials as a list of contents (facts, definitions, laws and properties) on which practical activities were based (DES, 2006a), it was believed that the revised syllabus would take a step away from the rote learning of bodies of facts and promote the development of scientific skills linked to everyday life. This study, however, found that many post-primary pupils are 'turned off' learning in science because of large amounts of rote learning in their first year in post-primary school. The issue of learning off definitions and long names was the most mentioned negative aspect of learning science at post-primary school with five pupils

commenting. Pupil 14 (Post-Primary Interview) stated that '*all the long names and stuff and having to learn them and that'* was a negative aspect to learning science and Pupil 8 (Post-Primary Interview) pointed out how they felt learning off facts did not allow opportunities for what they deemed more interesting activities such as experimentation. '*We had to learn tables and elements and stuff, I prefer to blow stuff up like'* (Pupil 8, Post-Primary Interview).While pupils natural inclination to dislike "rote-learning" may account for these findings, this study raises the question of whether the revised Junior Cycle Science Syllabus aim of promoting understanding is being carried through to the learning in the classroom.

The revised syllabus in Junior Certificate Science (2006a) had been drawn up to cater for the full range of student ability, aptitude and achievement (DES, 2006a). However, findings in this study have shown that much of the curriculum planning at post-primary level in particular has not been modified to allow for children's achievement in primary school. Responses gathered in this study support this assertion. Pupil 1 (Post-Primary Interview) felt they repeated '*most of the stuff*' and Pupil 12 (Post-Primary Interview) pointed out '*Once you have it learned once it's kind of pointless doing it again'*. Similar to findings by Shrigley (1990) and Jarman (1993) this study supports their claims that there is a notion by post-primary teachers that they are giving pupils a fresh start and are starting from scratch. In this study, just one post-primary teacher is stated as having made contact with a primary school teacher regarding the science learning of their pupils (**Table 5.4).** This consolidates the findings of a survey conducted by the INTO (2008), where just under 19% of post-primary teachers stated they were familiar with the primary school curriculum at all.

Furthermore, not only do pupils experience regular repetition of learning in post-primary science, this research shows that it is their post-primary school teachers have to deal with the perceptions developed before transfer and plan learning accordingly. Similar to Jarman (1993) and Campbell (2001) this study found that the main source of post-primary teachers' knowledge of primary science practices was teachers who talked to their pupils about their earlier science experiences. There was no evidence following teacher questioning that significant communication between themselves and their primary teacher counterparts with just one primary and one post-primary teacher stated as having contact regarding the teaching of science in their class (Chapter 5, pp.147-148)**.**

Similar to the objectives of the aforementioned curricula, this researcher feels that primary pupils are indeed being given regular opportunity to engage in regular

experimentation and enjoy this experience particularly at primary school. Primary pupils thus expect such regular experience of experimentation to continue, if not increase upon entry to post-primary school. However, this researcher has found that primary pupils' expectations of large amounts of experimentation are not being met following transition. As stated previously it confirms the view of Varley *et al.* (2008a) who also found that many pupils are not afforded regular opportunities to engage in hands on science, are not applying certain scientific skills and as is stated previously are experiencing teaching demonstration and explanation as a dominant feature of their primary science education. As one pupil stated when asked if science at post-primary school is what they expected, they answered '*No, because we don't do enough experiments in class, we should do one once a week'* (Pupil 7, Post-Primary Interview). Therefore, questions must be raised regarding the amount of time allocated to practical, experimental activities in post-primary school science, a core message in the revised Junior Cycle Science Syllabus.

It was the aim of the revised Junior Cycle Science Syllabus (2006a) that arising out of their experiences of studying science in the junior cycle, it was hoped that many students would be encouraged to study one or more of the science subjects in the senior cycle, thus preparing them for further study or work in this area. However, this study has found that in the early stages of post-primary school, pupils have mixed opinions on their future study of science. Many pupils feel it necessary to choose at least one of the science subjects in order to keep career options open as Pupil 9 (Post-Primary Interview) states '*Ya, I would pick one part'*. Other pupils are very definite about not continuing their studies in science after Junior Cycle. As Pupil 21 (Post-Primary Interview) states, '*No, it gets harder in Leaving Cert'.* This researcher feels that despite the aims of the revised Junior Cycle Science Curriculum to encourage a more positive attitude to continued study of science, pupils have developed certain opinions of science early in their post-primary schooling that clearly affect their attitude to studying science.

5.3.2 Curriculum Continuity

Galton, Gray and Ruddock (1999) claim that despite the introduction of new science curricula aimed at smoothing the move to post-primary school, there are still problems at transition with curriculum continuity. Issues surrounding curriculum continuity have significant implications for this study as it has been found that a lack of continuity between primary and post-primary science curricula have led to pupil dissatisfaction with the subject.

Table 5.1 below illustrates the continuity that exists between the Primary Science Curriculum (DES, 1999a) and the revised Junior Cycle Science Syllabus (DES, 2006a).

Table 5.1 Primary and Junior Cycle Science Curricula links.

Primary Science Curriculum (DES, 1999a)	Junior Cycle Science Syllabus (DES, 2006a)
Living things • Human life • Plants and animals	**Biology** • Human Biology food, digestion and associated body systems • Human Biology the skeletal/muscular system, the senses and human reproduction • Animals, plants and micro-organisms
Energy and forces • Light • Sound • Heat • Magnetism and electricity • Forces	**Physics** • Force and energy • Heat, light and sound • Magnetism, electricity and electronics
Materials • Properties and characteristics of materials • Materials and change	**Chemistry** • Classification of substances • Air, oxygen, carbon dioxide and water • Atomic structure, reactions and compounds
Environmental awareness and care • Environmental awareness • Science and the environment • Caring for the environment	

The notion that a lack of obvious sequence exists for the development of scientific concepts and skills within the primary science curriculum was raised in this study. As discussed in Chapter 2 (p. 24) the content of both curricula, which should lend itself to continuity, appears to lead to repetition rather that developmental approach to learning. The

primary science curriculum is based on a spiral approach, in which some aspects of the biological and physical environment are revisited at each class level. Consequently, the knowledge and understanding presented and the range of process skills that children are encouraged to use in scientific investigations are developed and extended at each class level (DES, 1999a). However, this "spiral approach" does not continue into the revised Junior Cycle Science Syllabus. There is no evidence of planning by the developers of curricula to continue this developmental approach to learning from primary into junior cycle post-primary. For example, in the topic area of Magnetism, curriculum planning at Junior Cycle level has clearly not taken into account learning in the Primary Science Curriculum. Pupils at 6th class primary level are enabled to learn that a magnet can 'push or pull magnetic materials' while in the following year at 1st year post-primary level, pupils are enabled to show 'attraction and repulsion between magnets'. While there is a difference in the language used to detail the learning at each level, the basic learning objective and outcome is the same. Primary pupils learning of how magnets can 'push or pull objects' at primary level has not been taken into account when developing learning outcomes in the Junior Cycle Science Syllabus. The following table shows repetition in pupils' learning objectives and outcomes at both levels of curricula.

Table 5.2 Learning about Magnetism at Primary and Junior Cycle Level.

Primary Science Curriculum (DES, 1999a)	Revised Junior Cycle Science Syllabus (DES, 2006a)
Strand: Energy and Forces Strand Unit: Magnetism and electricity	Main Topic: Magnetism Subtopic: Forces of attraction and repulsion
Objective: *The child should be enabled to* • Learn that magnets can push or pull magnetic materials.	Outcome: *On completion of this section students should be enabled to* • carry out simple experiments to show attraction and repulsion between magnets and test a variety of objects for magnetism.

Therefore, findings indicate that the overly sequential nature of both primary and post-primary curricula is a contributing factor to the repetition and recalling of material experienced by pupils upon entry to post-primary science classrooms. Eight pupils mentioned the issue of repetition of material causing boredom and disinterest in their learning of science in the Post-Primary Interview (**Appendix J).** The topics of magnets (**Table 5.2**) is mentioned in particular by pupils at the end of first year post-primary school as being

repeated from primary to post primary school. As Pupils 9 and 11 state '*It doesn't come to mind but I do like remember doing something we did before. Magnets it was actually* (Pupil 9, Post-Primary Interview). *It's sort of boring, you've learned it before and like magnets there's not much to learn and then you do it again* (Pupil 11, Post-Primary Interview). Therefore, it is apparent from this research that pupil disinterest in science across the transition is very much fostered by repetitive and monotonous science content and activities. It seems to confirm the above point that a lack of communication on academic and curricular matters at the point of transfer is seen as contributing to a repetition of material already experienced at primary school. This can lead to negative attitudes developing early in post-primary science.

Many authors have argued that, despite claims by published curricula to the contrary, science curriculum planning at post-primary level in particular has not been modified to allow for children's achievement in primary school. This concurs with the view of Ponchaud (2001) who found that much of the primary curriculum is a 'dilution' of the post-primary curriculum as opposed to science building blocks, which could be used on a basis on which to structure children's progressive development of scientific concepts and skills. Responses gathered in this study support this assertion. Pupil 1 (Post-Primary Interview) felt they repeated '*most of the stuff*' and Pupil 12 (Post-Primary Interview) pointed out '*Once you have it learned once it's kind of pointless doing it again'*. Similar to findings by Hadden and Johnstone (1983), Shrigley (1990) and Jarman (1993) this study supports their claims that there is a notion by secondary teachers that they are giving pupils a fresh start and are starting from scratch. Furthermore, in a survey conducted by the INTO (2008), just under 19% of post-primary teachers stated they were familiar with the primary school curriculum at all.

5.3.3 Teaching and Learning in the Curriculum

What follows in this section is a presentation of the teaching and learning taking place within each strand/topic area of both the Primary Science Curriculum and Junior Cycle Science Syllabus. Teachers were first asked their level of confidence in teaching the topic areas and following this, pupils were asked if they enjoyed learning about the various topics within both primary and junior cycle science curricula. Questions both the pupil and teacher questionnaires (**Appendices A and B)** were asked under the following headings (**Table 5.3**):

Table 5.3 Teacher and Pupil Questionnaire Links with Primary and Junior Cycle Curricula

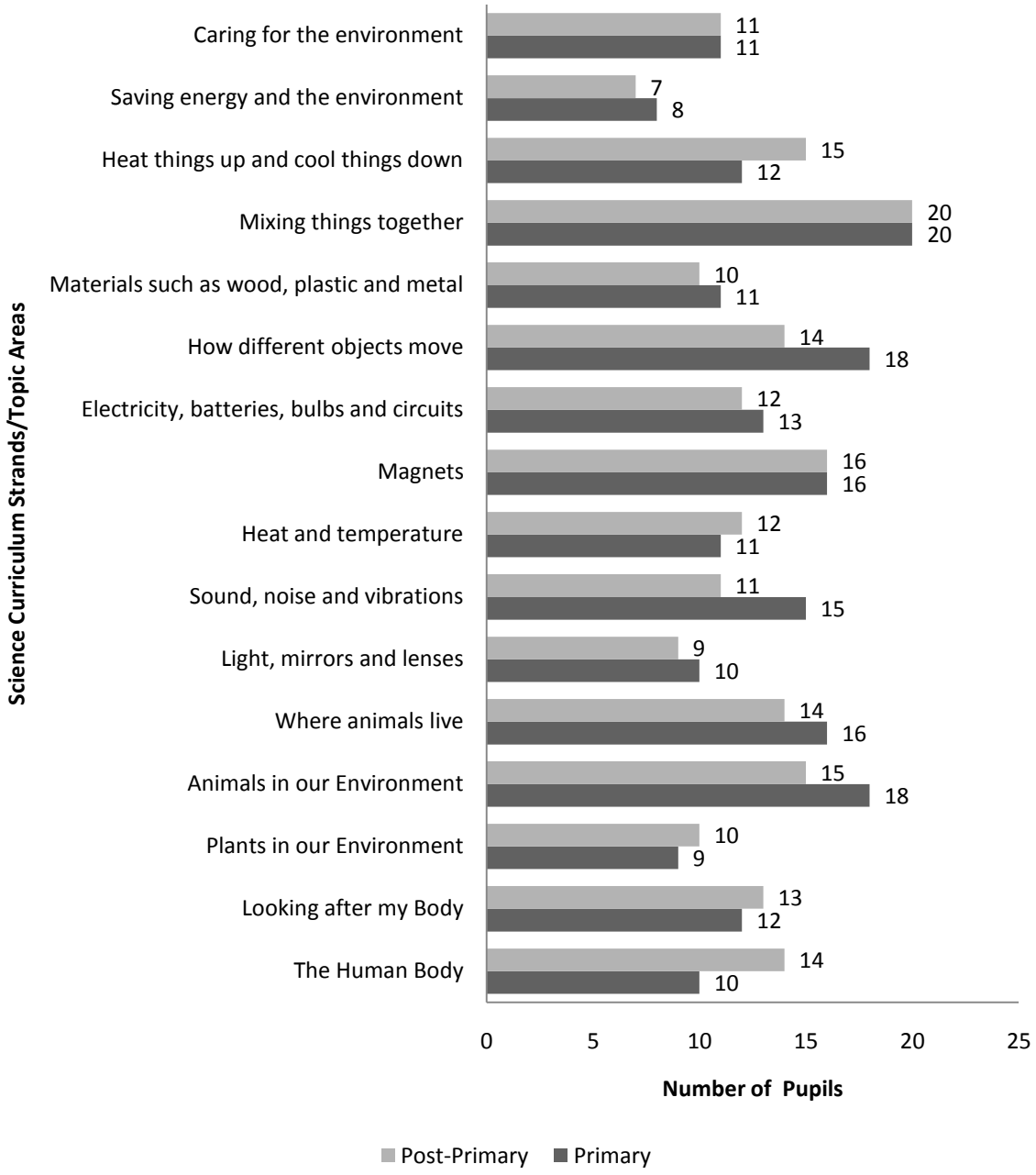
Class Level	Strands/Topics	Strand units/Sections	Topics covered in pupil/teacher questionnaire
Primary	Living things	• Human life • Plants and animals	• **The Human Body** • **How to look after my Body** • **Plants in our Environment** • **Animals in our environment** • **Where animals live**
Post-Primary	Biology	• Human Biology food, digestion and associated body systems • Human Biology the skeletal/muscular system, the senses and human reproduction • Animals, plants and micro-organisms	
Primary	Energy and forces	• Light • Sound • Heat • Magnetism and electricity • Forces	• **Light mirrors and lenses** • **Sound, noises and vibrations** • **Heat and temperature** • **Magnets** • **Electricity, batteries, bulbs and circuits** • **How different objects move**
Post-Primary	Physics	• Force and energy • Heat, light and sound • Magnetism, electricity and electronics	
Primary	Materials	• Properties and characteristics of materials • Materials and change	• **Materials such as wood, plastic and metal** • **What happens when you mix things together** • **What happens when you heat things up and cool things down**
Post-Primary	Chemistry	• Classification of substances • Air, oxygen, carbon dioxide and water • Atomic structure, reactions and compounds	

Primary	Environmental awareness and care	• Environmental awareness • Science and the environment • Caring for the environment	• **Saving energy and the environment** • **Caring for the environment**

In the following sections, the results of teacher questionnaires, pupil questionnaires and pupil interviews are combined and analysed to present an in-depth evaluation of teaching and learning in both the Primary Science Curriculum and the revised Junior Cycle Science Syllabus. In general, primary pupils seem well disposed to all aspects of the Primary School Science Curriculum with post-primary pupils' interest in topics from the Junior Cycle Science Syllabus increasing in the majority of subject areas on entry to post-primary school. The following **Figure 5.6** clearly indicates the particular topics/strands from both primary and post-primary found to be most popular among the pupil participants.

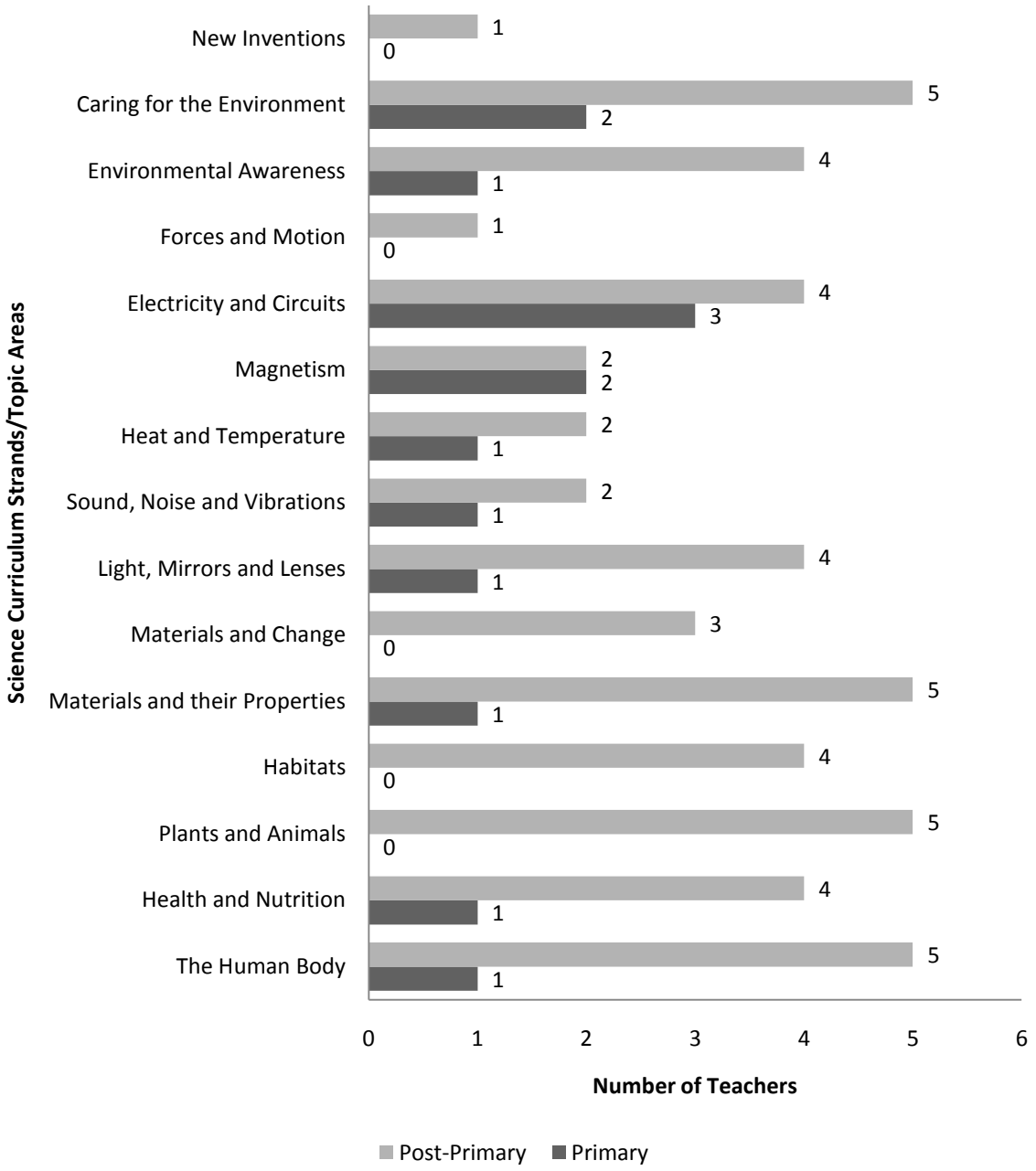
Pupils were asked in the pupil questionnaire to rate their level of enjoyment of the strand units and topic areas of both the Primary Science Curriculum and subsequently the Junior Cycle Science Syllabus. Pupils were given three response options, 'I agree', 'I am not sure' and 'I do not agree' to enjoying learning about certain strand/topic areas of the science curricula. The following figure (**Figure 5.6**) illustrates the total pupil (N=23) responses to 'I agree'.

Figure 5.6 Most Popular Science Topics Among Pupils in Primary and Post-Primary School (N=23)



The majority are well disposed towards learning about virtually all the content areas of the primary school curriculum and are very positive about hands on science, appearing to have opportunities to engage in it, applying a range of scientific skills as a result. The research found the majority of pupils enjoyed working this way (Varley *et al*., 2008a). **Figure 5.7** show the responses of teachers as being 'very confident' in their teaching of the science topics illustrated above.

Figure 5.7 Number of Teachers 'Very Confident' in Teaching Science Topic Areas (N=12)



The above **Figure 5.7** clearly indicates that post-primary teachers are significantly more confident in teaching all aspects of science. In all but one topic area (magnetism) did more post-primary teachers respond more positively than their primary counterparts. In the following sections, teachers confidence levels in teaching each of the above areas of the science curricula are compared with their pupils' enjoyment of learning in that area. It will compare teaching and learning prior to and following transition.

5.3.3.1 The Human Body

When questioned in relation to their confidence levels in teaching topics within the strands of 'The Human Body' and 'Health and Nutrition', primary teachers rated themselves as most confident in their teaching of 'The Human Body' with half of the respondents rated as 'confident' (**Figure 5.8**). **Figure 5.9** clearly indicates that no primary teacher rates their teaching of 'Health and Nutrition' as 'confident'. However, one primary teacher did rate their teaching of the human body topics as 'limited' as is shown below

Figure 5.8 Teaching about The Human Body (N=12)

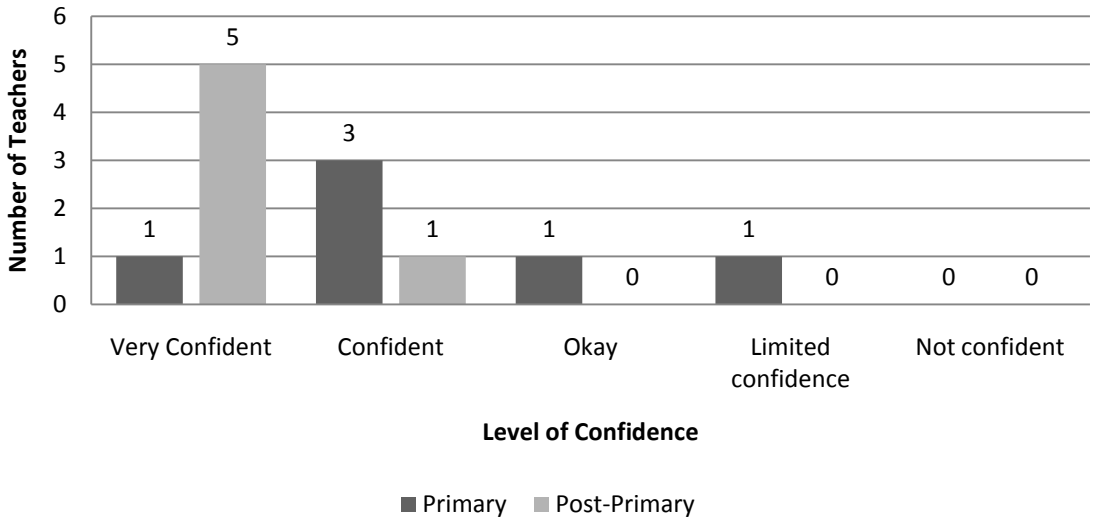


Figure 5.9 Teaching about Health and Nutrition (N=12)

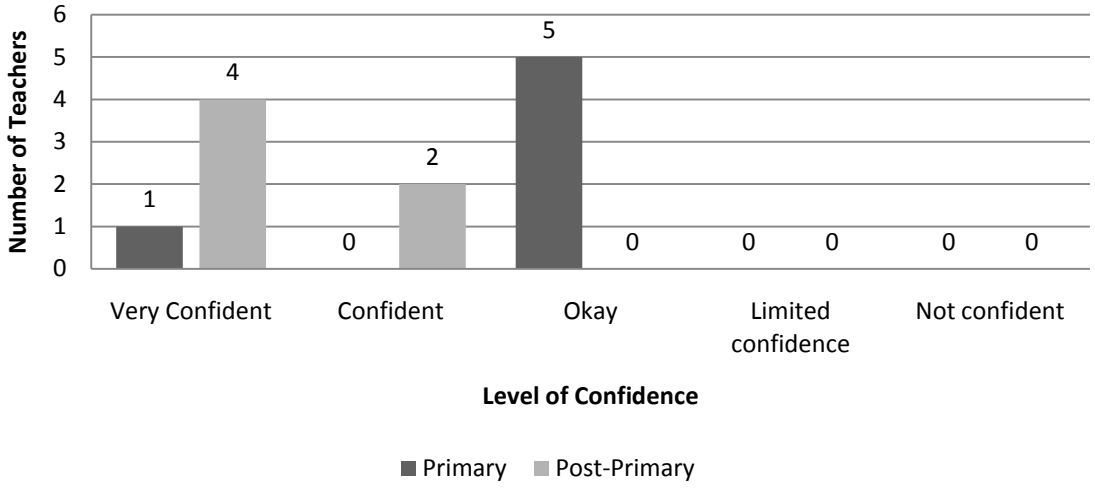


Figure 5.8and **Figure 5.9** above also show the continuing trend of post-primary teachers' high level of confidence in teaching biology topics. A total of five post-primary teachers rated themselves as very confident teaching 'The Human Body' with just one post-

primary teacher rated as 'confident' in their teaching. As regards teaching about 'Health and Nutrition', four post-primary teachers responded they felt very confident teaching this aspect of the biology curriculum, with two teachers responding they felt confident.

It is clear from **Figure 5.10** below that when asked about the human body, 44% of pupils (10 out of 23) stated they enjoy learning about the parts of the body in primary school. This number increased to 61% following the transition to post-primary school. Pupils show a continued level of interest and understanding of the importance of this topic. As Pupil 8 (Primary Pupil Interview) states during the interview in primary school (**Appendix I)** '*I like learning about bones and hearts and everything about them because they are very interesting even though I am scared of blood... I want to be a doctor so those are very interesting for me'*. Furthermore it must be noted that the number of pupils unsure about this topic also decreased upon entry to post-primary school (from 10 to 6 out of 23).

Figure 5.10 I enjoy learning about parts of the body (N=23)

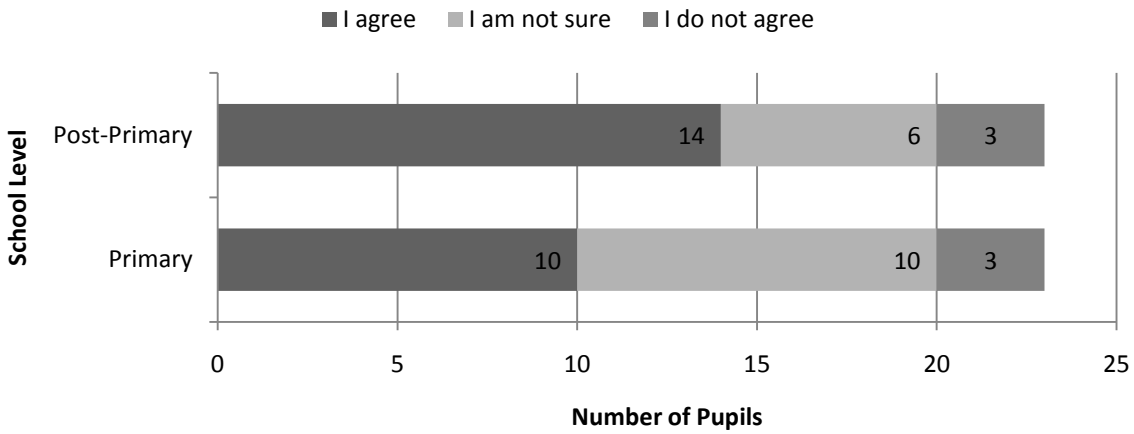


Figure 5.11 I enjoy learning about how to look after my body (N=23)

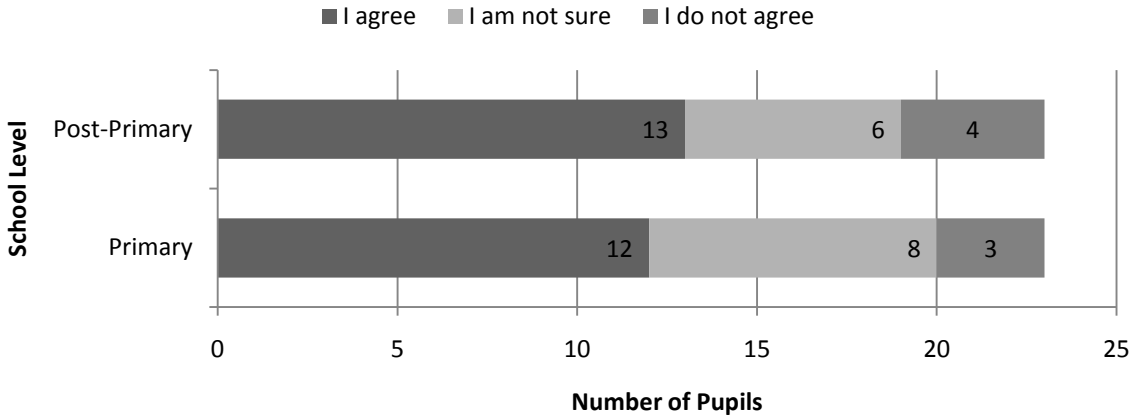


Figure 5.11 indicates that there does not appear to be any significant increase in pupil enjoyment of the topic 'how to look after my body' following the transition to post-primary school, with 12 pupils in primary school and 13 pupils in post-primary school, out of the total 23, indicating they enjoyed this topic. Just one pupil commented on this aspect of the science curricula during the interview process when asked about popular science topics (**Appendix I).** Pupil 13 shows an interest and understanding of this topic at the end of first year post-primary "*Food, it was kind of interesting knowing what you have was it good or bad for you and what you should be eating and what burns fat and what makes you strong and healthy*" (**Appendix J).**Furthermore, while only 4 out of the total 23 participating pupils did not enjoy learning about this topic following transition, it was the least popular topic with pupils when questioned further in the post-primary pupil interview (**Appendix J)** with five pupils commenting that they dislike learning in this particular subject area. Pupil 4 found it particularly difficult to learn all the words and parts of the digestive system (Pupil 4, Post-Primary Interview). The issue of rote-learning difficult vocabulary is further commented on by Pupil 17 who also has issues with learning in this area of science. "*Probably the body stuff, I don't really like all that because of all the stuff you have to try and remember and where they go in the body and all that*" (Pupil 17, Post-Primary Interview). Another pupil indicated a certain dislike of dissecting and stated, '*once we had to dissect a sheep's heart and I just didn't want to do it at all*' (Pupil 15, Post-Primary Interview).

It would appear therefore, that the increase in teachers subject knowledge and confidence in teaching about 'The Human Body' at post-primary level results in an increase in enjoyment of the subject area by pupils upon entry to first-year post-primary. Despite the increase in difficulty level in post-primary science as indicated by the pupils themselves, this

research shows that when teachers are more confident in their teaching, pupils' enthusiasm increased accordingly.

5.3.3.2 Plants and Animals

Teachers were then asked to rate their level of confidence in teaching about 'Plants and Animals' and 'Habitats'.

Figure 5.12 Teaching about Plants and Animals (N=12)

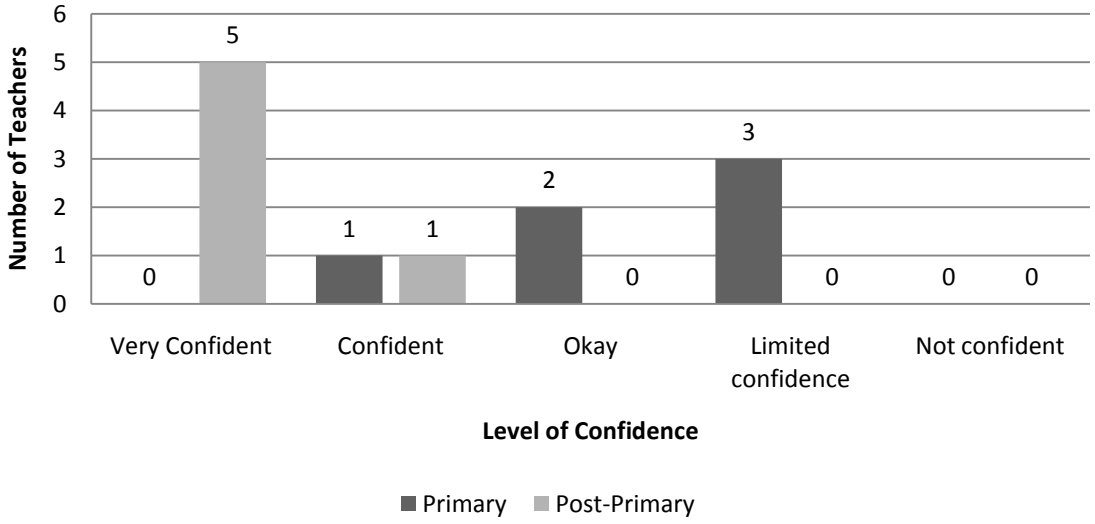


Figure 5.13 Teaching about Habitats (N=12)

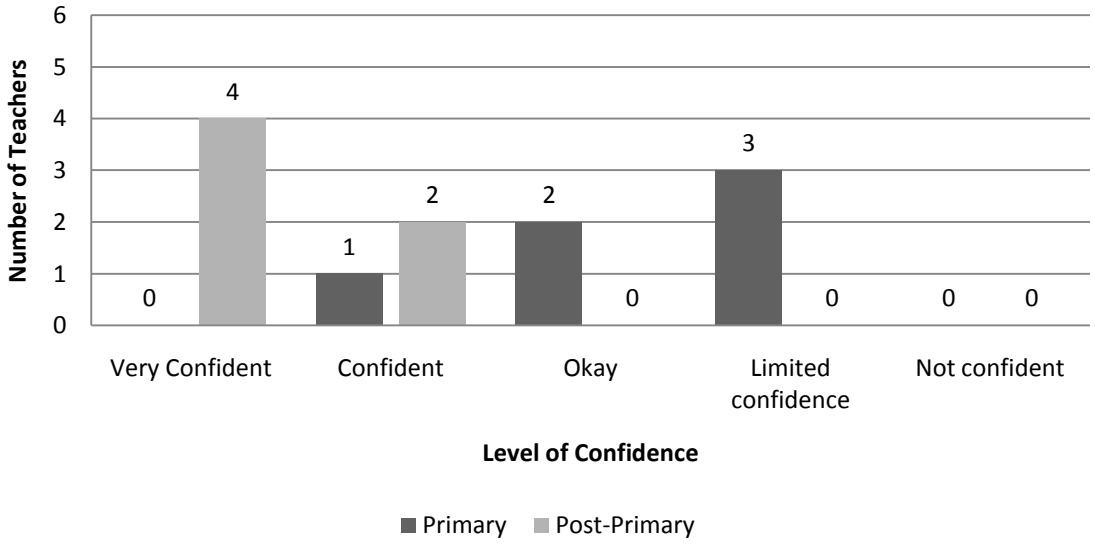


Figure 5.12 and **Figure 5.13** above clearly indicate that participating primary teachers showed slightly more confidence in their teaching of topics related to the human bodies than

those associated with plants and animals. Post-primary teachers continued to respond positively to this topic as with the previous biology topics. When questioned, no primary teacher (0 out of 6) felt very confident in teaching about 'Plants and Animals' or 'Habitats' while in comparison, a total of 5 post-primary teachers felt very confident. Two of the primary school respondents state they felt just 'okay' about their teaching and interestingly half (3 out of 6) stated they had limited confidence in teaching topics in the area of 'Plants and Animals'.

Pupils were then asked to assess their enjoyment of learning about plants and animals (**Figure 5.14** to **5.16**).

Figure 5.14 I enjoy learning about plants in our environment and how they grow (N=23)

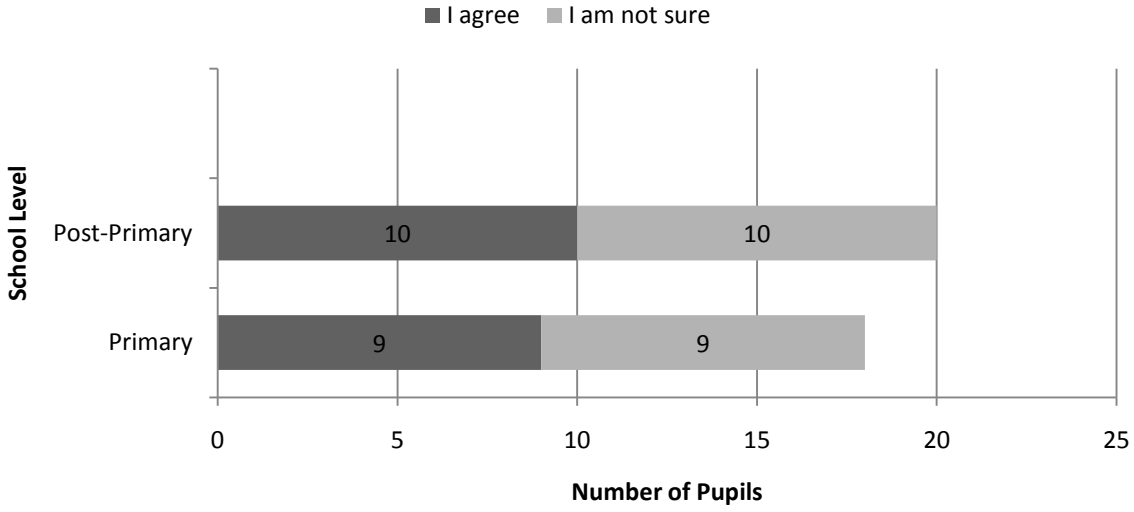


Figure 5.14 to **Figure 5.16** clearly indicate that pupils appear more positively disposed towards learning about animals and their habitats rather than plants. Five primary pupils and three post-primary pupils are stated as not enjoying learning about plants in our environment and how they grow. One pupil commented further that this area was not particularly enjoyable (**Appendix I)**. They stated that the one topic they did not like learning about was '*probably learning about trees and nature...it just doesn't interest me'* (Pupil 18, Primary Interview)

A number of pupils chose to further comment negatively on the topic of plants when questioned in post-primary school. Pupil 1 states simply that plants are the one topic in

particular they do not like learning about in school science (Pupil 1, Post-Primary Interview). Topics such as 'plants' are seen to be 'harder' and more challenging in post-primary school *"Like the plant thing, we did more work that what we did in primary school, then that made it harder. It was just kind of boring in primary school* (Pupil 13, Post-Primary Interview).

Figure 5.15 I enjoy learning about animals in our environment and how they live (N=23)

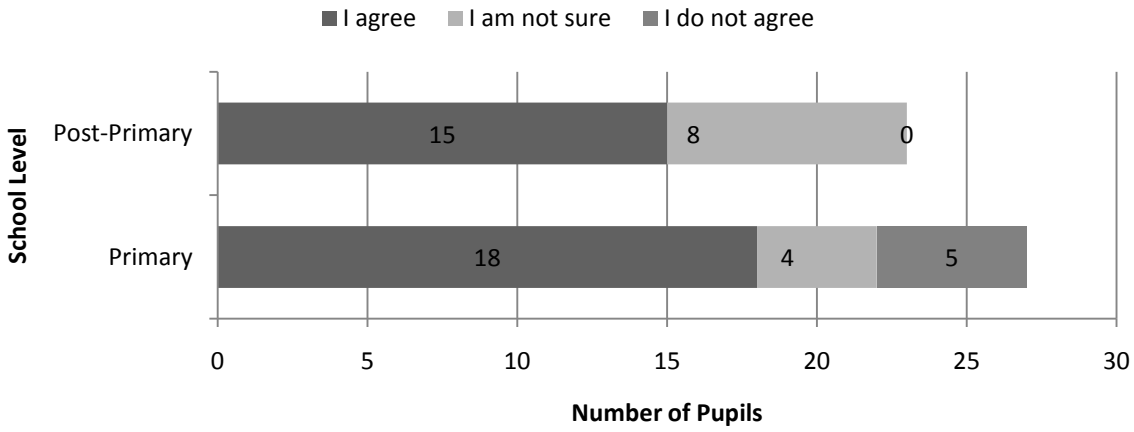
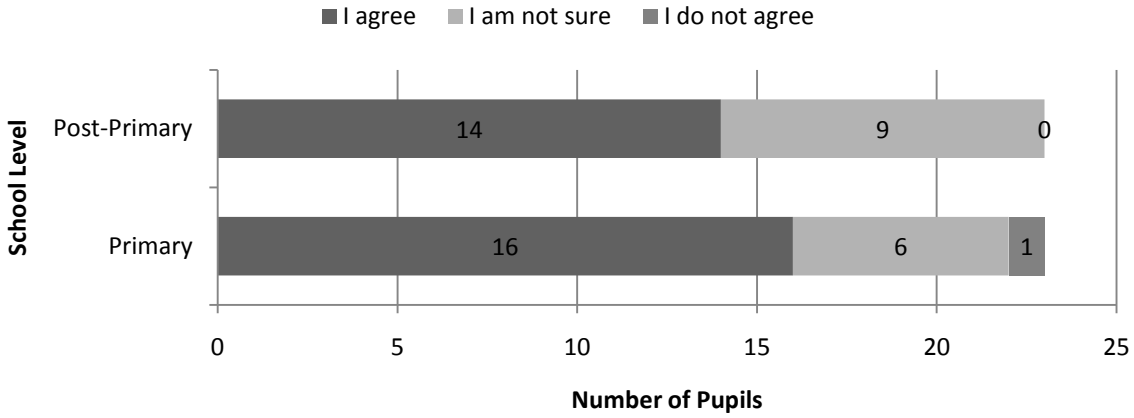


Figure 5.16 I enjoy learning about where animals live (N=23)



In contrast, **Figure 5.15** and **Figure 5.16** indicate that a majority of pupils, 18 out of 23– (67%) in primary and 15 out of 23– (65%) in post-primary, enjoy learning about animals in our environment and how they live. Furthermore, 70% of pupils (16 out of 23) in primary school and 61% (14 out of 23) pupils in post-primary school are stated as enjoying learning about where animals live. It must be noted that while the numbers of pupils who do not like learning about animals and habitats decrease upon entry to post-primary school (**Figure 5.15**

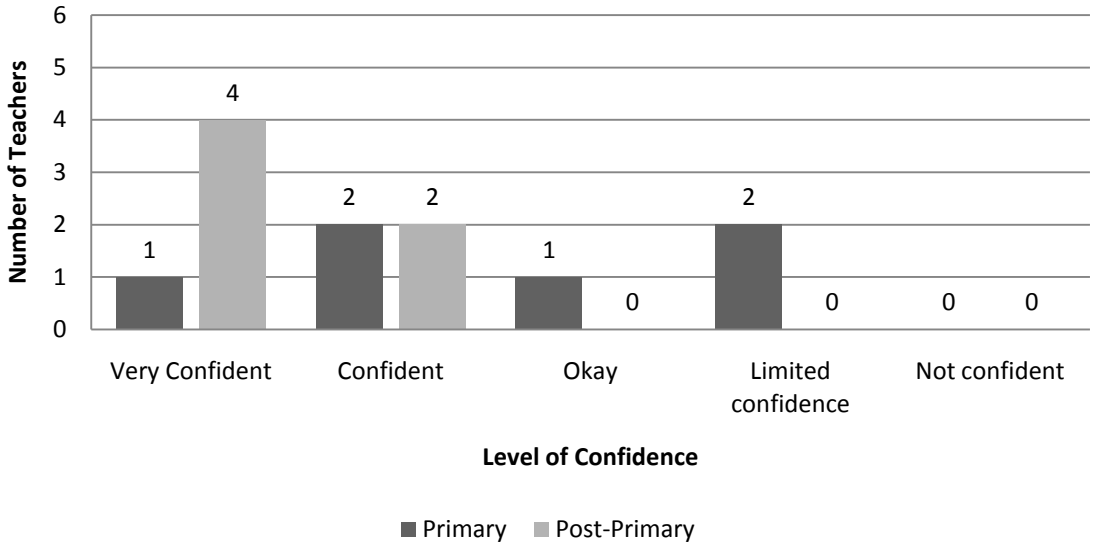
and **Figure 5.16**) this decrease does not equate to a corresponding increase in pupils' enjoyment following transition.

Findings above would again point to the influence of teacher confidence on pupils' learning in science. It is notable that of all subject areas in the primary science curriculum teachers were asked to rate, it was the topic of plants and animals that primary teachers displayed the least confidence, with half (3 out of 6) rated as having limited confidence in teaching 'Plants and Animals' and 'Habitats'. Subsequently, this researcher has found that despite post-primary teachers increased subject knowledge, many pupils found learning about both plants and animals far more difficult and intense in their post-primary school science classroom than the previous year in primary school (Pupil 13, Post-Primary Interview).

5.3.3.3 Light, Sound and Heat

As stated above (**Figure 5.7**) the teaching of Physical Science topics demonstrated a drop in confidence levels among post-primary teachers. With just one primary teachers rated as very confident in this area, it follows that just two post-primary teachers rated their confidence in teaching physics as very high. Teachers were then asked a range of questions aimed at examining their level of confidence in the teaching various topics such as 'Light and Mirrors', 'Sound, Noise, Vibrations', 'Heat and Temperature', 'Magnetism', 'Electricity and Circuits' and 'Forces and Motion'. Both primary and post-primary teachers showed a wide range of confidence levels when asked about their teaching of physical science topics as is shown in the below **Figures 5.17-5.19.**

Figure 5.17 Teaching Light Mirrors and Lenses (N=12)



Out of a total of 6 primary teacher respondents, two are stated as feeling confident about teaching about light and mirrors (**Figure 5.17**). However, a further two primary teachers admitted having limited confidence in this area. When their post-primary teaching colleagues were also questioned on their confidence in teaching about 'Light, Mirrors and Lenses', a majority of 4 (out of 6) stated they were very confident in their teaching of this topic and the remaining 2 stated they were relatively confident teaching this subject area. Throughout the physical science topics primary teachers' recorded similar responses as above with the same numbers rated in the teaching of sound, noise and vibrations and heat and temperature.

Figure 5.18 Teaching Sound Noise and Vibrations (N=12)

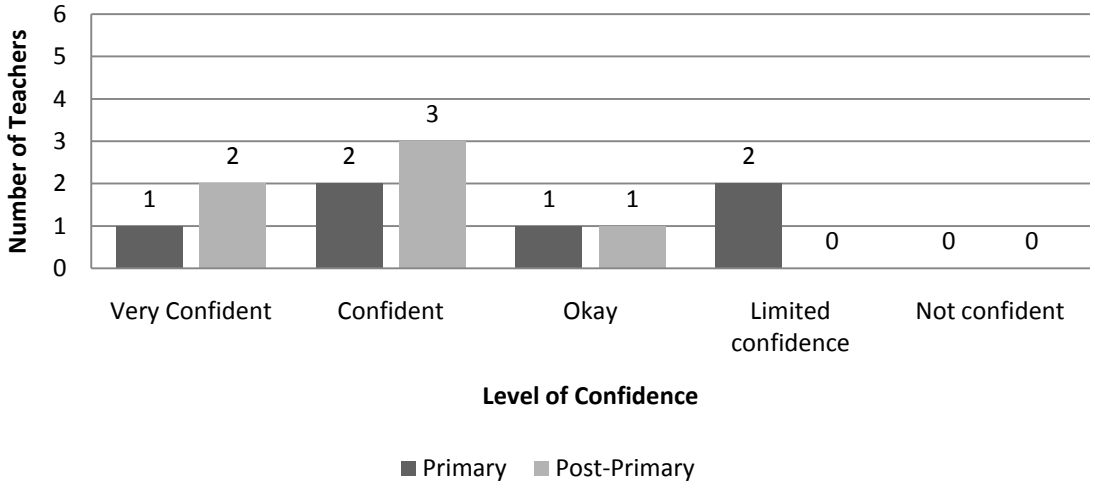
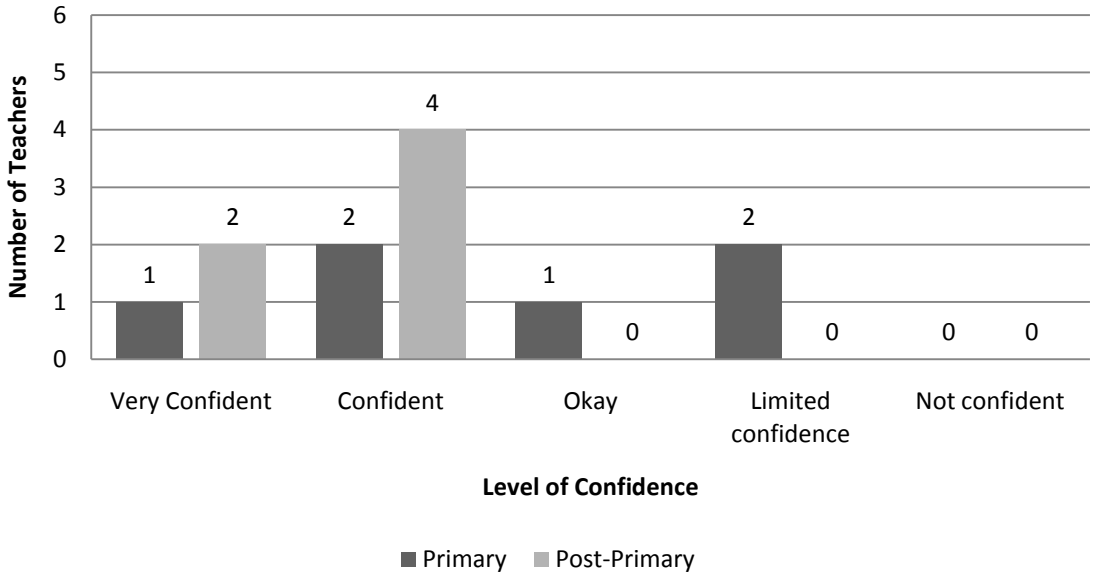


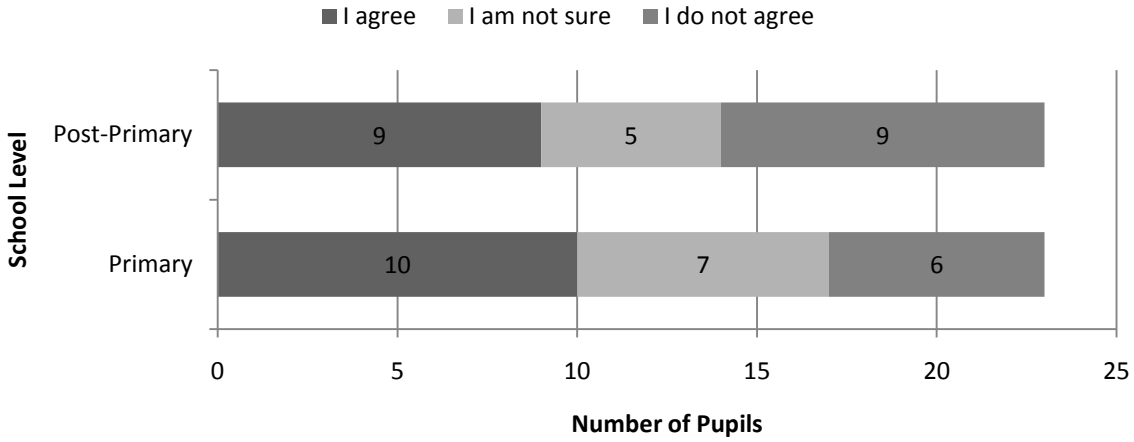
Figure 5.19 Teaching Heat and Temperature (N=12)



Markedly, post-primary teachers' responses indicate a varied confidence in teaching the subject areas of 'Light, Sound and Heat'. Three post-primary teachers rate themselves as 'confident' teaching about 'Sound Noise and Vibrations' (**Figure 5.18)** and a further four post-primary teachers rated as 'confident' in teaching 'Heat and Temperature' (**Figure 5.19**). However, one post-primary teacher cited themselves as feeling their confidence level is just 'Okay' in their teaching of 'Sound and Vibrations' equal to the number of primary teachers in the same category.

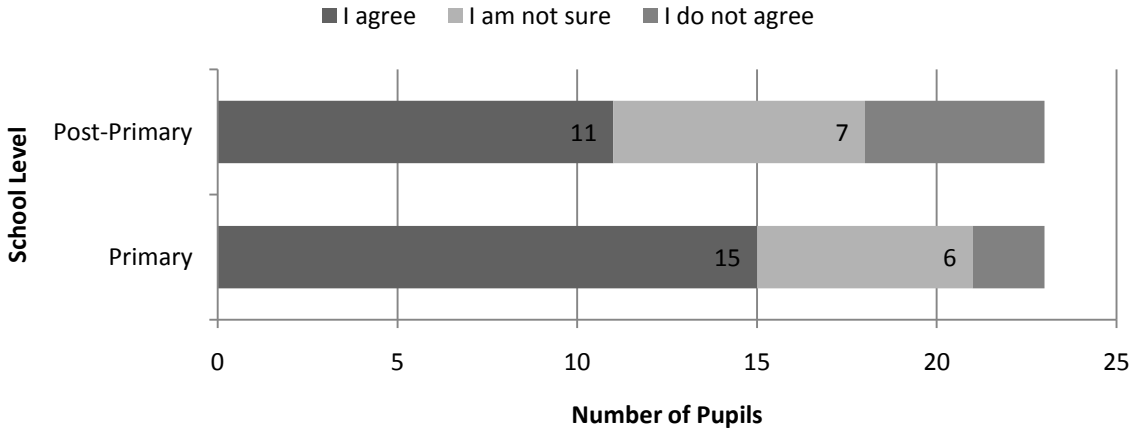
Following this, it is clear from the figures below (**Figures 5.20** to **5.21**) there is mixed reaction by pupils in both primary and post-primary school to learning about physical sciences in line with the varied confidence levels of their respective teachers displayed above. Results indicate that pupils view this area of the science curricula to be less engaging and less 'hands-on' and as expectations at post-primary level are not being met they essentially disengage with learning this topic. In all three of the figures presented below, the number of pupils who 'do not enjoy' learning these topic areas increased upon entry to post primary school.

Figure 5.20 I enjoy learning about light mirrors and lenses (N=23)



When asked on either side of the transition if they enjoy learning about 'light, mirrors and lenses', the number of pupils responding in the negative increased by a factor of three, from 6 to 9 (out of 23) pupils (**Figure 5.20).** Similar findings emerged when pupils were questioned about 'sound, noises and vibrations' with the number of negative responses increasing from 2 to 5 (out of 23) and those stated as enjoying the topic falling from 15 to under half (11 out of 23) the total pupils participating (**Figure 5.21).**

Figure 5.21 I enjoy learning about sound, noises and vibrations (N=23)



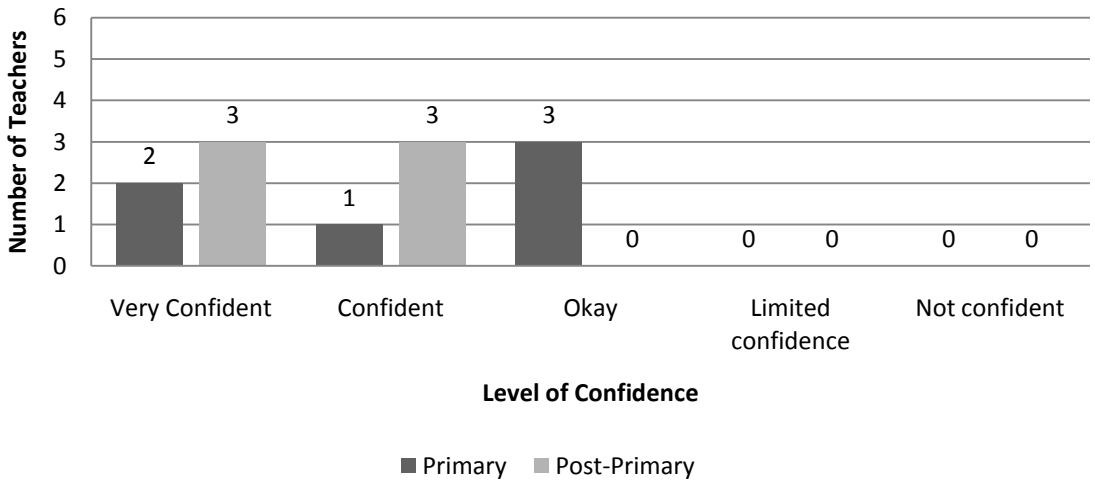
The topic of 'sound' proved to be particularly unpopular when pupils were questioned further during the interview with three pupils commenting in the negative (**Appendix I).** One pupil in particular pointed out the lack of engaging activity while learning about such topics "*Sound as well, it was boring like, you'd be only listening to stuff like whereas in the other ones you could actually do stuff yourself like"* (Pupil 2, Primary Interview*).* It is evident

from the above results that pupils respond more positively to more active and engaging activities. It clearly consolidates the findings of Nilsson and Driel (2010) that low confidence often results in teaching that is limited to scientific activities that are ensured to work and that involve only science pedagogy contiguous with which teachers feel comfortable and familiar (Nilsson and Driel, 2010). Teachers in both primary and post-primary science classrooms are confined to the limits of their own understanding and confidence, and therefore must plan lessons and pupil learning according to those limits. What can only come from such confined planning are the issues discussed in (Chapter 4, pp. 107-110) and which pupils see as 'barriers' to their learning in science across the transition.

5.3.3.4 Magnets and Electricity

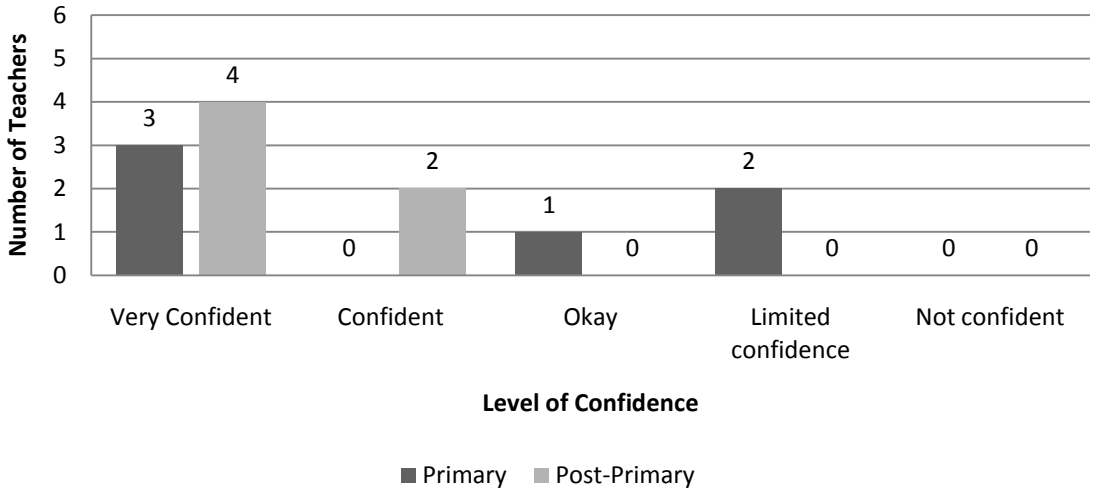
There was a noted increase in confidence among both groups of teachers across the transition when asked about teaching the topic of magnets and electricity and circuits (**Figure 5.22).**

Figure 5.22 Teaching about Magnetism (N=12)



Two primary and three post-primary teachers respectively rated themselves as very confident in their teaching of magnets and magnetism, one of the highest confidence level displayed by primary teachers in this study. However, a further three primary teachers rated their teaching of the topic as just okay, demonstrating some doubt in their ability to teach about magnets.

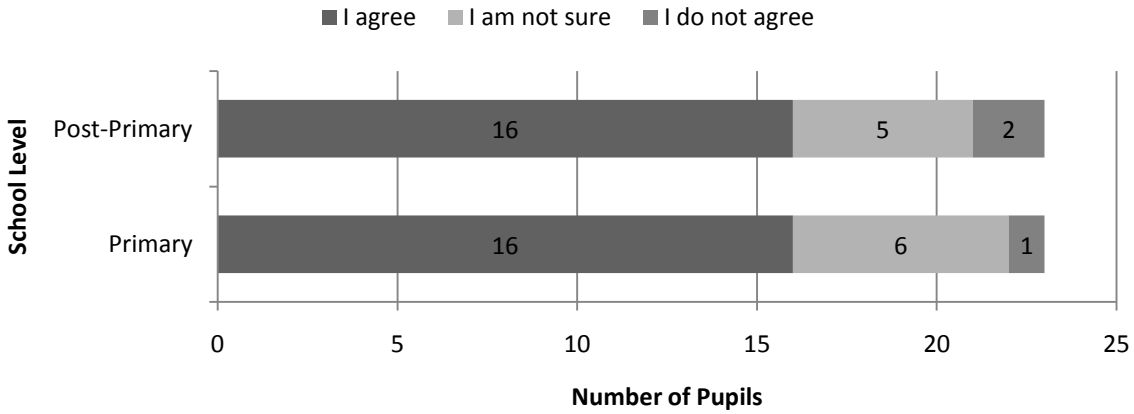
Figure 5.23 Teaching Electricity and Simple Circuits (N=12)



Both primary and post-primary teachers reported higher levels of confidence in teaching electricity and circuits. As seen in previous science curricular areas, post-primary teachers appear more confident in teaching electricity and circuits than their primary counterparts. However, in this category half the primary teachers questioned rated themselves as very confident in their teaching of 'Electricity and Magnets' with four post-primary teachers rated as very confident in their teaching of the same topic area. Despite such high confidence levels among a number of primary teachers, two of their primary colleagues rated their teaching of this topic as having limited confidence.

Consequently, a large majority of both pupils in both primary (16 out of 23) and post-primary (16 out of 23) had a continuous, positive experience of learning about magnets across the transition (**Figure 5.24**).

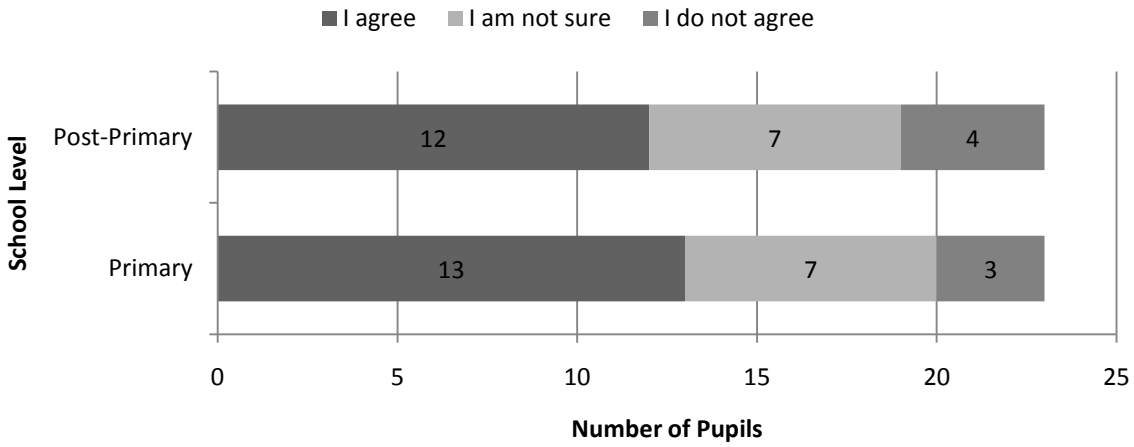
Figure 5.24 I enjoy learning about magnets (N=23)



Pupils in primary school in particular were well disposed to working with magnets. Two pupils commented positively on their learning in this subject area during the interview (**Appendix I).** Pupils 4 and 8 are stated as liking this topic area in particular (**Appendix I).** Just one pupil in primary school and two pupils in post-primary school stated they did not like learning about this topic.

However, findings indicate that the topic of magnets is mentioned in particular by pupils as being repeated from primary to post-primary. As is stated by Pupil 10 in the post-primary pupil interview *"It's sort of boring, you've learned it before and like magnets there's not much to learn and then you do it again"* (**Appendix J).**While it would not appear that lack of post-primary teachers' subject knowledge is the cause for repetition of learning in this area, it is clear that such repetition is not fostering new interest in this topic area or in science in general across the primary - post-primary transition. The finding that repetition of topics can lead to a fall in interest in school science is consistent with studies mentioned in Varley *et al.* (2008a) who pointed out that a lack of communication on academic and curricular matters at the point of transfer is seen as contributing to a repetition of material already experienced at primary school and thus, leads to negative attitudes developing in early post-primary school. This issue is discussed further with regard to pupil expectations on entry to post-primary school science and teacher communication (Chapter 5, p.151).

Figure 5.25 I enjoy learning about electricity, batteries, bulbs and circuits (N=23)



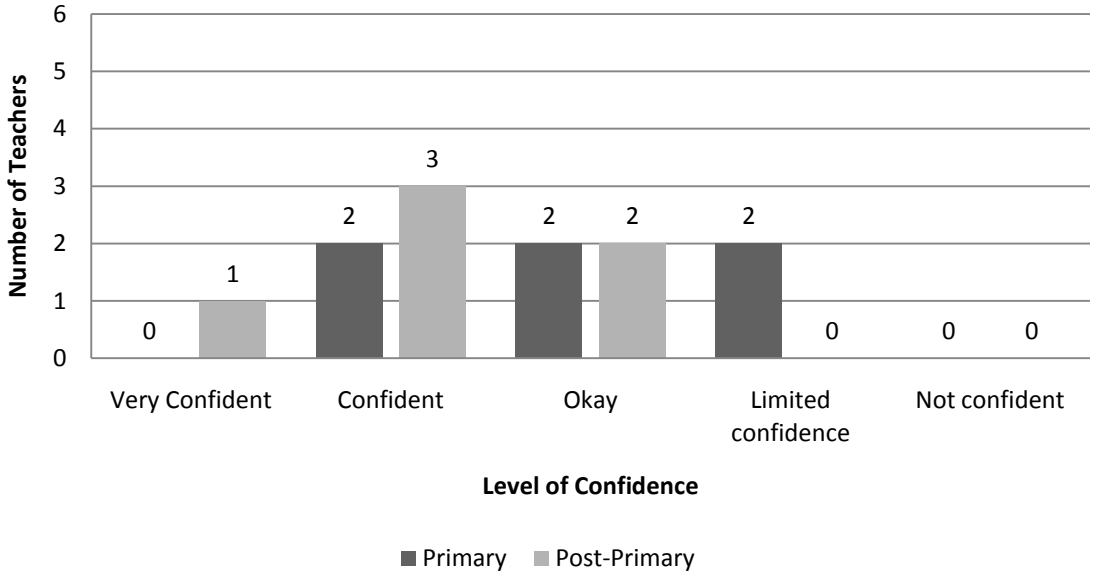
Thirteen out of twenty three primary pupils indicated that they enjoyed learning about 'electricity, batteries, bulbs and circuits' with just three pupils not in agreement with the above statement (**Figure 5.25**). When asked to indicate their opinion following entry to

post-primary school, twelve of the pupil cited they enjoyed the topic and four responded negatively. Thus opinion in studying electricity, batteries and bulbs remains relatively unchanged by the transition of post-primary school despite a number of primary teachers' limited confidence in this field of study (**Fig 5.23**). Further findings confirm that electricity proved overall a positive experience for pupils, particularly at the end of primary school. As stated in previous sections, it is seen by pupils as an active and practical topic and is thus more popular among pupils. Two pupils cited electricity as a particularly enjoyable compared to other aspects of their science lesson (**Appendix I)** and as Pupil 1 (Primary Interview) notes that "*It depends on what we do, if we're doing electricity that'd be good and if we're doing stuff about water that's all right too but then again if you're just doing writing the whole time that's not good".* While this research confirms the findings of Osborne *et al.* (1998) that any activity other than hands-on experiments, such as written work, are seen as 'barriers' to real learning by pupils at both levels, this researcher again questions if it is primary teachers lack of confidence in teaching certain areas of curricula that leads to less engaging teaching strategies such as large amounts of pupils reading and writing science.

5.3.3.5 Forces and Motion

Teacher confidence was found to drop again in both teaching levels however, when teachers were asked about teaching forces and motions. (**Figure 5.26).**

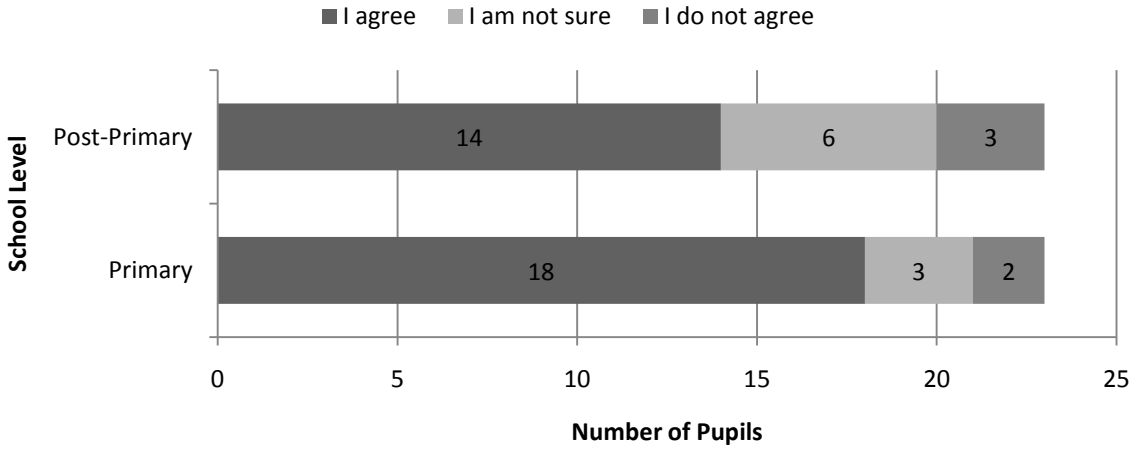
Figure 5.26 Teaching Forces and Motion (N=12)



Interestingly, no primary teacher rated themselves as very confident teaching about 'Forces and Motion' and just one post-primary teacher rated themselves in the same category

(**Fig 5.26).** A further two primary teachers have limited confidence in their teaching about this topic.

Figure 5.27 I enjoy learning about how different objects move (N=23)

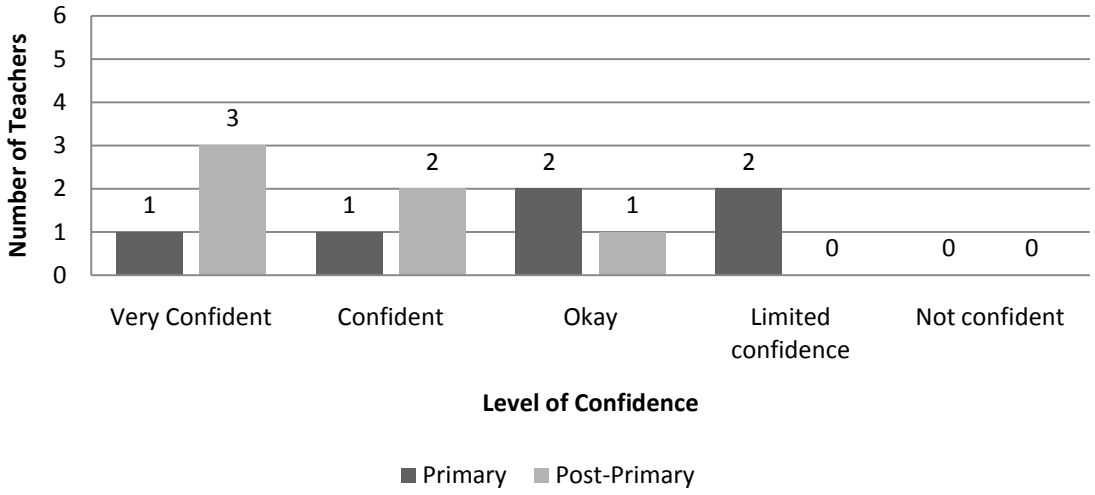


Therefore, it is notable that contrary to findings above, the limited confidence of primary teachers in the area of 'Forces and Motion' does not affect pupil enjoyment of this subject area at primary level. A large majority of primary pupils (eighteen out of twenty three) enjoyed learning about objects and how they move during their time in primary school. However, this number drops by the end of first year post-primary to just fourteen out of twenty three (a factor of 4). These findings would appear to mirror those in **Figure 5.26** above, where there is an increase in complexity of learning about 'Forces and Motion' at post-primary level, lack of high levels of post-primary teachers confidence in this area must lead to inadequate teacher explanation and demonstration of the topic content and skills.

5.3.3.6 Materials and their Properties

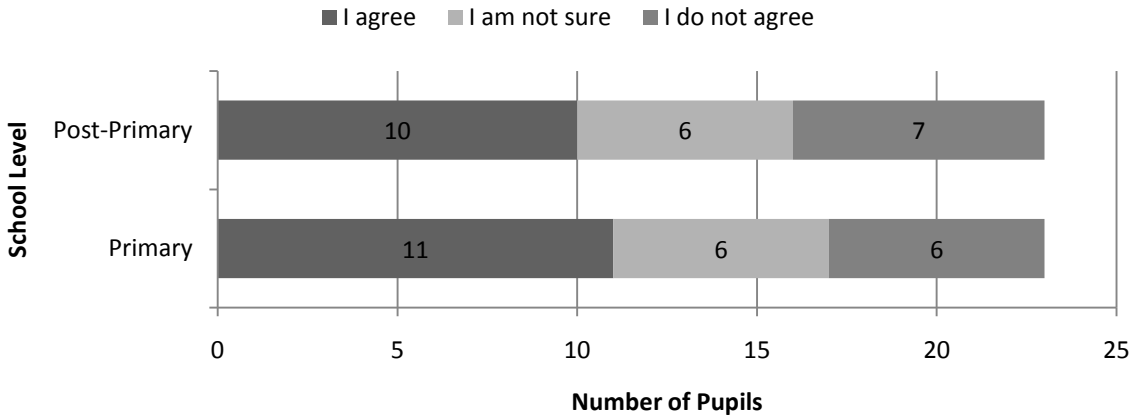
Following a general overview of teacher confidence levels in teaching Chemistry teachers were then asked more in-depth questions on their competencies in teaching particular topics in the area of chemistry. **Figures 5.28** to **5.29** present the findings when teachers were asked if they felt confident teaching about 'Materials and their Properties' and 'Materials and Change'.

Figure 5.28 Teaching Materials and their Properties (N=12)



In the teaching of 'Materials and their Properties' there appears to be an even distribution of confidence levels among both primary and post-primary teachers (**Figure 5.28**). Just one (out of 6) primary teachers did rate themselves as very confident in their teaching of materials. However, this is counteracted by two further teachers rated as having limited confidence teaching this topic. This compares their counterparts at post-primary level, who again display high levels of confidence in their teaching of chemistry topics such as materials with 3 (out of 6) stated as very confident.

Figure 5.29: I enjoy learning about materials such as wood, plastic and metal (N=23)



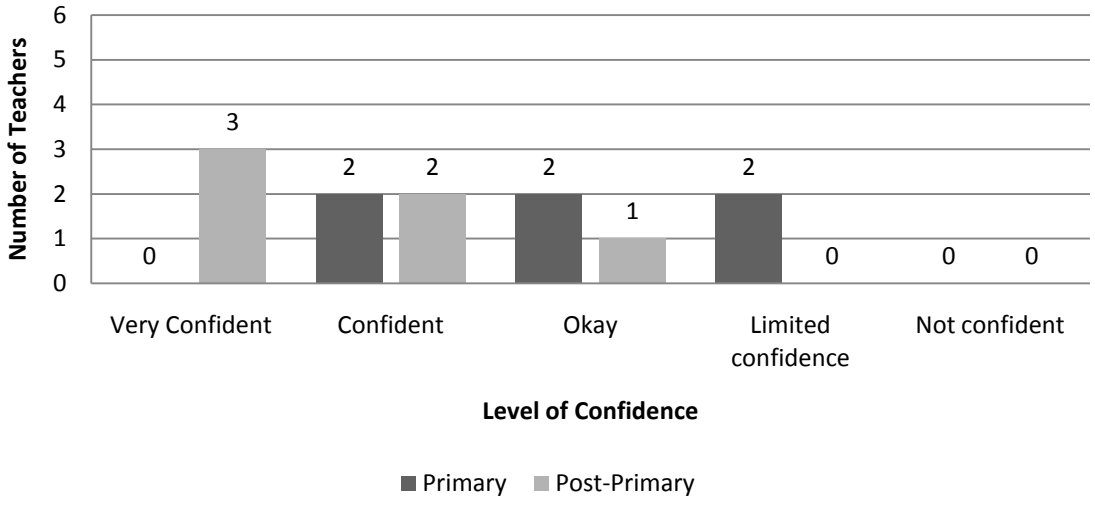
Findings from both primary and post-primary pupil data indicate that pupils are less disposed to learning about materials such as wood, plastic and metal with this trend continuing from primary into post-primary schooling. Just under half the primary pupils

stated they enjoy learning in this topic area (11 out of 23) with this number decreasing by just one factor to ten post-primary pupils (10 out of 23). It was noted by the researcher that no pupil commented on this topic area during the interview (**Appendices I and J)** perhaps illustrating the lack of influence topics such as 'Materials' have on pupils' attitude to science. Furthermore, it would appear to this researcher that low teacher confidence levels, particularly at primary level, are causing some teachers to build a poor impression of certain parts of the science curriculum for their pupils.

5.3.3.7 Reactions

Interestingly, compared to figures recorded above (**Figure 5.28)** when questioned further about their teaching of 'Materials and Change' the number of primary teachers rated as 'very confident' decreases to zero (out of 6), in comparison to three (out of 6) post-primary teachers continually rating themselves as very confident in teaching about 'Materials'.

Figure 5.30 Teaching about Materials and Change (N=12)



Despite the low level of confidence displayed by primary teachers above (**Figure 5.30),** an overwhelming majority of pupils in both primary and post-primary school enjoy learning about what happens when you mix materials and things together (twenty out of twenty three) (**Figure 5.31**). Just two pupils were undecided on this area of learning when asked at both the end of primary and the end of first-year post-primary and one pupil did not agree with the other respondents in either class grouping.

Figure 5.31 I enjoy learning about what happerns when you mix things together (N=23)

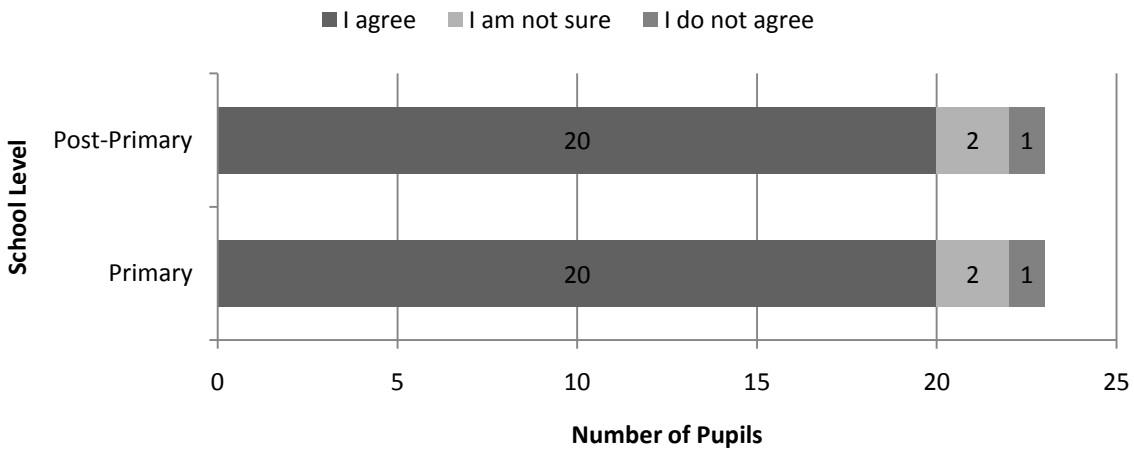
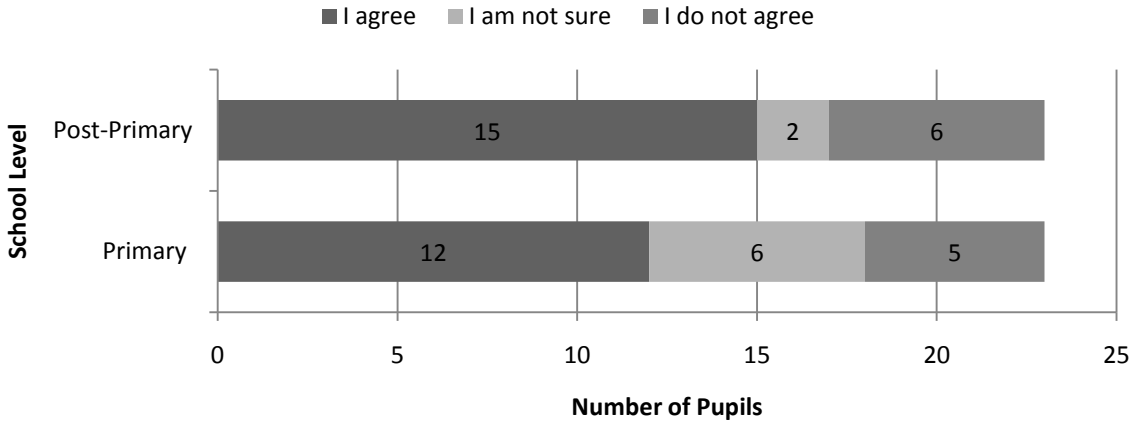


Figure 5.32 I enjoy learning about what happerns when you heat things up and cool things down (N=23)



Findings in this study show that the topic of making reactions is seen as one of the most enjoyable to learn in the science classroom, both primary and post-primary. The terms 'explosion' and 'reactions' are commented upon frequently as particularly enjoyable topics (**Appendix I).** Though teacher confidence levels are not particularly high for this area of the curriculum, a large majority of pupils in this study (20 out of 23) indicate that lessons encompassing 'what happens when you mix things' are most memorable and stand out. It is simply the fact that pupils are 'actively' engaged in their own learning while partaking in this topic area. **Appendix I** shows two pupils citing the above topic as particularly agreeable. Pupil 11 is quoted as liking learning about how things react (Pupil 11, Primary Interview). Pupil 16 confirms the importance pupils place in science being active and engaging. "*I like*

doing the experiments with the explosions, stuff like that because it's much more fun and sort of active like" (Pupil 16, Primary Interview).

When asked to describe a lesson in this topic area Pupils 17 and 19 were very animated and engaged in the learning that took place in this area of the curriculum. *"When we made the volcano... We got the baking soda and the vinegar and the red dye and we put it in, and we made a mould out of a volcano with trees and everything and then we put in the vinegar and all that and the red dye and it all erupted up foamy and everything"* (Pupil 17, Primary Interview) ..*Ya that was my favourite* (Pupil 19, Primary Interview). In the follow-up interview Pupil 19 is cited as recalling an experiment where pupils made a volcano as a particular stand out moment in primary science '*We only did one good one I can remember and that was it really. The volcano that was it*' (Pupil 19, Post-Primary Interview).

Furthermore, findings indicate that while twelve primary pupils enjoyed learning in the area of heating things up and cooling things down this number actually increases when questioned at the end of first year post-primary to fifteen out of twenty three (**Figure 5.32**). Four pupils commented positively in regards mixing chemicals and heating things up and cooling them down. Pupil 4 simply states how much fun it is to learn and Pupil 5 also had similar positive remarks (**Appendix J)**. It is Pupil 1 who found that '*Learning about the stuff you use, test tubes and that and using all these new chemicals'* more interesting as it was more interesting , practical and had never been part of their learning before (Pupil 1, Post-Primary Interview).These positive opinions at the end of the pupils first year in post-primary school may be due to the fact that pupils are more actively engaged in their own learning and furthermore, have a wider range of equipment available to them in post-primary school. According to Varley *et al.* (2008a), the majority of pupils are very positive about hands on science, appearing to have opportunities to engage in it and applying a range of scientific skills as a result. Their research found the majority of pupils enjoyed working this way (Varley *et al*., 2008a).

5.3.3.8 The Environment

Further topics questioned in both pupil and teacher questionnaires were 'Environmental Awareness' and 'Caring for the Environment'. Firstly, teachers were then asked to rate their level of confidence in teaching these topics in their classrooms.

Figure 5.33 Teaching about Environmental Awareness (N=12)

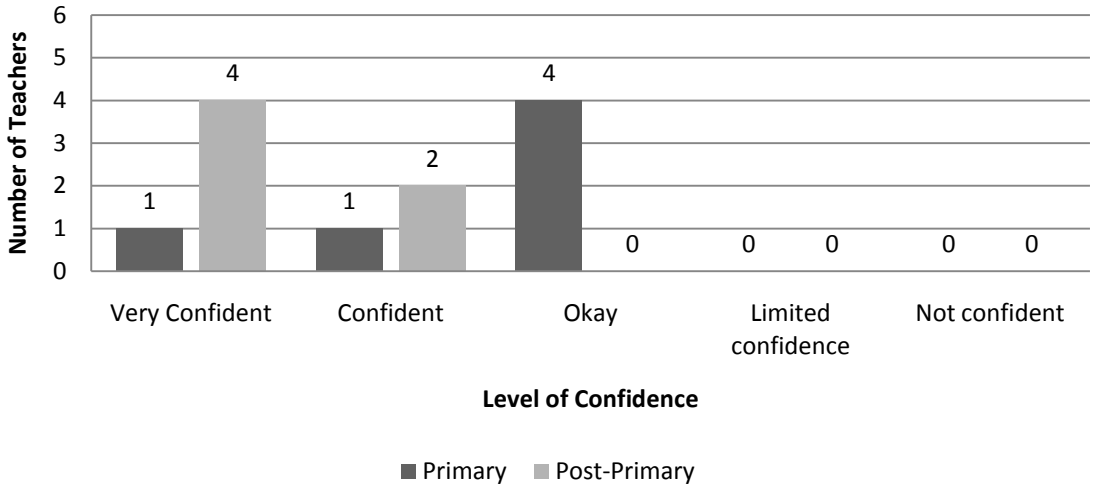
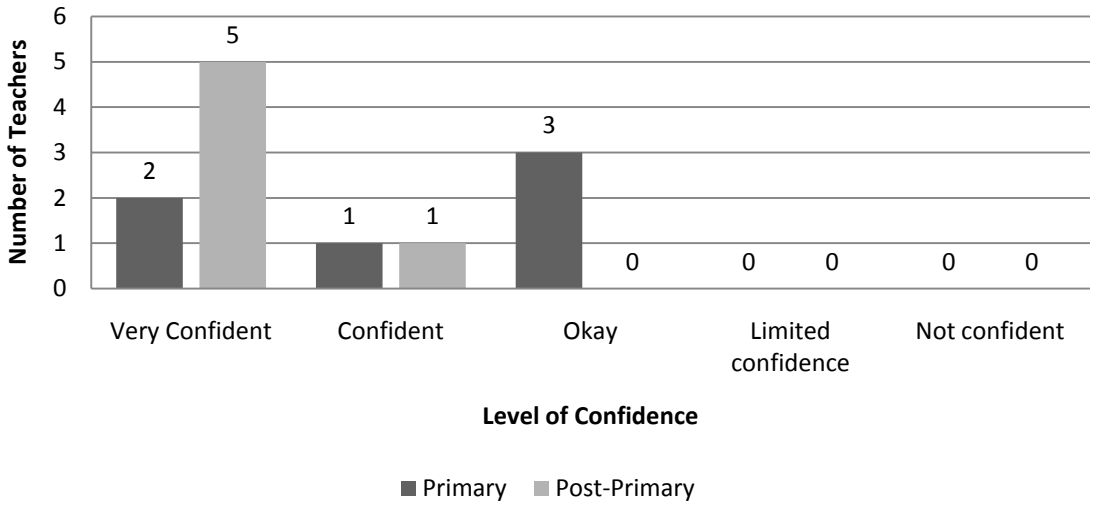


Figure 5.34 Teaching about Caring for the Environment (N=12)



Figures 5.33 and **5.34** clearly indicate that primary teachers rate their teaching in this topic area as particularly low. A significant number (4 out of 6) of primary teachers rated their confidence in teaching this topic as 'okay'. Their post-primary counterparts displayed significantly higher levels of confidence. Notably, primary teachers are slightly more confident teaching the topic of 'Caring for the Environment'. Two primary teachers rated their teaching as 'very confident' and a further teacher rated as 'confident'.

Despite post-primary teachers high confidence levels teaching about the environment**,** **Figure 5.6** above clearly indicates that it is the least popular area of learning in science with both primary and post-primary pupils with just 8 primary and 7 post-primary pupils stated as enjoying learning about saving energy and the environment. Furthermore, **Figures 5.35** as

well as **Figure 5.36** below indicate that learning within the topic area of 'the environment' is less even more unpopular with pupils following the transition from primary to post-primary schooling.

Figure 5.35 I enjoy learning about saving energy and the environment (N=23)

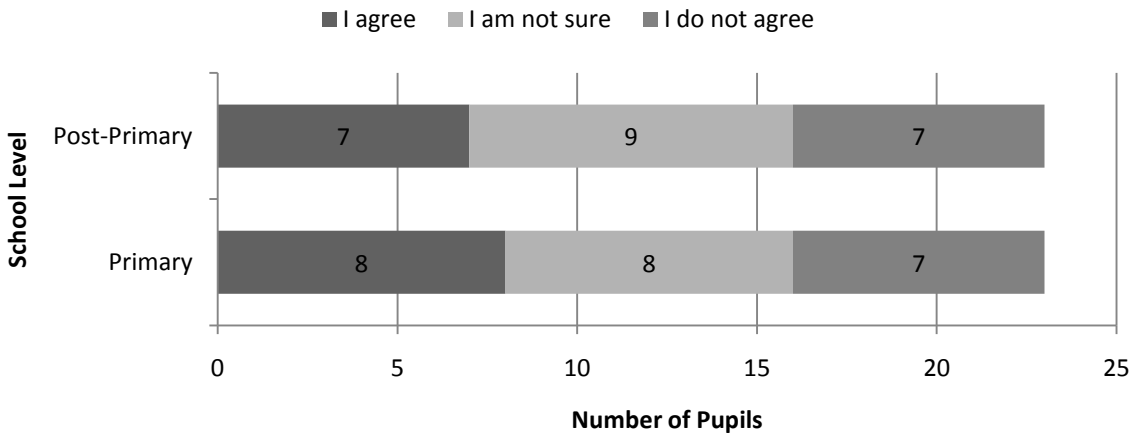
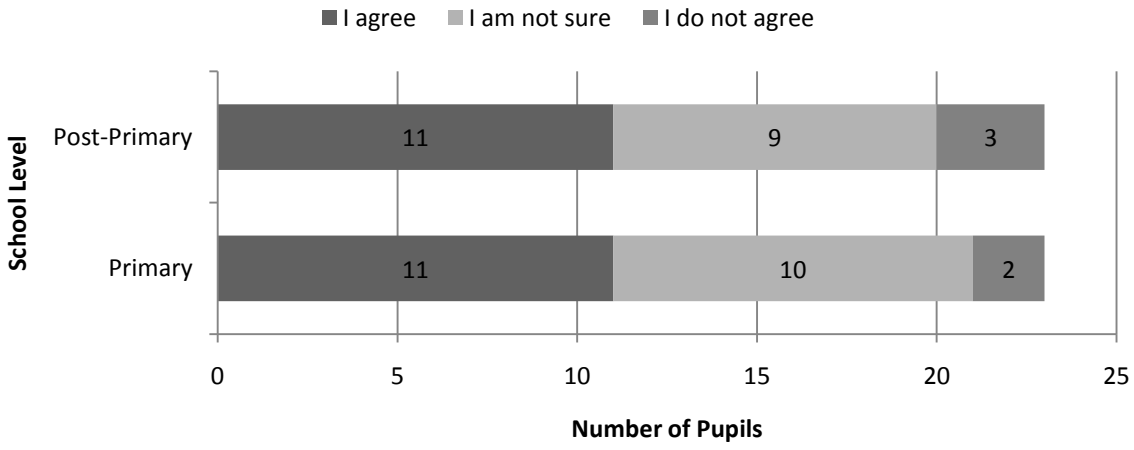


Figure 5.36 I enjoy learning about how to care for the environment (N=23)



Pupils at the end of primary school cited the repetition of material and the lack of a challenge as negative aspects of learning in this area (**Appendix I).** Pupils 18 states '(I don't like)...*learning about trees and nature... because it's too easy, it just doesn't really interest me***"** (Pupil 18, Primary Interview). Another pupil, Pupil 5 (Primary Interview) stated ' *I don't like doing things we already know as in, we learned about the Dead Sea and how much salt is in it, you have to, like you learn about it ever year and we already know about it and it's kind of, sure we already know about it'*. Pupil 7 (Primary Interview) points out further lack of interest in this strand area of the curriculum '*Ya, we were just learning about the trees*

and stuff and I just don't like learning about the global warming and stuff because I get worried about it. Someone was going around saying the world would end in 2012 and that's only two years so I don't know' (**Appendix I).** Findings in this study would again confirm the work of Appleton (2003) and Harlen *et al.* (2005) that teachers, particularly those at primary level, when low in confidence teaching a particularly complex topic area, tend to teach as little of the science concept as possible and rely heavily on worksheets, avoiding all but the simplest practical work.

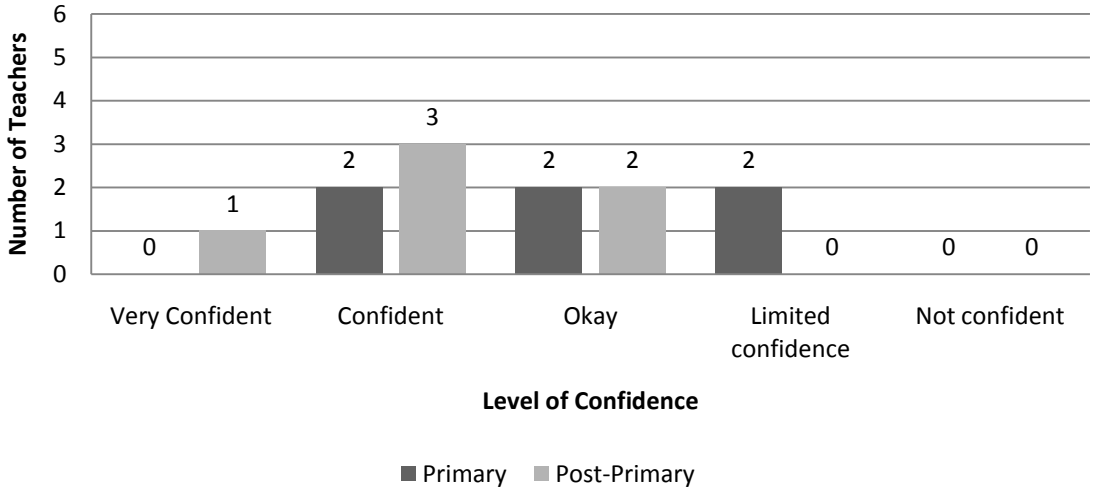
5.3.3.9 Other topic areas.

Pupils and teachers were questioned further on a number of other activities from both primary and post-primary curricula. These include their attitudes to the teaching and learning of 'New Inventions and Machines' and 'Designing and Making New Things'.

New Inventions and Machines

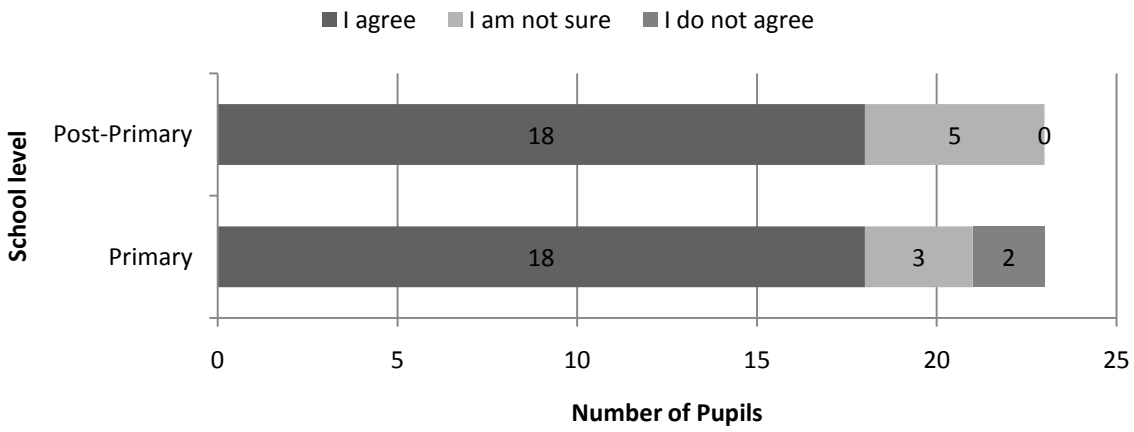
Teachers, both primary and post-primary were asked about their level of competence in teaching about new inventions and machines.

Figure 5.37 Teaching New Inventions and Machines (N=12)



Confidence levels teaching topics in this aspect of the science curricula appear to be slightly lower than in previous topics. **Figure 5.37** clearly indicates that less teachers feel very confident in their teaching of 'New Inventions and Machines'. Just one post-primary teacher state they were very confident teaching this area and no primary teacher rated themselves as very confident.

Figure 5.38 I enjoy learning about inventions and new discoveries (N=23)

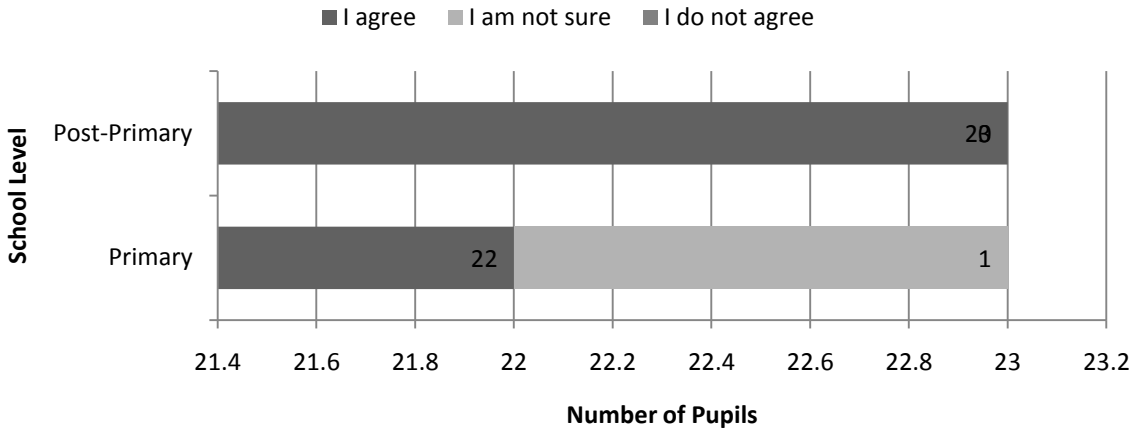


The above **Figure 5.38** indicates that despite low teacher confidence levels, learning about inventions and new discoveries is also a popular area of learning for pupils across the transition. Eighteen pupils (out of 23) enjoyed learning about inventions and new discoveries in both primary and post-primary school. This research thus questions if teachers lack the confidence to teach this topic, and as the literature suggests may perhaps refrain from teaching low confidence aspects of science, how pupils' enjoyment levels are so high. It may be that pupils focused more on the concept of 'discovering new inventions' themselves rather than learning about the 'new inventions and discoveries' of others.

Designing and Making New Things

Figure 5.39 clearly shows that pupils in both primary and post-primary school enjoy designing and making new things in their science class.

Figure 5.39 I enjoy designing and making new things (N=23)



Twenty two (out of 23) pupils in primary and twenty three (out of 23) in post- primary stated they enjoyed this aspect of the science curriculum. These lessons appear to be most memorable to pupils with 'making a volcano' and a weather wheel mentioned numerous times in the follow-up interview (**Appendix J).**Thus, this researcher agrees with the findings of Jarvis and Pell (2005) who indicated that although teachers may need to extend their knowledge in some areas as illustrated in the above figures, they do not need a great depth of scientific knowledge. As is shown in **Figure 5.38** to **Figure 5.39** they do need to be open-minded, however, and to allow children to be curious and to think about what they experience and question it.

To summarise, this research study indicates that limited primary teacher confidence levels in teaching science may lead to negative pupil attitudes to certain topic areas of the science curriculum developing at primary level. However, inconsistencies and contradictions have emerged in the above data related to the link between teacher confidence and pupil enjoyment of learning science. Findings above clearly indicate that in a number of topic areas, where primary teachers recorded 'okay' or 'limited' confidence levels; pupil enjoyment of the particular topic remained high. It is also evident through the data collected in this research that teachers have been found to use strategies involving as little of the 'low-confidence aspect' of science as possible, such as teaching science through worksheets, minimal questioning and discussion and by avoiding all but the simplest practical work in their science lesson.

5.4 Primary and Post-Primary Teacher Communication

The final section of the teacher questionnaire examines the level of communication between primary and post-primary school teachers across the transition. It investigates the level of curricular knowledge of teachers on either side of the transition and also questions their willingness to develop more substantial communication links between teachers.

The following **Table 5.4** presents the findings when teachers were asked if they have had previous contact with their teacher colleagues regarding the teaching of science in their class.

Table 5.4 Teacher Contact – Primary and Post-Primary Teachers (N=6)

Statement Have you ever had contact with a primary/post-primary teacher regarding the teaching of science in your class?	**Number of 'Yes' responses**	**Number of 'No' responses**
Primary Teachers	**1**	**5**

Post-Primary Teachers	**1**	**5**

The above **Table 5.4** clearly indicate that teachers on either side of the transition do not have regular contact regarding the teaching of science in their class. Just one teacher in primary and one in post-primary have had contact with their equivalent teaching colleagues across the transition. The remaining five primary and post-primary teachers are stated as never having contact. According to Varley *et al.* (2008a) the level of communication in relation to academic matters at the time of transfer would appear to be of concern. There is no policy on sharing information between schools. Further studies by Smyth *et al.* (2004) revealed that only a minority of post-primary principals received information form primary schools on transfer with just 1/3 of teachers receive information at all about 1st year students prior to entry.

Teachers were then asked if they would regard contact with their primary/post-primary science teacher colleagues beneficial in the teaching of science in your class. The following **Table 5.5** clearly indicate the results.

Table 5.5Primary and Post-Primary Teachers Attitude to Contact across Transition (N=6)

Statement Would you regard contact with a primary/post-primary science teacher beneficial in the teaching of science in your class	**Number of 'Yes' responses**	**Number of 'No' responses**
Primary Teachers	**3**	**3**
Post-Primary Teachers	**4**	**2**

The above results **Table 5.5**clearly reveals that opinions are split among teachers in both primary and post-primary school as regards contact with their primary/post-primary colleagues and its benefits to their teaching. Half the primary teachers (3 out of 6) stated they would find contact with their equivalent post-primary teacher beneficial to their teaching. Teacher 1 (Questionnaire) stated it would be beneficial '*To know what they will be doing next year'*. The remaining half of respondents however did not agree and thus do not feel that contact with a post-primary teacher would aid or assist in their teaching of science. Teacher 3 (Questionnaire) stated '*I think the curricula are totally different'* and thus does not regard contact with a post-primary school teacher as beneficial. Teacher 4 (Questionnaire) states,

having '*No time*', as an issue with contacting post-primary teachers. Another teacher (Teacher 6) also regards contact as a time issue. '*Too much time if we started doing it with all the other subjects*' (Teacher 6, Questionnaire).

When post-primary teachers were questioned, four (out of 6) cited they would regard contact with teachers from their primary feeder schools beneficial. Teacher 7 (Questionnaire) states it '*would give a better overview of what first-years know on entry'.* Teacher 10 (Questionnaire) also states that contact would '*Make for better planning'*. Just two (out of 6) responded negatively to the statement. Teacher 12 (Questionnaire) stated there were '*no hours available to meet every teacher from every school'*.

5.5 Further Discussion of Findings from the Teachers' Perspective

The results of this study clearly indicate that, in for primary and post-primary science teachers, there are a number of issues arising in the teaching of science that can affect pupils' experience of science at both school levels. The discussion from the teachers' perspective will be divided into the subsequent headings;

- Teachers' Attitudes to Science – Primary and Post-Primary
- Teaching the Primary and Post-Primary Curricula

5.5.1 Teachers' Attitudes to Science – Primary and Post-Primary

This research is consistent with the work of Appleton (2003) in highlighting the importance of the teachers' knowledge of science in order to inspire students' interest and learning. When primary teachers were questioned on their confidence regarding the teaching of science, results show just one teacher rated as very confident (**Figure 5.1).** In contrast, the majority of post-primary teachers (4 out of 6) were stated as being very confident in their teaching of science. Childs and McNicholl (2007) have also found that when a teacher felt confident with their subject matter knowledge, she was better able to match the content of science teaching explanation. Therefore it is interesting to note that in this study, where teacher confidence in teaching a particular topic area significantly increased from primary to post-primary level, pupils' enjoyment of the topic in question increased correspondingly (**Figure 5.6** and **5.7**).

A frequent argument in much literature about primary science education has been the awareness and apparent reluctance of many primary teachers to teach science (Varley *et al*.,

2008a). However, despite a number of primary teaching participants indicating a lack of confidence in their teaching of science, results in this research point to a majority (5 out of 6) teaching the required amount of science (1 hour per week) as laid out in the time allocation framework of the Primary School Science Curriculum (DES, 1999a). Therefore, this research highlights that it is not the amount of science teaching that is a factor in declining interest in science in the transition from primary to post-primary school but perhaps the 'coping' strategies and methodologies being employed by teachers.

This research assumes that if primary teachers are disinclined to carry out more challenging investigations and use more complex equipment in their science lessons due to a lack of confidence, their pupils gain the perception that primary science investigations lack challenge and purpose. Tantamount to the above evidence, there were a number of primary teacher respondents who did not agree that teachers should be able to use scientific equipment skilfully (**Figure 5.3**). Consolidating this point, this research also found that primary teachers tended to adopt coping strategies if and when confidence was limited. Similar to Harlen *et al.* (1995) this study found that these strategies include teaching as little of the 'low-confidence aspect' of sciences as possible, relying heavily on worksheets, minimal discussion and questioning and avoiding all but the simplest practical work. However, this researcher notes that since pupils see worksheets, copying from the board, reading their book and simple experimentation as barriers to what they perceive to be 'real' science learning to be, it stands to reason that teachers attempt to use a wider range of strategies in their science teaching.

In all topic areas of the science curriculum, post-primary teachers, having specific subject-based training, are more confident than their primary counterparts (Figure 5.1)**.** Similar to Osbourne and Simon (1996), findings here suggest that primary teachers, with having to acquire content knowledge, pedagogical content knowledge and curricular knowledge across a large number of subject areas, cannot feel fully confident teaching all aspects of just one subject area, in this case science. This researcher questions if it is lack of teacher confidence and knowledge at primary level that may lead to disinterest and disengagement among pupils even prior to transition to post-primary school.

5.5.2. Teaching the Primary and Post-Primary Curricula

Findings in this research propose that the most popular topics in both primary and junior cycle post-primary school appear to be those in which the pupils are actively engaged

in their own learning. The Primary Science Curriculum (1999a) and the revised syllabus in Junior Certificate Science (2006a) had been drawn up to cater for the full range of student ability, aptitude and achievement. The majority of pupils are well disposed towards learning about virtually all the content areas of the primary school curriculum and are very positive about hands on science, appearing to have opportunities to engage in it, applying a range of scientific skills as a result. The research found the majority of pupils enjoyed working this way. When questioned, 20 out of the total 23 at both primary and post-primary respectively agreed to enjoying learning about 'reactions' in science. This point validates the key message within both the Primary School Science Curriculum (1999a) and the revised Junior Cycle Science Syllabus (2006a) that children's learning by investigating is at the heart of these new and revised curricula.

However, this study, found that many post-primary pupils are 'turned off' learning in science because of large amounts of rote learning in their first year in post-primary school. The issue of learning off long definitions and vocabulary was the most mentioned negative aspect of learning science at post-primary school with five pupils commenting (**Appendix J**). Pupil 8 (Post-Primary Interview) pointed out how they felt learning off facts did not allow opportunities for what they deemed more interesting activities such as experimentation. Furthermore, findings have also shown that much of the curriculum planning at junior cycle post-primary level has not been modified to allow for children's achievement in primary school. Responses gathered in this study support this assertion. Pupil 1 (Post-Primary Interview) felt they repeated '*most of the stuff*'. In this study, just one post-primary teacher is stated as having made contact with a primary school teacher regarding the science learning of their pupils**.** Similar to findings by Jarman (1993) this study supports the claim that post-primary teachers often believe they are giving their pupils a fresh start and start from scratch.

Issues surrounding curriculum continuity have significant implications for this study as it has been found that a lack of continuity between primary and post-primary science curricula have led to pupil dissatisfaction with the science. Findings indicate that the overly sequential nature of both primary and post-primary curricula is a contributing factor to the repetition and recalling of material experienced by pupils upon entry to post-primary science classrooms. Eight pupils mentioned the issue of repetition of material causing boredom and disinterest in the Post-Primary Interview (**Appendix J).** Moreover, this research also questions if the recorded limited confidence levels of primary teachers may lead to negative experiences of science by pupils at primary school. Appleton (2003) highlights that a

significant number of primary teachers avoid teaching science due to the fact that they are not knowledgeable about science and thus lack the confidence to teach it.

5.6 Summary

This chapter discussed the findings of the research from the teachers' perspective. Through the evolving themes and sub-themes, the research sought to provide an analysis into these key findings by direct comparison of teachers' opinions and view of teaching science in primary school and junior cycle post-primary school.

Chapter 6

Summary, Conclusions and Recommendations

6.0 Introduction

The main purpose of this research was to investigate the transition from primary to post-primary science. Where the previous chapters were concerned with the presentation and analysis of data collected, this chapter continues to consider the implications of the findings in this study. A number of conclusions will be presented and discussed as derived from the results and findings. These will be followed by a set of recommendations aimed at the various stakeholders in the area of transition from primary to post-primary school science. Finally, consideration will be given to areas for further research and a conclusion of the study will be made.

6.1 Summary of results

This study investigated pupils' attitudes to learning science before and after transition to post-primary school. It dealt with primary pupils expectations of science prior to transition and examined if these expectations are being fulfilled following transition to post-primary school. It also examined the type of science pupils experience at both primary and post-primary level and how they experience teaching and learning in the science classroom. It was also concerned with an enquiry into primary and post-primary teachers' attitudes to the teaching of science across the transition, their level of confidence teaching science and the communication between primary and post-primary colleagues. A multi-method approach was adopted wherein pupil and teacher questionnaires and pupil interviews formed the construct of the research. This method is justified in that the use of quantitative research to corroborate qualitative research findings, or visa versa is a significant concept in qualitative research methods, and involves supporting conclusions with evidence from different sources (Slavin, 2008). In the case of this study, both pupil and teacher findings combine to present a comprehensive picture of transition in science, albeit from the perspective of two different and distinct stakeholders.

The research was conducted over a one-year period, between June 2010 and May 2011, with a group of 23 pupils and their respective teachers (12). Data was collected from the twenty three pupils first in sixth class of primary school and subsequently at the end of their first year post-primary school. Six primary and six post-primary teachers completed the teacher questionnaire. Thus, the collection and analysis of data from the pupils' perspective was grounded in these two strands of investigation. Results from both pupils and teachers

produced a comprehensive array of data. Throughout the research, themes and sub-themes emerged from the relevant findings and following this, an insight was reached on the related issues by analysis of the data. Four major themes emerged from the research findings.

- **Theme 1: Expectations of Science Across the Transition** narrated a clear and concise picture of pupils' expectations of science in the final years of primary schooling and the outcomes of these expectations upon transition to initial stages of post-primary school in the Irish context. It postulated on the issue of pupils developing very high expectations of science by the end of primary school which are often not realized upon entry to post-primary school.

- **Theme 2: Pupils' Attitudes to Science Learning Across the Transition** reported the extent to which primary pupil attitudes to learning school science can be altered following transition to post-primary science and how an incoherent transition to post-primary education in science is detrimental to student interest and engagement in learning and uptake of the subject at later stages of education.

- **Theme 3: Teacher Attitudes to Science Across Transition** gave an insight into the issues facing teachers when teaching science in the final years of primary school and the first year of post-primary school. Teacher's opinions on matters of teacher confidence, teaching strategies and curriculum continuity in science education were compared and contrasted to their pupils' responses to give a broad view of teaching of science across the primary – post-primary transition.
- **Theme 4: The Science Curriculum Across Transition – Curriculum Continuity** reported on the relevant curricular documents concerning the transition from primary to post-primary science, by comparing and contrasting teaching and learning across the curricula from the experiences of both pupils and teachers and the focus and format of pupils' learning in science. It gave an insight into primary and post-primary teachers' confidence levels when teaching science and compared these to pupils' enjoyment in learning various strands and topic areas of the primary and junior cycle post-primary science curricula.

For further clarification, conclusions reached in this research are divided into the four thematic strata, as described above. It is inevitable and practical that these four themes are

interrelated and woven inextricably in any implications for the future of science education (**Figure 3.9**). These conclusions are presented below.

6.2 Conclusions

6.2.1 Expectations of Science across the Transition

- **Primary pupils hold extremely high expectations of post-primary science and these expectations are often not realised following transition.**

This research suggests that in the final stages of primary school, pupils' interest in and expectation towards post-primary science is especially high. The data indicates that while primary pupils anticipate that learning in science may become more extensive and difficult in post-primary school, they expected it to become more interesting and engaging. At the outset of this research, just three (out of 23) of the pupils partaking in this study were not looking forward to further studies in science in post-primary school. Seven pupils commented in the primary interview on how much better science would be following transition (**Appendix I).** It can be concluded that while primary pupils perceive there to be an increase in workload and cognitive challenges ahead of them in post-primary science, they expect it to be a worthwhile experience. These findings concur with studies by Campbell (2001) which found that while the majority of pupils expected science content to be the same but more extensive, they expressed an expectation that once at post-primary school they would be given more responsibility for their learning.

Findings establish that pupils acquire certain expectations of science from the media and generic perceptions of science and scientists. Pupils expected to see '*dissections and explosions'* as part of post-primary school science (Chapter 4, p.71). Pupils in this study also gained expectations of the type of topics they would learn about in post-primary science and acquired the perception they would do more experiments at post-primary level from pre-transfer visits to their new school prior to entry. As Pupil 2 stated (Primary Pupil Interview) '*I think we'll do lots of experiments because we were down there one night and they had lots of different acids and all these kinds of explosions and that'*. The research recorded that these expectations had not been realised by pupils once at post-primary school. The research

findings imply that primary pupils are shown activities and experiments on open evenings that they may not necessarily partake in themselves once in first-year, which in turn may lead to disappointment and disinterest in post-primary science following transition.

The documented data in this study thus established disparity between pupils' high expectations of post-primary science and their continued enthusiasm for learning science following transition. Ten pupils in this research clearly indicated that they felt their expectations had not been met following transition (**Appendix J).** Evidence here suggests that a recorded decrease in interest in science is due to pupils realising that science at post-primary school is not what they hoped it to be. Pupil 22 (Primary Pupil Interview), when asked at the end of primary school, had already developed certain negative attitudes to science '*It's just boring, all of it's boring, I don't know it's hard to explain*'. These attitudes were shown to continue into first-year post-primary school due to expectations not being met following transfer, '*I thought experiments would be different like, the experiments are not babyish but we could do harder things'*(Pupil 22, Post-Primary Interview). These findings verify those of Campbell (2001) who stated that a factor in the aforementioned regression in pupils' interest in school science is that primary pupils' expectations of secondary science are not being met.

It is notably from pupil responses in this study, such as those above, that primary pupils have high expectations of having the opportunity to do more personal investigations and seeing less teacher demonstration of experiments when in post-primary school. This research found that 91% of all pupils surveyed stated they expected to do investigations themselves once in post-primary school (Chapter 4, p.69). This echoes the findings of Varley *et al* (2008a) that pupils left primary school with the perception that the most important learning activity was personal, practical experimentation. As Pupil 11 (Primary Pupil Interview) stated '*I don't think the teacher will be doing the experiments, I think we'll be doing them and she'll be going around'*. The data collected also documented that primary pupils have high expectations of being in laboratories with specialised equipment and facilities once at post-primary school, contrasting with the classroom science of their primary science with its simple apparatus (Chapter 4, p.70). The findings document that once in post-primary school, first year students found their expectations of engaging in increased amounts of personal investigative work and of regularly being in the laboratory using various apparatus were not being met. According to Pupil 9 (Post-Primary Interview) *'...I thought we'd be doing more*

experiments and fun stuff but now it's all work'. It can be concluded from this study that when pupils' perception of what they perceive post-primary science to be is not realised, it can lead to disengagement with learning in science. The level of disappointment recorded by pupils in this study could be related to the pupils' prior experience of the primary school curriculum in nurturing pupil learning that is independent and self-motivating not being continued in the teaching of the Junior Cycle Science Syllabus once at post-primary school.

6.2.2 Pupils' Attitude to Science across the Transition.

- **Pupils are generally enthusiastic about science education but interest and pupil enjoyment in several areas of learning in science can decrease following transition to post-primary school.**

This research recorded various conclusions with regard to pupils' attitudes to learning science across the transition. These attitudes are concerned with pupils' interest in science and enjoyment in learning science. These findings indicate that at the end of primary school, pupils generally view science as an enjoyable subject to study. A majority of primary pupils (15 out of 23) noted how interesting and 'fun' science is and showed particular interest in the practical aspect of "doing" science (Chapter 4, pp.73-74). This finding consolidates Varley *et al* (2008a) as they found that Irish primary children are well disposed towards learning about virtually all the content and areas of the primary school curriculum.

However, much of the commitment, attentiveness and enthusiasm for certain aspects of learning science built up in primary school were found to decrease on transfer to post-primary school. Diminished pupil enjoyment in learning science following transition is evident in the results here as pupil enjoyment in eight (out of the 16) topic areas of the Junior Cycle Science Syllabus decreased following transition (Chapter 5, p.122). Evidence would appear to suggest that when compared with responses recorded in pupils' final year in primary school, there appears to be more negative attitudes towards learning many of the science topics at the end of their first-year at post-primary school. For example, significant decreases in pupil enjoyment were recorded in the following topic areas: '*Animals in our Environment, Where Animals Live, Light Mirrors and Lenses, Sound and Vibrations, Electricity, Batteries, Bulbs and Circuits, How Different Objects Move, Materials and Saving Energy'* (Chapter 5, p.122**).** These findings are in direct contrast to those of Varley *et al* (2008a) who contends that

interest in science is sustained if not increased across the primary – post-primary transitional divide.

It is also apparent from the findings that overall attitudes towards learning about biological and chemical topics are more positive than attitudes towards physics topics at the end of first year post-primary school. This research that recorded that the greatest decrease in interest in science topics across the transition was recorded in the area of Physics, with 4 less pupils stated as enjoying learning about '*Sound, Noise and Vibrations'* and a further 4 pupils indicating they liked learning about '*How Objects Move'* less following transition (Chapter 5, p.122). Therefore, findings in this study reinforces the theories of Campbell (2001) and Murphy and Beggs (2005) that pupil enthusiasm for much of the science curriculum developed and nurtured in primary school is not built upon following transition to their post-primary science classroom.

- **Many primary and post-primary pupils hold their primary school science education in low esteem.**

Following transition, pupils' impression of and attitude towards their learning of primary school science would appear to be of concern according to findings in this study. Pupils' view that primary science is not '*genuine*' was evidenced in responses recorded in this research. As Pupil 5 (Post-Primary Pupil Interview) stated '*We get to do it more in detail here, in primary school you're not given a reason why we do it but now you know, it has like a meaning to it'.* While there may be a number of factors influencing pupils' attitude to their primary school science education, for example varying experiences of how they were taught, diverse teacher attitudes towards science and a range of teaching methodologies used, the data also suggested that pupils perceive primary science to be lacking challenge and purpose and reiterated the results findings of Campbell (2001). This researcher also suggests that an excessively negative view of primary science was conveyed by pupils at post-primary level in an effort to distance themselves from their experience of primary school science in general with a number of pupils showing distain for their learning in science at primary level.

- **Pupils, both primary and post-primary view any activity other than personal experimentations as 'barriers' to continuity of learning in science.**

Findings in this research clearly indicate that active engagement in learning science is preferable to pupils at both school levels and that any activities other than '*hands-on'* investigative work are seen as "barriers" to real learning by pupils. '*Doing experiments*' was mentioned by a total of 8 pupils (out of 23) as the most positive aspect to learning science in post-primary school (**Appendix J**). However, despite the new Primary Science Curriculum (1999a) and the revised Junior Cycle Science Syllabus (2006a) placing more emphasis on developing students' understanding of science concepts and the necessary scientific process skills through child led, personal enquiry based learning, findings here make a strong case for disagreement as a significant number of the pupils in this study commented upon large amounts of teacher demonstration, teacher talking, reading and writing in their science lessons. According to Pupil 6 (Primary Pupil Interview) '*We had to take down all the writing from the board when we came in. It's just a waste I'd rather spend more time doing the experiments.* This trend, despite the high expectations of pupils, continued into post-primary school, as Pupil 6's attitude towards written activity in science class had not improved '*There's more writing after it'* (Pupil 6, Post-Primary Interview). It would appear that the coherence of child-centred, active, enquiry based content and learning implicit in the 1999 Primary Science Curriculum and revised Junior Cycle Science Syllabus may not be carried through to its full potential in the science classroom.

Further to this, it was found that once at post-primary level, many pupils are 'turned off' learning in science because of increased amounts of rote learning upon transition to their first year of post-primary school. The issue of learning off definitions and long names was the most mentioned negative aspect of learning science at post-primary school in this research study (**Appendix J**). Five pupils in the post-primary pupil interview commented on learning definitions and long vocabulary (**Appendix J**). Pupil 9 (Post-Primary Interview) stated '*Well I didn't really like having to learn most of the elements of the table, that was kind of confusing and hard'.* The research clearly indicates that both primary and post-primary pupils felt that they do too much memorising and written work in science. The researcher questions if the Primary Science Curriculum and revised Junior Cycle Science Syllabus' aim of promoting understanding through active engagement is being carried through to pupils' learning in the classroom and if disparity is evident between official and the experienced curriculum.

The above conclusions relate to the pupils' experience of learning science across the transition from primary to post-primary science. While it has been shown that pupils are

generally enthusiastic about science education, interest and pupil enjoyment in certain aspects of learning science can decrease following transition to post-primary school. Primary pupils hold extremely high expectations of post-primary science. Not only are these expectations often not realised following transition, many pupils often hold their primary science education in low esteem. Clearly, pupils experience discontinuity between the prescribed curricular documents and actual learning experiences in the science classroom with significant amounts of reading, writing and rote-learning recorded in this research.

The following points illustrate the conclusions rooted in primary and post-primary teachers' experiences of teaching science across transition.

6.2.3 Teachers' Attitude to Science across Transition

- **Primary teachers feel significantly less confident in their teaching of science than their post-primary counterparts leading to issues for pupil learning prior to and upon transition to post-primary school.**

A lack of confidence in teaching science at primary school level is a significant concern arising from this research. Findings highlight the importance of the teachers' confidence in science as a means to stimulate students' interest and learning processes. For example, half of the total primary teachers (3 out of 6) participating in this study rated themselves as having 'limited confidence' in teaching about 'Plants and Animals'. In comparison, less than half the primary pupils in this research are stated as enjoying learning about '*Plants in our Environmen*t' (9 out of 23) and as noted by Pupil 18 (Primary Pupil Interview) when asked what they did not enjoy learning '*probably about trees and nature, it just doesn't interest me'*. This research questions if limited confidence levels in teaching science at primary level may lead to negative attitudes to learning in certain topic areas of the science curriculum developing even prior to transition. However, inconsistencies have emerged related to the link between teacher confidence and pupil enjoyment of science present in this study. In a number of topic areas, it was found that where primary teachers recorded okay or limited confidence, pupil enjoyment of the particular topic remained high. For example, in the teaching of 'Materials and Change' two primary teachers rated themselves as '*okay*' and a further two rated their confidence as '*limited*'. However, in comparison, a total of 22 out of 23 primary pupils stated they enjoyed learning about 'mixing things together' (Chapter 5, pp.140-142). It is notable however, that pupils enjoy learning this aspect due to its 'active'

and ‘hands-on’ nature, as Pupil 16 (Primary Pupil Interview) stated ‘*I like doing experiments with explosions, stuff like that because it’s much more fun and sort of active like’*.

It was also found in this research however, that despite all post-primary teachers responding as being more confident than their primary counterparts in teaching science (Chapter 5, pp. 147-148), this did not equate to an increase in post-primary enjoyment of science. Firstly, the number of post-primary pupils stated as enjoying learning science, while remaining high, did fall by two pupils when compared to primary pupil responses. Furthermore, despite increased teacher confidence levels, the number of pupils at post-primary level who find science ‘easy’ did not increase. Eight pupils in sixth class primary and the same number in first-year post-primary stated they found science easy (Chapter 4, p.75). The number of post-primary pupils who agreed that science was their favourite subject was also significantly low (Chapter 4, p.78). It was also noted in this study that the number of post-primary pupils who look forward to studying science at school had decreased following transition (Chapter 4, p.78).

Strategies including teaching as little of the ‘low-confidence aspect’ of science as possible, are evident through the representational data collected in this research. Teachers have been found to teach science through worksheets, minimal questioning and discussion and by avoiding all but the simplest practical work in their science lessons (Chapter 4, pp.99-100). Findings in this study correlate with those of Harlen *et al.* (1995) who suggest that teachers should attempt to use a wider range of strategies in their science teaching, since pupils see worksheets, copying from the board and reading their book as barriers to what they perceive to be ‘real’ science learning.

- **Post-primary teachers receive information on pupils’ prior learning from the pupils themselves and not their primary teacher counterparts.**

This study found that in many cases the singular source of post-primary teachers’ knowledge of primary science practices came from conversations with pupils about their earlier science experiences. Therefore, post-primary science teachers have to deal with the attitudes developed by pupils regarding science before transfer and must plan their teaching and pupil learning accordingly. This research indicated the level of communication between junior cycle post-primary teachers and their primary teacher counterparts regarding pupils’

previous experiences of learning science to be of particular concern. Just one teacher in primary and one in post-primary have had contact with their equivalent teaching colleagues across the transition. The remaining five primary and post-primary teachers are stated as never having contact (Chapter 5, p.147). The lack of communication across transition has already been flagged in the '*Literacy and Numeracy for Learning and Life – The National Strategy to Improve Literacy and Numeracy Among Children and Young People 2011-2020'* when it stated that one of its objectives was to ensure that relevant information on the child's learning and development is transferred from the home to preschool, to the primary school to post-primary school in order to smooth transition.

6.2.4 The Science Curriculum across the Transition

- **There are issues at transition with curriculum continuity.**

Despite the introduction of new science curricula aimed at smoothing the move to post-primary school, there are still concerns at transition regarding curriculum continuity. While there appears to be an obvious sequence in the primary science curriculum for the development of concepts and skills, curriculum planning at post-primary level in particular has not been modified to allow for children's achievement in primary school. There appears to be particular repetition of material in the area of Physics. For example, pupils found there to be repetition in learning objectives and outcomes when learning about 'Magnetism' at primary and post-primary level (Chapter 5, pp.118-119). As Pupil 11 states (Post-Primary Pupil Interview) '*It's sort of boring, you've learned it before and like magnets there's not much to learn and then you do it again'.* Therefore, it is apparent from this research that the content of both curricula, which aims to lend itself to continuity, appears to lead to repetition rather than a developmental approach to learning. These findings reinforce the theory of Ponchaud (2001) who contend that much of the primary curriculum is a 'dilution' of the post-primary curriculum as opposed to science building blocks, which could be used on a basis on which to structure children's progressive development of scientific concepts and skills.

The primary school curriculum presents an opportunity to prepare pupils for their future study of science at post-primary level, and conversely, the Junior Cycle Science syllabus allows teachers to build on students' earlier experiences at primary school. Findings conclude that while the continuum between primary and post-primary education is clear, an

understanding of this has apparently not permeated the system in a meaningful way. The extent to which this curriculum continuity has been recognised by primary and post primary teachers, who are focussed on coming to terms with the implementation of the respective science curricula, remains to be seem.

Findings point to the overly sequential nature of both primary and post-primary curricula as contributing to repetition and recalling of material experienced by pupils upon entry to post-primary science classrooms. Pupil disinterest in science across the transition is cultivated by repetitive and monotonous science content and activities.

6.3 Recommendations

Based on the analysis and conclusions of this research a number of recommendations are presented for the benefit of the various stakeholders with an interest in the teaching and learning of science in the transition from primary to post-primary schooling.

6.3.1 Limitations of Research

A number of important limitations need to be considered regarding the present study. Firstly, geographical spread may be considered one such constraint in this research. If it had been feasible for the researcher to administer questionnaires to a wider range of schools and teachers or to conduct interviews with them, a more representative sample may have been yielded.

Secondly, as there was no way of accessing the entire population of 6th class and 1st year pupils and their teachers in Ireland, the study was somewhat limited by the small sample size. With a small sample size, caution must be applied, as the findings might not be transferable to a representative population and the generalizations offered may not be valid. Qualitative researchers employing a smaller sample use a different approach in selecting samples than researchers concerned with extending generalizations to other populations (LeCompte&Preissle, 1993). In defence of small sample size in educational research, Borg and Gall state that;

> "In many educational research projects, small samples are more appropriate than large samples. This is often true of studies in which role-playing, in-depth interviews, projective measures, and other such time consuming techniques are employed…. A study that probes deeply into the characteristics of a small sample often provides more knowledge than a study that attacks the same problem by collecting only shallow information on a large sample".

(Borg and Gall, 1989; 236-237).

Furthermore, this study was limited by its reliance on questionnaires and interviews as data collection methods. Semi-structured interviews and self-completion questionnaires both have their respective advantages and disadvantages, but a particular problem with questionnaires is that they are frequently limited by producing a low response rate. The researcher is limited by not being able to follow-up directly on comments and responses made in the questionnaire. While these comments can be returned to in the group interview, the impact of immediate response is somewhat lost. Furthermore, the researcher avoided steering interviewees in answering questions in a particular manner throughout the interview process, thus preventing bias.

6.3.2 Local Stakeholders -Recommendations for classroom practice

- **Targeted Professional Development**

It is clear from this research that pupils' interest and engagement in science is not consistent across the curricula at either primary or post-primary level. Despite the aims of science curricula, pupils at primary and post-primary have commented throughout this research on the lack of active engagement in a number of areas of learning. In particular, six pupils in the primary interview displayed negative opinions towards learning about the body due to large amounts of rote-learning and lack of investigative activities (Chapter 5, pp.125-126). Pupil 17 (Primary Pupil Interview) is stated as not liking learning about '*Probably the body stuff. I don't really like all that because of all the stuff you have to try and remember and where they go in the body and all'.* It is notable that when primary teachers were questioned on their confidence in teaching about 'The Human Body', one teacher rated themselves as 'okay' and another as having 'limited confidence' (Chapter 5, p.124). This research concluded that one reason for this is teachers' lack of confidence is stemming from poor content knowledge. Primary teachers in particular have raised concerns about their implementation some areas of the primary science curriculum. This has significant implications for the coverage of the full range of scientific subject content areas and by extension, the full range of scientific skills. Primary teachers essentially need further training to teach concepts effectively so there is continuity of learning upon transition to post-primary level. To address this it is recommended that through targeted professional development in

the areas recorded in this study as being of lower confidence level, for example, teaching about 'The Human Body' or 'Plants and Animals' (Chapter 5, p.123), primary teachers may gain the confidence to develop their own ideas for teaching and promoting science study in their respective classrooms. There is a level of inconclusiveness evident in this research however in respect of the aforementioned link between teachers' confidence in teaching science and pupils' enjoyment of the subject. While low teacher confidence in teaching particular aspects of the science curriculum were comparable with low pupil enjoyment levels in the same area of the curriculum, it was also found in this study that in a number of science topic area, high levels of pupil enjoyment were recorded despite low teacher confidence in teaching that topic (Chapter 5, pp. 122-123).

A second related recommendation relates to the attentiveness of post-primary science teachers to first-year pupils' prior learning at primary school. This research has found there to be a lack of communication between post-primary and primary teachers (Chapter 5, pp.147-148). It is recommended therefore that post-primary science teachers involved in teaching first-year pupils would benefit from an improved awareness of science curriculum continuity. Information regarding teaching and learning at 6th class primary school should be made more accessible to 1st year science, be it through curricular support, professional development courses or improved communication across the transition. Making post-primary science teachers more aware of pupil learning in the Primary Science Curriculum would aid them in their planning and implementation of science lesson content.

Furthermore, this research has concluded that pupil engagement in learning science at either primary or post-primary level may be affected by teacher strategies such as reliance on worksheets, written work, reading from the textbook and avoidance of practical work in science. Both curricula advocate that '*In well-planned, practical investigations, children's natural curiosity is channelled'* (DES, 1999a) and that there is an emphasis on '*hands-on engagement'* with practical activities and the development of appropriate relevant process skills (DES, 2006a). As Pupil 6 commented (Primary Pupil Interview), '*We had to take down all the writing from the board after we came in. It's just a waste. I'd rather spend the time doing the experiments'.* Once at post-primary, large amounts of writing consolidate disinterest in this aspect of learning of science, as recorded in the follow-up interview by Pupil 6 (Post-Primary Interview). '*It's different to last year. The workbook, we didn't really write them up, I really think it's boring, there's not enough space'.* To address this issue in

the learning of science across the primary –post-primary transition, it is recommended that professional development specific to developing the strategies used to teach science at both school levels. In developing a wider range of strategies in their science teaching, pupils' 'natural curiosity' will be guided and extended in accordance with the aims of relevant science curricula.

- **Development of Primary - Post-Primary Teacher Liaison**

Promoting dialogue between primary and post-primary teachers across the transitional divide on science content, pedagogy and assessment is critical to a positive and successful transition for students. The level of communication in relation to academic matters at the time of transfer would appear to be of concern. Teachers in this study were found to have little or no contact regarding the teaching of science with their teaching counter-parts across the transition (Chapter 5, p.147). Just one primary teacher and one post-primary teacher responded as having contact concerning the transition of pupils. According to Varley *et al* (2008a), there currently is no Irish educational policy on sharing information between schools. While the new 'Literacy and Numeracy Strategy' aims to '*ensure that relevant information on the child's learning and development is transferred to...the post-primary school'*, at the time of writing this strategy has yet to come into effect. Therefore, it is recommended that greater levels of communication and cooperation between primary and post-primary teachers should be encouraged in order to promote dialogue about pupils' scientific concept development, previous learning experiences in science and other issues which effect teaching and learning in science across transition. Cooperation may take the form of '*vertical teaming'* as advocated by Smyth *et al* (2004) or the development and use of '*bridging units'*, both beneficial for teachers and pupils alike. Increased liaison and communication across the primary – post-primary divide would facilitate pupils' in developing their scientific learning skills and engagement with personal investigation, which would appear from the findings of this research to be a decidedly underdeveloped feature of both primary and early post-primary experiences of science.

- **Development of realistic expectations of post-primary science at pre-transfer open day/visit.**

This study has found that pre-transition 'induction' visits or 'taster experiences' by primary pupils to their new post-primary schools are leading to unreasonably high expectation of what post-primary science will entail. Three primary pupils commented on experiencing experimentation and investigation on a visit to their new post-primary school. As Pupil 2 (Primary Interview) stated *'I think we'll do lots of experiments because we were down there one night and they had lots of different acids and all these kind of explosions and stuff'*. Following transition however, ten pupils commented negatively on their expectations of post-primary science not being realised. Pupil 10 (Post-Primary Interview) consolidates this view '*I thought it would be all experiments every second day and that, but it's more writing now'*. Pupils, upon transition, are disappointed to learn that first-year science is not what they were led to believe at pre-transfer visit and open day. Interest and enthusiasm for the subject appear to diminish due to such experiences. It is recommended that any experiences primary pupils encounter on these visits should consist of activities solely based on their future learning in first-year post-primary school i.e., the types of investigations, the use of the laboratory and the equipment and chemicals used only in first-year. Since Braund and Driver (2002) further highlight the effect of high expectations due to pre-transition experiences, it is imperative that pupils' experiences within these induction visits are being met upon entry to post-primary science. If pupils' expectations are genuinely developed at the point of transition, post-primary teachers are better able to match pupils' expectations of learning science once at post-primary school.

6.3.3 National Stakeholders

- **That a policy on educational provision for transition from primary to post-primary education be developed.**

A coherent policy on educational provision for pupils during their transition from primary to post-primary school is absent in the Irish education system. This study has shown that pupils face a period of major change at transition to post-primary school where the single teacher primary classroom with a largely curriculum gives way to multi-teacher, subject-based learning content at second level. In particular pupils in this study were found to enjoy learning science in a smaller classroom setting '*She might put us into groups with the younger ones in the class. Afterwards we get sheets and we have to help the small ones with that as well...it's a good thing because then the lads that come in next year will be able to*

teach them' (Pupil 1 and 2, Primary Pupil Interview). This smaller, more personal experience of learning science is not always continued into post-primary school and this is noted by Pupil 3 (Post-Primary Interview) when asked do they carry out activities in groups '*Depends, sometimes we do it in groups. It's better because you're with your friends and it's 'funner'*. In their paper '*Transitions on Primary Schools'* (2008) presented at the INTO Consultative Conference on Education, the INTO outlined a number of strategies for preparing primary pupils for second-level as suggested by 6th class teachers. However, while the current NCCA '*Assessment in the Primary School'* document, advocates sharing pupils assessments with parents, other teachers, the children themselves as well as outside agencies dealing with particular schools, nowhere in the document does it mention passing information from primary to post-primary schools to assist learning following transition. It is recommended therefore, that The Department of Education in conjunction with the NCCA should address general transition issues such as those arising in this study, i.e. pupil expectations, change in school organisation, change in pupils' social status, curriculum continuity etc. It would be appropriate to develop a transfer policy to provide for such a transfer programme to be implemented in all primary – post-primary schools. In smoothing the transition to post-primary schooling, pupils learning experiences may become more positive.

- **Revision of Primary and Junior Cycle Science Curricula to allow for clearer curriculum continuity.**

Issues regarding curriculum continuity have been addressed in this study. In comparing the science curricula this study has found that while there are many commonalities of experience envisaged in both curricula within the two school settings, the reality in both primary and post-primary science classrooms is often very different from the approaches suggested. Areas of both curricula where overlap in learning occurs include 'Magnetism' and 'Teeth' (Chapter 5, pp.118-119). Pupils in this research also commented on the repetitious nature of much of the Junior Cycle Science Syllabus. Pupil 7 stated (Post-Primary Interview) '*Ya, like we've done a lot of the things before its just harder now'*. It is recommended that there needs to be clearer links developed between The Primary Science Curriculum and Junior Cycle Science Syllabus and that both primary and post-primary teachers be made aware of the links and continuity in all topics and skills to be learned from 6th class primary to first-year post-primary. For instance, physics content of the Junior Cycle Science Syllabus

needs to change in order to further pupils' conceptual understanding developed in primary science. Following this, if curriculum links are made clearer, teachers would in turn be better able to match their teaching of science on both sides of the transition.

- **That teacher education courses, at both primary and post-primary level, would provide pre-service student teachers with adequate education through content specific courses in the areas of science education across the transition.**

Findings in this research point to problems with teachers' knowledge of science, particularly among primary teachers. The pre-service preparation of primary teachers firstly should include a more in-depth study of science content knowledge. The introduction of the four year Bachelor of Education programme may provide the opportunity for students to take in-depth specialisation within science education. For example, in Mary Immaculate College students will have the prospect to take a five module specialisation in science education as part of their degree. This will give student teachers an opportunity to continue studies in science and gain valuable content knowledge skills aimed at improving science instruction in the science classroom.

It was also found in this research, as shown above, that post-primary teachers show a lack of awareness of their pupils' prior learning of science at post-primary school (Chapter 5, pp.118-119). It is also recommended that pre-service education courses for post-primary science teachers should include a more in-depth study of the Primary Science Curriculum, particularly concentrated on pupil learning of science at 6th class primary level. In doing so, the assumption of many post-primary teachers that they have to start from 'scratch' with first-year post-primary science pupils would be reversed. Giving post-primary teachers the opportunity to study their pupils' prior learning may lead to better planning and learning experiences for pupils at post-primary level.

6.4 Areas for further research.

The benefits of additional research on the experience of pupils and their teachers in the transition from primary to post-primary science education are considerable.

- Firstly, there would be merit in repeating a similar study with pupils in many different schools throughout Ireland. As conclusions drawn above are limited by the small

scale and length of the study, this study could be replicated across the primary – post-primary transition by a larger participant number of pupils. The inclusion of greater numbers may support the weight of findings with more ability to generalise. The researcher feels confident, however, that the results were obtained ethically, through the triangulation of multiple data collection methods, validity is supported. A more thorough understanding of their experiences and concerns is needed and would greatly benefit our general understanding of this aspect of pupils' educational careers.

- Secondly, further research needs to be conducted with a larger representation of both primary and post-primary teachers involved in the transition and their concerns in the teaching of science across the transition. It is imperative that the issues and concerns raised by teachers within this transition be established in our education system as a basis for forward provision of curricular planning and provision. Specifically such research should investigate the required focus for continuity professional development in the area of transition in science and the most appropriate formats of such professional development.
- There is a level of inconclusiveness evident in this research however in respect of the aforementioned link between teachers' confidence in teaching science and pupils' enjoyment of the subject. While low teacher confidence in teaching particular aspects of the science curriculum were comparable with low pupil enjoyment levels in the same area of the curriculum, it was also found in this study that in a number of science topic area, high levels of pupil enjoyment were recorded despite low teacher confidence in teaching that topic (Chapter 5, pp.122-123). A more thorough understanding of how teacher confidence levels affects pupils' attitude to learning science across the transition is needed and would benefit our understanding of this aspect of pupils' science education.

6.5 Summary

This chapter has sought to offer the reader a brief summary and discussion of the main findings that have become evident in this research study. A number of recommendations focussing on issues of local and national concern were presented which endeavour to address these findings.

It was the aim of this research to undertake an investigation into the issues and concerns arising in the teaching and learning of science across the primary – post-primary transition. It addressed pupils' attitudes to and experiences of learning science and the type of science being learned before and following transition to post-primary school. It was also concerned with both primary and post-primary teachers' attitudes to the teaching of science.

Findings indicate that while pupils are generally enthusiastic about learning science, enjoyment in learning certain aspects of science can decrease following transition. Furthermore, pupils experience discontinuity in science curricula across the transition. Data also recorded there to be no significant communication between junior cycle post-primary teachers and their primary teacher counterparts regarding pupils' previous experiences of learning science. It was also found that primary teachers feel significantly less confident in their teaching of science than their post-primary counterparts leading lead to issues for pupil learning in particular areas of science upon transition. Contrary to these findings inconsistencies also emerged where despite recording high levels of confidence by post-primary teachers, the number of pupils at post-primary level who stated they enjoying science, who look forward to studying science and who stated that science is their favourite subject decreased.

This research recommends that at local level, both primary and post-primary teachers be provided with targeted professional development in the area of science. Dialogue between primary and post-primary teachers across the transition should also be promoted and developed. It recommends that realistic expectations of post-primary science be displayed during school open days and induction visits for 6^{th} class primary pupils. Nationally, it is recommended that a policy on educational provision for transition from primary to post-primary education be developed and furthermore, in order to allow for clearer science curricula continuity, revision of the Primary and Junior Cycle Science Curricula may be necessary. Furthermore, it is hoped that teacher education courses, both primary and post-primary, provide pre-service student teachers with content specific courses in the area of science education across the transition.

In essence this study has attempted to emphasise the need in science education of giving students and their teachers a voice, allowing them to express their views and opinion, or their likes and dislikes in the teaching and learning of science across the primary – post-

primary divide and in doing so, may support the aspirations of improving accessibility and engagement in learning science and in scientific literacy for the future.

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Appendices

Appendix A

Master of Arts in Education Postgraduate Research Study

Pupil Questionnaire

I am male ☐ I am female ☐

Age: _____

Class/Year: _____

School: _____

Please read each of these sentences carefully and tick (√) the correct box if you agree, are not sure or disagree with the sentence.

School in general:	I agree 	I am not sure 	I do not agree 
1. I enjoy school			
2. School is interesting			
3. I enjoy doing school-work			
4. I work hard at my school work			
5. I enjoy working with my teacher			
6. I enjoy working with my friends			

Science in general:	I agree 	I am not sure 	I do not agree 
1. I enjoy science			
2. Science is important in the work around us			

3. I would like a job using science			
4. Science is easy			
5. Science is my favourite subject			
6. I look forward to doing science in school			

Science Learning: I enjoy learning about:	I agree 	I am not sure 	I do not agree 
1. Parts of the Body			
2. How to look after my body			
3. Plants in our environment and how they grow			
4. Animals in our environment and how they live			
5. Where animals live			
6. Light, mirrors and lenses			
7. Sound, noises and vibrations			
8. Heat and Temperature			
9. Magnets			
10. Electricity, batteries, bulbs and circuits			
11. How different objects move			
12. Materials such as wood, plastic and metal			
13. What happens when you mix things together			
14. What happens when you heat things up or cool them down			
15. Saving energy and recycling			

16. How to care for the environment			
17. Inventions and new discoveries in science			
18. Doing Experiments			
19. Designing and making new things			
20. How machines work and move			
In our science lesson	I agree 	I am not sure 	I do not agree 
1. I like watching the teacher doing the experiments			
2. I like doing the experiments myself			
3. I like doing the experiments with my friends			
4. I enjoy planning my own investigation			
5. I like copying from the board			
6. I like when my teacher explains things to the class			
7. We go outside to do science			
8. We have visitors to our science class			
9. We go on science trips			
10. I like using the computer in our science class			
11. I like doing worksheets			
12. I like using my science book			

In Science class:	I agree 	I am not sure 	I do not agree 

1. Science is a subject full of things to talk about			
2. My teacher often asks questions about science			
3. I ask my friends about science			
4. I often talk about science in a group			
5. I like working in a group to talk about things in science			
6. When I am in a group I am listened to			
7. When I am in a group I listen to others			

PRIMARY PUPILS ONLY In secondary school	I agree 	I am not sure 	I do not agree 
1. I look forward to doing science			
2. I will work by myself			
3. I will work with my friends			
4. I will do experiments			
5. My teacher will do experiments			

What would you like to do more of in science?_____

Why?_____

What would you like to do less of in science?_____

Why?_____

SECONDARY PUPILS ONLY

Do you think the science you are now studying in secondary school is different to the science you learned in primary school? _____

If yes, how is it different?

_____

_____

Do you find secondary science better than primary science? _____

If yes, why?

_____

_____

Will you continue to study science in school? _____

Why/Why not?

_____

_____

Thank you for completing this questionnaire.

Adapted from a questionnaire used in a study by Varley *et al* (2008) in *Science in Primary Schools*, *Phase 1*, *Final Report*, Research commissioned by the National Council for Curriculum and Assessment (NCCA). Dublin, December, 2008

Appendix B

Master of Arts in Education Postgraduate Research Study

Teacher Questionnaire

Thank you for completing this questionnaire. It will assist in further analysis of the pupil questionnaire.

Please complete as appropriate:

1. Are you: male ☐ female ☐ 2. Length of teaching experience: _____ yrs

3. What class(es) do you teach? _____ 4. How many pupils in your class(es)?

On average _____

5. In what type of school do you teach?
(Please tick all appropriate boxes)

(i)Location:

(a) rural
(b) urban

(ii)Type of school:

(a)senior school
(b)vertical school (all classes to 6th)
(c) other (please specify) _____

(iii)Is your school included in the Disadvantaged Areas Scheme? Yes ☐ No ☐

(iv) Gender Mix

(a)boys only
(b)girls only

(c)mixed gender

6. Do you have children with special needs in your class? Yes ☐ No ☐

7. Do you have a special needs assistance in your class? Yes ☐ No ☐

8. How long do you typically spend on the teaching of science per week? ____ min/hrs

9. How long do you typically spend planning/preparing for a science lesson per week? ___min/hours

10. Please rate your confidence with teaching the following aspects of the Primary Science Curriculum.

VC=Very Confident, C=Confident, OK=Okay, LC=Limited Confidence, NC=Not Confident.

	VC	C	OK	LC	NC
1. Science in general					
2. Biology (life processes and living things)					
3. Chemistry (materials and their properties)					
4. Physics (physical processes)					
5. The Human Body					
6. Health and Nutrition					
7. Plants and Animals					
8. Habitats					
9. Lights, Mirrors and Lenses					
10. Sound, Noise and Vibrations					
11. Heat and Temperature					

12. Magnetism					
13. Electricity and Simple Circuits					
14. Forces and Motion					
15. Materials and their Properties					
16. Materials and Change					
17. Environmental Awareness					
18. Caring for the Environment					
19. New Inventions and machines					

11. Please indicate the degree to which you agree or disagree with the following statements regarding the teaching of science by ticking the appropriate box.

SA=Strongly Agree, A=Agree, UN=Uncertain, D=Disagree, SD=Strongly Disagree

	SA	A	UN	D	SD
Teacher's should					
1. Be able to demonstrate an experiment					
2. Use ICT in a science lesson					
3. Be able to use science equipment skilfully					
4. Teach the class as a whole					
5. Allow children to work in groups					
6. Use a range of questioning skills					
7. Revise earlier topics/learning					
8. Plan and carry out new investigations					
9. Do science activities based on children's ideas					
10. Have adequate resources available to them					
11. Ask for help from a colleague					

12. Ask for help from an outside source					
13. Receive regular in-service training					
Pupil's should:					
1. Be made aware of the importance of science in their lives					
2. Think for themselves					
3. Plan and carry out their own experiments					
4. Use scientific vocabulary					
5. Make predictions, observations, records and representations					
6. Copy notes from the board					
7. Choose to take their own notes					
8. Understand science concepts					
9. Recognise how classroom learning relates to the outside world					
10. Learn from one another					

Have you ever had contact with a primary/post-primary teacher regarding the teaching of science in your class?

Yes ☐ No ☐

Would you regard contact with a primary/post-primary science teacher beneficial in the teaching of science in your class?

Yes ☐ No ☐

Why/Why Not?

_____

Thank you for completing this questionnaire.

Adapted from a questionnaire used in a study by Varley *et al* (2008) in *Science in Primary Schools, Phase 1, Final Report,* Research commissioned by the National Council for Curriculum and Assessment (NCCA). Dublin, December, 2008

Appendix C

Master of Arts in Education Postgraduate Research Study

Pupil Interview - Guide Questions

- Do you like science?
- Why/ Why not?
- Do you find Science easy?
- What kinds of things do you like doing in science?
- What kinds of things do you not like doing in science?
- What was the last thing you learned about in science?
- Tell me about the lesson? Did you like it? Why? Why not?
- What was your favourite part of the lesson?
- What would a typical lesson be like in your class?
- What would you/your teacher/your friends be doing?
- Do you work in groups in your science class?
- Do you like working in groups? Why / why not?
- Did you do the experiment yourself/groups/teacher show you?
- Do you have a science book/copy?
- What do you like / dislike about it?
- Do you use computers in science class?
- What kind of things did you do?

Primary Pupils Only:

- Describe what you think science will be like in secondary school
- Do you think it will be easier / harder?
- Do you think you will be doing lots of experiments?
- Do you think you will have textbook?
- What kind of things would like to do more of in science?
- What kind of things would like to do less of?

Secondary Pupils Only:

- Did you ever learn about any topics from this year when you were in primary school? Were they different or difficult?/How?
- Did you do any of your experiments before in primary school? Were they different or difficult?/How?
- How is your science book/copy the same/different as in primary school?
- Describe your pre-visit/open-day visit to this school and your visit to the lab?
- Is science in secondary school like what you thought it would be like? How?

Appendix D

An investigation of the impact of transition from primary to post primary school on pupils' and teachers' learning and teaching of science

Parental Consent Form

Dear Parent/Guardian,

As outlined in the **parental information sheet** the current study will look at the issues and concerns of primary and secondary pupils in the teaching and learning of science within the transition from primary to secondary school. This parental information sheet should be read fully and carefully before consenting for your child to take part in either the questionnaire or interview in the study.

Your child's anonymity is assured and you are free to withdraw your child from either part of the study at any time. All information gathered will remain confidential and will not be released to any third party. In accordance with the Data Protection Act (2003) all participant data will be stored for the length of time that it is required to produce this thesis at which time it will be destroyed

Please read the following statements before signing the consent form.

• I have read and understood the **parental information sheet.**

• I understand what the project is about, and what the results will be used for.

• I am fully aware of **all** of the procedures involving my child, including the use of questionnaire and interviews, and of any **risks and benefits** associated with the study.

• I know that my child's participation is voluntary and that I can withdraw him/her from either part of the project at any stage without giving any reason.

• I am aware that all results will be kept confidential.

Name (PRINTED): _____

Name (Signature): _____

Date: _____

Appendix E

An investigation of the impact of transition from primary to post primary school on pupils' and teachers' learning and teaching of science.

Parental Information Sheet

What is the project about?

This project is part of a postgraduate M.A in Education study from Mary Immaculate College which aims to enhance teaching and learning. The study plans to examine the transition from primary to secondary science education in Ireland. It will focus on finding out the issues and concerns of teachers and pupils in the teaching and learning of science within this transition. It will find out teachers' views of the science curriculum and their experiences in teaching science in the final years of primary school and first year of secondary school. It will look at pupil's interest in science and their experiences in the science classroom.

Who is undertaking it?

My name is Sarah Blackwell and I am a Postgraduate research student attending Mary Immaculate College. I am also a qualified primary school teacher in St. Flannan's National School Inagh, Co. Clare. I am presently completing my MA in Education by research through the NationalCentre of Excellence in Mathematics and Science Teaching and Learning under the supervision of Dr. Neil Ó Conaill. This current study will form part of my thesis.

Why is it being undertaken?

The purpose of the studyis to look at the issues and concerns of pupils and teachers within the transition from primary to secondary school science.

What are the benefits of this research?

It is hoped that the data collected will (a) improve our understanding of the issues arising among pupils and teachers in the transition from primary to secondary science and (b) may have implications for how science will be taught in our schools in the future.

Exactly what is involved for the participant (time, location, etc.)

For each school, it is hoped that questionnaires will be carried out in the target class and with the class teacher. Following this, small group interviews with a number of the pupils from these classes will take place. These interviews need to be tape-recorded for ease of data collection but will be destroyed afterwards. Timings will be agreed with the participating schools to fit in with timetables and daily routines.

All participating pupils must receive permission from a parent/guardian for both the questionnaire and the interview part of the study before taking part.

Right to withdraw
Your anonymity is assured and you are free to withdraw from either part of the study at any time without giving a reason.

How will the information be used / disseminated?
The data from questionnaires and interviews will be combined with that of the other participants in this study and used to form the results section of my thesis. A summary of the data collected only will appear in the thesis; individual participant data will not be shown.

How will confidentiality be kept?
All information gathered will remain confidential and will not be released to any third party. A random ID number will be generated for each participant and it is this number rather than the participant's name which will be held with their data to maintain their anonymity.

What will happen to the data after research has been completed?
In accordance with the Data Protection Act (2003) all participant data will be stored for the length of time that it is required to produce this thesis at which time it will be destroyed.

Contact details:
If at any time you have any queries/issues with regard to this study my contact details are as follows:
Miss Sarah Blackwell
Glann

Ennistymon

Co. Clare

065-7071121/085-1342818

If you have concerns about this study and wish to contact someone independent, you may contact:
MIREC Administrator
Mary Immaculate College
South Circular Road
Limerick
061-204515
mirec@mic.ul.ie

Appendix F

An investigation of the impact of transition from primary to post primary schoolon pupils' and teachers' learning and teaching of science.

Children's Information Sheet

I am doing a project all about how you learn science in primary school and what you think science will be like in secondary school. It's like a project you might do in class. I am trying to learn about ways of teaching children science. So if you agree I would like give you a question sheet to fill out about science and also interview you to find out what you think of science in school. This interview will help other teachers to see the best ways to teach science to children.

When you are being interviewed there will be other children being interviewed at the same time so that might make it easier. It's not a test - we will just be having a chat and thinking all about science in school.

If, when we are doing the interview, you want to stop talking or leave that's okay. If you don't want to be recorded you won't get in trouble. You can still take part in the chat we will be doing, we just won't record you.

The tapes will only be listened to by me. I will not let anyone else listen to the tape because those are the rules in my college. When I am writing my report on the interview I won't use your name or your school name so people won't know who you are.

If you have any worries after we have our interview you can come talk to me or to your teacher or parents.

Appendix G

An investigation of the impact of transition from primary to post primary school on pupils' and teachers' learning and teaching of science.

Participating Teacher Consent Form

- I have read and understood the Participant Information Sheet.
- I understand what the project is about.
- I know that my participation is voluntary and that I can withdraw from the project at any stage without giving any reason.
- I am aware that my results will be kept confidential.
- I have read this form completely, I am 18 years of age or older and am happy to take part in this study on the transition from primary to post-primary science education.

Signed: _____ Date: _____

Appendix H

An investigation of the impact of transition from primary to post primary school on pupils' and teachers' learning and teaching of science.

Teacher Information Sheet

What is the project about?

This project is part of a postgraduate M.A in Education study from Mary Immaculate College. It is being funded by the Strategic Innovation Fund (SIF) which aims to enhance teaching and learning.

The study aims to examine the transition from primary to secondary science education in Ireland. It will particularly focus on identifying the issues and concerns of teachers and pupils regarding the teaching and learning of science within this transition. It will probe teachers' views of the science curriculum and explore teachers' experiences in teaching science in the final years of primary school and first year of secondary school. It will examine pupil's interest in science and their experiences in the science classroom.

Who is undertaking it?

My name is Sarah Blackwell and I am a Postgraduate research student attending Mary Immaculate College. I am also a qualified primary school teacher in St. Flannan's National School Inagh, Co. Clare. I am presently completing an MA by research through the NationalCentre of Excellence in Mathematics and Science Teaching and Learning under the supervision of Dr. Neil Ó Conaill. The current study will form part of my thesis.

Why is it being undertaken?

The objective of the studyis to examine the issues and concerns of pupils and teachers within the transition from primary to secondary school science.

What are the benefits of this research?

It is hoped that the data gathered from participants will (a) enhance our understanding of the issues arising among pupils and teachers in the transition from primary to secondary science teaching and learning and (b) may have implications for how science will be presented in our schools in the future.

Exactly what is involved for the participant (time, location, etc.)

For each school, it is hoped that questionnaires will be conducted in the target class and with the class teacher. Following this, small group interviews with a number of the pupils from these classes will take place. These interviews need to be tape-recorded for ease of data collection but will be destroyed afterwards.

Timings will be negotiated with the participating schools to fit in with existing timetables and daily routines.

All participating pupils must receive permission from a parent/guardian before taking part in either section of the study.

Right to withdraw

Your anonymity is assured and you are free to withdraw from the study at any time without giving a reason.

How will the information be used / disseminated?

The data collected will be combined with that of the other participants in this study and used to form the results section of my thesis. Summary data only will appear in the thesis, individual participant data will not be shown.

How will confidentiality be kept?

All information gathered will remain confidential and will not be released to any third party. A random ID number will be generated for each participant and it is this number rather than the participant's name which will be held with their data to maintain their anonymity.

What will happen to the data after research has been completed?

In accordance with the Data Protection Act (2003) all participant data will be stored for the length of time that it is required to produce this thesis at which time it will be destroyed.

Contact details:

If at any time you have any queries/issues with regard to this study my contact details are as follows:

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If you have concerns about this study and wish to contact someone independent, you may contact:

MIREC Administrator
Mary Immaculate College
South Circular Road
Limerick
061-204515
mirec@mic.ul.ie

Appendix I

Primary Pupil Interview Responses

<table>
<tr><th>Catagories (and subcatagories)</th><th>Number of primary pupils who commented</th></tr>
<tr><td>Catagory 1: Pupils attitude to science

• Positive attitudes</td><td>21</td></tr>
<tr><td colspan="2">Positive attitudes

Pupil 3: Ya, because you get to do experiments.

Pupil 2: Ya, when you mix the chemical things they blow up

Pupil 3: Ya, I like it because it’s interesting.

Pupil 1: It’s interesting and you find out about how things work.

Pupil 4: You get to do experiments....

Pupil 5: Ya, it’s fun. It’s interactive because we get to do lots of experiments and stuff like that.

Pupil 6: It’s interesting because we get to do loads of different activities.

Pupil 7: Because it’s fun and you can make stuff.

Pupil 8: It’s exciting.

Pupil 9: I like it... I like to do the experiments.

Pupil 10: It’s fun and it’s good to know stuff when your older

Pupil 11: Its good most of the time...

Pupil 12: Because I like doing experiments, and I think it’s fun.

Pupil 13: Because you learn a lot of things out of it and you get to do experiments.

Pupil 14: I do like it because you get to do a load of experiments and you learn things.

Pupil 15: Ya I like science, you do experiments and you learn all the different parts of different things.

Pupil 16: A little bit, I like it kind of because sometimes it’s interesting...

Pupil 17: Like, I like knowing how like electricity and all that...

Pupil 19: I like learning about it.</td></tr>
<tr><td>• Negative attitudes</td><td>11</td></tr>
<tr><td colspan="2">Pupil 4: ... but sometimes though we have to write down lots of things on the board and I really didn’t like that part of it at all.

Pupil 7: ...but I don’t like listening to the teacher much,

Pupil 11: ...a lot of the time you’re taking stuff down from the board into your copy and you’re not doing the experiments.</td></tr>
</table>

Pupil 16: ...and sometimes it can be boring.

Pupil 17: I don't like a few things but I can' really say.

Pupil 18: Well its ok, I kind of like it and I don't as well. I just like the way some of the things are very interesting and then I think some things are boring.

Pupil 20: Because it's boring and it weird's me out some of it and I don't like light bulbs and stuff like that. I don't like artificial light, it hurts my head.

Pupil 22: It's just boring, all of it is boring. I don't know it's hard to explain.

Pupil 20: J: I don't think so, well anything I've learned anyway.

Pupil 21: No I don't like it because it's boring.

Pupil 23: No, I don't even understand science properly.

Catagory 2: Topics Pupils Like	
• **Doing Experiments**	**7**

Pupil 2: I don't like all the writing. You have to write a description of all the stuff, its just easier to just do the experiment.

Pupil 5: It's alright, if its stuff on the board it's not that great but if its stuff like experiments I like that.

Pupil 6: Its when we do work like experiments in groups and get to talk about it rather than doing worksheets like.

Pupil 9: All experiments.

Pupil 11: I like experiments, and, I don't really like reading, because I find it like hard enough to learn.

Pupil 12: ... And I don't really like books either.

Pupil 13: I do like the experiments but i don't really like reading about them, in the books, I just like doing them and ah like mysteries, we went to the library once and we had to find out who was this and who was that and we had to like find out the thief.

• **The Human Body**	**5**

Pupil 8: I like learning about bones and hearts and everything about them because they are very interesting even though I am scared of blood, when I see blood everywhere...

Pupil 9: And she wants to be a doctor...

Pupil 8: Ya, I want to be a doctor so those are very interesting for me.

Pupil 10: I like the bones and hearts as well.

Pupil 16: I actually do like the sheep's heart, when the blood started pumping out it was horrible but ah, I really like it.

• **Field Trips/Going Outside**	**3**

Pupil 9: Doing experiments outside.

Pupil 14: I like experiments and going out on field trips too like

Making a volcano

Pupil 17: When we made the volcano... We go the baking soda and the vinegar and the red dye and we put it in,

and we made a mould out of a volcano with trees and everything and then we put in the vinegar and all that and the red dye and it all erupted up foamy and everything.	
• **Animals**	**3**
Pupil 6: I Like learning about animals and nature. Pupil 8: ...and about how animals work and that. Pupil 20: I like last year we did a project about the pond and we found out all about the different trees and tadpoles and all the different types of animals.	
• **Electricity**	**2**
Pupil 1: It depends on what we do, if we're doing electricity that'd be good... but then again if your just doing writing the whole time that's not good. Pupil 4...and electricity	
• **Magnets**	**2**
Pupil 4: I like the magnets. Pupil 8: I like doing the magnets.	
• **How Things React/Explosions**	**2**
Pupil 11: How things react. Pupil 16: I like doing the experiments with the explosions, stuff like that because its much more fun and sort of active like.	
• **Water**	**1**
Pupil 2: ...and if we're doing stuff about water that's all right too.	
• **Light**	**1**
Pupil 7: I like learning about light and how light makes all the different colours.	
• **How things work**	**1**
Pupil 15: How things work	
Category 3: Topics Pupils Do Not Like • **The Human Body**	**6**
Pupil 4: Learning about the digestive system, learning all the words and the parts. Pupil 11: Everything, most of all the body. Pupil 11: Because it makes me sick and I vomited a couple of times over it. I like passed out completely. Pupil 15: I don't like learning about dissecting things, once we had to dissect a sheeps heart and I just didn't want to do it at all. Pupil 17: Probably the body stuff, I don't really like all that because of all the stuff you have to try and remember and where they go in the body and all that. Pupil 19: I don't like the heart and bones.	

• **Sound**	**3**
Pupil 1: Sound. Pupil 2: Sound as well, it was boring like, you'd be only listening to stuff like whereas in the other ones you could actually do stuff yourself like. Pupil 21: The sound and noise because it's kind of boring.	
• **Electricity**	**2**
Pupil 12: Electricity, because it's boring I just don't find it interesting Pupil 23: ...also electricity- those experiments just weren't fun.	
• **The Environment**	**2**
Pupil 5: I don't like doing things we already know as in, we learned about the Dead Sea and how much salt is in it, you have to, like you learn about it ever year and we already know about it and its kind of, sure we already know about it. Pupil 7: Ya we were just learning about the trees and stuff and I just don't like learning about the global warming and stuff because I get worried about it. Someone was going around saying the world would end in 2012 and that's only two years so I don't know.	
• **Magnets**	**1**
Pupil 18: ...and magnetism, because it's too easy.	
• **Light**	**1**
Pupil 23: Light activities, I'm just not interested in them ...	
• **Animals**	**1**
Pupil 3: Learning about like animals and stuff, that's kind of boring	
• **Plants and Nature**	**1**
Pupil 18: Probably learning about trees and nature...it just doesn't interest me.	
• **Rocks and Soil**	**1**
Pupil 21: ...the earth as well and all about the rocks.	
Category 4: Teachers Role in a Typical Science Lesson • **Teacher Explains the Lesson**	**6**
Pupil 1: Well first our teacher explains what we are going to do and then you do the actual experiment. Pupil 2: We mostly do, the teacher would do it first on the board, she'd label it first on the whiteboard and then she'd tell you to connect the wire to this and that and then we'd go off and maybe have to change things. Pupil 6: First our teacher shows us what we have to do in the experiment and then we do it. He does it first so we can see what to do. Pupil 5: The teacher would be describing to us what to do, and we would be following her instructions and sometimes you have to wait to the end of the day for the experiment to actually work... Pupil 7: Our teacher always does the experiment first to show us what to do. Then he'll go around and help us if	

we can't do it. Pupil 10: He writes all the stuff on the board. All how to do the experiment and that.	
• **Teacher Talking**	**7**
Pupil 3: The teacher does most of the talking. Pupil 7: We'd usually just listen to the teacher and take notes if you wouldn't think you'd be able to remember. Pupil 13: She'd be explaining to us how it works and like she'd tell us what pages to go to in the books. Pupil 14: Up talking to us about stuff, while we're working she'd be up doing something at the desk. Pupil 17: Talking. Pupil 19: Talking and giving out. Pupil 20: Talking and giving out.	
• **Teacher Asking Questions**	**1**
Pupil 11: Our teacher would probably be asking us some questions or something like that and then they'd be only a couple of hands up because like some people wouldn't understand it and others would be like oh yaya I know it, even if they don't like it or something.	
• **Teacher Prepares Equipment**	**1**
Pupil 6: Mr ****and (assistant) get all the things ready for the experiments. Sometimes we get to help. But he always does that.	
• **Teacher Checking and Helping**	**1**
Pupil 1: She'd be checking on us to see if we are doing it properly and maybe checking our mistakes and seeing if there is anything wrong with it	
Category 5: Pupils' Role in a Typical Science Lesson • **Listening to the Teacher**	**5**
Pupil 8: Well you'll either see us listening to ***** while she's doing up stuff or us going up and she asking us questions. Pupil 11: I would be listening ya, but I don't know if I'd have my hand up to answer the things because, am , like I don't know, I would know some of the things. I just wouldn't because I'd find it boring and that. Pupil 13: It would be quiet, very few people speaking, like I'd be listening because some stuff can be really interesting, but there might be some people who are bored and they might be chatting. Pupil 20: Listening and listening to all the different things. Pupil 19: Listening to the teacher...	
• **Reading Our Books**	**4**
Pupil 3: In our Earthlink book there's a blue box for experiments to write out together. Pupil 5: ...But mostly we are reading our books. Pupil 9: ...then we have to read the book and then write the answers.	

Pupil 23: You might be picked to read something out but that's like it.	
• **Writing**	**5**
Pupil 3: Maybe at the end we write Pupil 5: Then we have to take down a lot of writing from the board all the notes about what we did, and our results. It's the worst part, it's so boring. Pupil 7: We write down what we did ... of the experiment. Pupil 14: We'd be doing stuff in our books or doing stuff on the board. Pupil 12: There would be some writing work, answering questions, and reading.	
• **Pupils Doing Experiment**	**5**
Pupil 2: well if its electricity your doing you'd be connecting the wires to the battery and the bulb, then we give the other lads a try afterwards. Pupil 3: We'd be doing the electricity with the wires. Pupil 6: Well the last experiment we did was the water wheel, we didn't have to wait for results for the end, we made a water wheel and then we drew it out in our copy. Pupil 9: We get to do experiments and if we are good at it we get to go around and help our friends. Pupil 12: We get to do experiment sometimes but not that much.	
• **Helping Younger Pupils**	**3**
Pupil 1: She might put us into groups with the younger ones in the class and we make up the electricity circuits and whatever we're doing. Afterwards we get sheets and we have to help the small ones with that as well. Pupil 2: It's a good things because then the lads that come in next year will be able to teach them and so on. Pupil 1: Sometimes we have to tell the small ones, not tell them but give them hints.	
• **Doing Worksheets**	**2**
Pupil 19: Filling in sheets like, we'd be talking about the parts we're doing and we'd have to fill in sheets Pupil 20: You'd see miss **** giving us out sheets and we'd have to name all the different parts of the sheets.	
• **Pupils Talking**	**2**
Pupil 3: You talk about what you are doing at the start and you have to talk all about the stuff you are going to do. Pupil 3: ...we talk about it to each other and do it we don't write it down	
• **Drawing Pictures**	**2**
Pupil 7: ...and we draw a picture as well. Pupil 9: I think we just learn the experiment and we have to draw pictures and stuff into the copy and sometimes like you don't actually do the experiment, sometimes you just put down the pictures. But sometimes we do.	
• **Pupils Answering Questions**	**1**

Pupil 13: If there was something I didn't get I'd put my hand up and I'd ask the teacher about it and she'd explain it to us.	
• **Learning From the Board**	**1**
Pupil 8: Maybe our teacher would put up a flipchart on the board and we'd be learning from the board because she often does that, ya, and the books as well.	
• **Pupils Asking Questions**	**1**
Pupil 2: Padraig asks questions...because you get to know more .	
Category 6: Working in Groups • **Positive**	**3**
Pupil 20: Ya we work in groups, now sometimes we'd get individual sheets but we mostly work in groups. Pupil 22: Yes Pupil 23: We do all our experiments in groups.	
• **People are bossy/do everything/not listening**	**4**
Pupil 4: Sometimes people can be a bit bossy and they take over and you'd just be sitting there watching. Pupil 12: Sometimes the people would be talking when you're trying to do it. Pupil 10: It's fun but sometimes you're with people in a group and they do everything in the experiment and you don't get a go doing anything. I really don't like when that happens. Pupil 17: Oh sometimes you might have an ideas for such and such and then the other people might want to do something else.	
• **Help your friends/Good to have help**	**8**
Pupil 1: I like it, it might be a bit hard and they can help out with more people. Pupil 2: Well sometimes it's good because it can be hard and maybe someone else would be able to do it. Pupil 8: And if any of your friends are stuck you get to help them. Pupil 11: But sometimes it's good because everyone lets you tell them what you think of it and its good when everyone listens so then it can be good, then it can be bad at the same time. Pupil 14: Ya because say if your asked a question and you didn't know that question but someone else in the group might answer that question and they mightn't know a question and you might know it so it's good. Pupil 17: Usually she gives us a topic, like the last thing was for history and stuff, but like she gives us a topic and you have to go to the computer and find out about your topic and like what happens. And being in a group is kind of better because you don't know what to look for and you don't know what to put down and what not to put down. Pupil 23: When you're working in groups every time you get stuck then maybe another person that your working with can help you. Pupil 23: I actually like it sometimes because they can help you out if you're stuck at the job you are doing in the group.	
• **Be With Your Friends/More Fun**	**6**

Pupil 6: I like it because it's more fun and you get to be with your friends Pupil 7: Ya it's fun to do things all together like. Pupil 15: Well I like working with people so i find its good. Pupil 20: It's good the way you can work with other people. Pupil 21: It's funwhen you're working with other people than working on your own. Pupil 22: Working with your friends.	
• **More Opinions/Share Ideas**	**2**
Pupil 13: There's more opinions. Pupil 17: Ya, it's good because we get to share our ideas instead of keeping it within ourselves, and like doing it on our own, so we get to help each other.	
• **Rather Do it Themselves**	**2**
Pupil 3: Ya, I agree, you get to do it all yourself and decide what happens but if your there with someone else you don't really get to decide. Pupil 4: Ya we always do, i like it sometimes you'd rather be doing it yourself that way you can do every single bit.	
• **Do Experiments**	**1**
Pupil 14: we do our experiments in groups.	
• **Get to Know People**	**1**
Pupil 21: Good for socializing with friends and people you don't know very well you get to know them.	
• **Groups Disagree**	**1**
Pupil 9: Sometimes it's not good because groups disagree	
• **Solve Problems/Projects**	**2**
Pupil 1: We talk to the person in our group about what we're doing and then we put the thing together and we then know what we're doing. Pupil 2: We talk all together in circles and then we do our sheets.	
• **People Don't Help**	**3**
Pupil 13: We have to work in a group say if we are learning about the world or something we have to get together and do work like projects and things. Pupil 19: We discuss like, she might ask us like questions and you'd have to discuss it and you have to pick an answer and tell her. Pupil 10: Just talk about how things could work. Go into a circle and we are given a topic and we have to work out that problem	
• **Get A Job You Do Not Want**	**3**
Pupil 22: I like it but sometimes it can be a bit annoying. Because sometimes people they would say pick the best jobs and you would be left then like with a boring one. Pupil 23: And sometimes I don't like it in case you don't get a job you want or they don't agree with something	

that you think is good. People not listening Pupil 18: It's good, some people are really smart and then some people don't like bother at all, they just do their usual work and like read a book.	
Category 7: Experiments • **Found it Interesting/Surprising**	**4**
Pupil 13: Ya, because it had to do with the body and I really like learning about the body. Pupil 22: Good enough, surprising to see what stuck. Pupil 7: I enjoyed it because we found out all about light. It's really interesting and I liked the lasers as well. Pupil 5: Ya it was interesting and I just really like the lasers. They were cool.	
• **Seeing the Experiment Work**	**4**
Pupil 2: We learned how to make switches. And how they work. Pupil 16: My favourite part was actually doing it, making sure it works. Pupil 17: Doing the actual experiment, we were just cutting around the stuff and drawing, it was easy. And putting it together, but we didn't get to laminate it our teacher did it, then we just did the experiment. Pupil 17:... I liked it because we got to decorate it and do lots of things with it.	
• **Helping Younger Children**	**1**
Pupil 2: Ya, you were there with the little people and we were trying to trick them and then try to help them make it.	
• **Writing Out/From the Board/Sheets**	**5**
Pupil 2: The writing out. Pupil 17: My least favourite part would have been you know when we got the question sheet about where is this in the ear and that. Pupil 22: The writing Pupil 23: We had to write down stuff. Pupil 6: We had to take down all the writing from the board after we came in. It's just a waste. I'd rather spend more time doing the experiments.	
• **Repeating Experiments**	**4**
Pupil 3: I thought it was only okay because we had done it a couple of times already. Pupil 11: I didn't like it either, coming away from the fact that I don't like that stuff, I didn't like it because we've learned that stuff loads of times before and it's just learning the same stuff over which I don't like. Pupil 14: I kind of like it and I kind of didn't as well because, like we did do it before and then i didn't like it because I learned a few times. Pupil 23: It was alright because I already knew what stuck to the magnets.	
• **Too Easy**	**2**

Pupil 1: Kind of, because it was kind of easy. Pupil 18: I liked the water one but, it was kind of easy, because all we used was paper, I suppose it was fun like.	
• **Not Enough Equipment**	**2**
Pupil 19: Some people didn't get, like there wasn't enough magnets. Found it boring Pupil 12: Not really, because it was kind of boring.	
• **Teacher Does Experiments First**	**9**
Pupil 2: We mostly do, the teacher would do it first on the board, she'd label it first on the whiteboard and then she'd tell you to connect the wire to this and that and then we'd go off and maybe have to change things. Pupil 3: She shows us first and then we do them. Pupil 9: No because Miss F has us already told what to just go and do the planning thing. Pupil 13: Ya, the teacher would put up o the board the steps of what we have to do. Pupil 21: Most of the time, no not most of the time she will do the experiment an d either she might pick out a few people to do it themselves and she does do the experiments but we do get to do them. Pupil 22: Our teacher shows us how to do it first and then we do it. Teacher helps /Good when experiment is difficult/You know what to do Pupil 3: Well sometimes it can be good when the teacher helps you because sometimes you can get stuck and then you know what to do. Pupil 21: We do them in groups but our teacher helps us. Pupil 23: Sometimes if it's hard she shows us first.	
• **Following Orders/Better Yourself**	**1**
Pupil 4: We like sometimes if she's doing them then we kind of know what to do so it's basically like were following her orders, but sometimes you're better off just doing it yourself that way you'll find out more.	
• **Help Younger Pupils**	**1**
Pupil 1: Sometimes we have to tell the small ones, not tell them but give them hints.	
• **Write Up the Experiment**	**1**
Pupil 3: Maybe at the end we write	
• **In Groups**	**2**
Pupil 3: We talk about it to each other and do it we don't write it down Pupil 9: Ya we are mainly in our groups while doing experiments.	
• **Skip Planning**	**2**
Pupil 9: ...so we kind of skip the planning part and just go and do the experiment. Whole class puts steps in order Pupil 14: We put it in words and we have to try to put it in the order and whatever was the best one you'd put	

that up.	
Category 8: Examples of Experiments • **Magnets**	**5**
Pupil 7: Not sure... Pupil 6: It was magnets. Pupil 5: We got the magnets and we saw how they stick together and how they move away. Pupil 8: We saw the static and we tried out what material stuck to the magnets. Pupil 7: We'd to write down what stuck and draw a picture of the materials that were lifting up and what wasn't.	
• **Waterwheel**	**3**
Pupil 15: We drew a circle with a design on it and then we laminated it, and we put like, cut holes in it and the water went down and it turned the wheel. Pupil 16: In the hall, we had it and an exhibition and all the parents came to see it, so we had to present it. Pupil 18: We did a really good one, it worked really well.	
• **The Heart**	**5**
Pupil 14: Oh about the heart. It's the first thing in our hardbacks. Pupil 12: We ran to see how fast our heartbeat was. Pupil 11: We took the pulse of before and after to see if it was different and to see how fit we were. We were looking at loads of things up on the board. Pupil 13: We seen like how fast a birds heart beat was and it beats really fast. Pupil 14: We wrote out some stuff about what we did with our pulse and them we did some questions on it as well. We drew as well, the heart, just on the outside, not the inside with all the chambers and that.	
• **Light**	**7**
Pupil 3: last week we did all about light. Pupil 2: Ya, how when the sun hits like a mirror you can shine it and you see all the different colours. Pupil 3: Like you think the sun light is just one colour but its not. Pupil 1: We also got to use mirrors and lenses and we put them in water and we saw how the light is different when it is in water. Pupil 2: We also got to use lasers. That was cool. Pupil 3: We learned that light is made up of more than what you see. Like infra-red/uv light you can't see any of that. Pupil 4: We went outside and saw the different colours of light with the mirrors.	
• **The Ear**	**2**
Pupil 17: Well we learned all about the ear and the different parts of the ear and how sound travels and that.	

Pupil 19: She used the interactive whiteboard and she had like pictures of it and she made us fill in the different parts of it.	
• **Electricity**	**3**
Pupil 23: We did electricity. Pupil 21: We had to get into pairs and in our pairs we had to hook up all the wires and tell if they all work and then our teacher told us to take away one of the wires and see of you notice what was missing in the circuit. Then we had to try and put it back together again. Pupil 22: We had writing to do after; we had to name the parts and that.	
Category 9: Science Book • **Integrated SESE Book**	**8**
Pupil 6: It's like history quest but its science, like you might be learning something in history and it has some science for you to do in it. Pupil 7: But we don't actually have a science book. Pupil 8: Ya, we have a book called Earthlinks, for history, geography and science. Pupil 9: Earthlink – all the subjects. Pupil 10: We also have a book called science all around me, but we only used it once, and we had it last year and we didn't use it at all. Pupil 8: We didn't use it at all we just use our Earthlinks over and over again. Pupil 9: I think Earthlinks is just a better book. Pupil 10: Ya, its go history and geography in it as well.	
• **Worksheets**	**3**
Pupils 1-3: No, our teacher she has a science book and she photocopies that and say at the end of the year we might get a test on the sheets we have done. She gives us all the sheets at the end so we can revise and look over them.	
• **Reallife/Factual/Experiments**	**2**
Pupil 10: It's a good book coz all the experiments in it are good and real life things and there's questions – real life and experiments. Pupil 11: You can learn from that too other than doing experiments too.	
• **Comic Strips**	**1**
Pupil 9: I like it because it has comic strips in it and it shows you the factual stuff and it tells you little facts that are actually cool. I like the average heartbeat of a bear is like...i can't remember but it's fun like.	
• **Interesting/Good**	**1**
Pupil 13: Some pages are interesting...	
• **Boring**	**2**

Pupil 13: ...and then some are kind of boring. Pupil 14: Some I think would be really good but others I just think they're boring like.	
• **Know What Your Doing Next Week**	**1**
Pupil 4: I'd prefer to have a book that way you'd know what you were going to do the next week so you can just turn the page and have a look.	
• **Don't Know What You Are Doing Next Week!**	**2**
Pupil 3: It's a bit better to have the sheets because you don't know what you are going to do. In the end you just staple them together and you have all the different sheets. Pupil 2: think its better to have no book.	
• **Don't Have to Buy a Book**	**1**
Pupil 2: ...and you don't have to buy a book.	
• **Science Copy Book**	**2**
Pupils 21-23: Ya we have sheets or we take it down in our science copy book from the board.	
Category 10: Pupils' Expectations • **More Experiments**	**3**
Pupil 2: I think we'll do lots of experiments because we were down there one night and they had lots of different acids and all these kind of explosions and stuff. Pupil 14: More experiments than in primary school. Pupil 16: We'll be doing experiments.	
• **Will Do Experiments Themselves**	**2**
Pupil 11: I don't think the teacher will be doing the experiments I think we'll be doing them and she'll be going around. Pupil 23: ...so I guess we will be able to do more experiments on our own.	
• **Will Work In Groups**	**2**
Pupil 12: A couple of table and a few on one – in pairs. Better coz you won't have to be disagreeing with more people. Pupil 22: I think we do more in groups. There's a club you can go to after school. Its' Formula One. I hope we do more in mechanics and how they work I really like that and Formula One.	
• **New Equipment**	**1**
Pupil 20: Microscopes and test tubes and the box things	
• **Teacher Give More Instruction**	**1**
Pupil 12: She'll write the steps on the boards and we'll follow them.	
• **Harder/More Challenging/Advanced**	**4**
Pupil 1: It will be abit harder and there will be lots more things to do, like different things and the experiments	

will be harder but she'll go through them. Pupil 11: I think it will be more interesting we will do much more challenging things. It will be hard but I thing that it will be better. Pupil 13: It'll be getting harder but while it's getting harder you'll be getting better. Pupil 22: In first year it might be like a small step kind of harder and then up along the years it gets harder, so first year it'd be okay.	
• **More Responsibility**	**2**
Pupil 12: We'll have more responsibility. Pupil 23: Ya it will be more advanced and we will be much more responsible... so I guess we will be able to do more experiments on our own.	
• **New Topics/No Repetition**	**1**
Pupil 11: Experiments will be different they'll be better than in primary school they were only simple experiments.	
• **In a Science Laboratory**	**2**
Pupil 3: We'll be doing our science in the lab every day. Pupil 15: I think it'll be better because all the equipment will be in the room and you won't have to be going in and out	
• **More Writing**	**1**
Pupil 13: More work writing; well have a lot more writing in sec school.	
• **More Detail**	**1**
Pupil 11: I think we will be doing the same thing really just in more detail.	
• **Teacher Will Do Experiment**	**1**
Pupil 3: The teacher would do the experiment and we might have to do it afterwards in groups and then write down about it.	
• **Not Working With Younger Pupils**	**1**
Pupil 4: I'm expecting us to be in groups of two and you'll be explaining to someone else, maybe our partner or the teacher but there'll be no explaining to the small people. The teacher might give you some instruction but she might not give you everything so then you go off then and do it yourself.	
• **Less Reading**	**1**
Pupil 14: ...less reading and older.	
• **The Human Body**	**1**
Pupil 16: More of the human body because in the science rooms there's more of the models.	

Appendix J

Post-Primary Pupil Interview Responses

Catagories (and subcatagories)	Number of post- primary pupils who commented
Catagory 1: Pupils Positive Attitudes to Science Following Transition. • **Doing Experiments**	**3**
Pupil 9: Doing all the different experiments in the lab. Pupil 10: The cells we got to look at like an onion in a microscope. Pupil 11: Today i got to spit in a tube to see if saliva could break down starch	
• **Using Chemicals**	**3**
Pupil 1: Chemicals and that, because we get to do loads of experiments and the chemical part of it. Pupil 4: Chemistry, because it fun. Pupil 5: The mixing the chemicals and the chemical stuff.	
• **The Human Body**	**2**
Pupil 13: Food, it was kind of interesting knowing what you have was it good or bad for you and what you should be eating and what burns fat and what makes you stron and healthy. Pupil 14: The human body and the cells. I liked looking at the onions and that	
• **Cells**	**2**
Pupil 10: The cells we got to look at like an onion in a microscope. Pupil 14: The human body and the cells. I liked looking at the onions and that	
• **Machines**	**1**
Pupil 3: How machines worked and how the human body worked they were interesting.	
• **Not A Lot Of Writing**	**1**
Pupil 7: We don't do more writing and talking we do more activities	
Category 2: Negative Pupil Attitudes to Science Following Transition • **Learning Definitions/Long Names**	**5**
Pupil 2: Ya, The definitions for the works can't really learn them Pupil 14: All the Long names and stuff and having to learn them and that. Pupil 1: Learning the chemicals and stuff too hard to remember Pupil 8: When we had to learn tables and elements and stuff i prefer to blow stuff up and like. Pupil 9: Well I didn't like having to learn most of the elements of the table that was kind of confusing and hard.	

• **Teeth**	**2**
Pupil 6: The teeth, i didn't see any point in doing it already Pupil 20: The teeth they were kind of boring.	
• **Repeating Topics**	**2**
Pupil 6: The teeth, i didn't see any point in doing it already Pupil 7: Ya, like we've done a lot of the things before its just harder now.	
• **Physics and Maths**	**1**
Pupil 15: Physics and maths and stuff.	
• **Plants**	**1**
Pupil 21: Plants, I don't really like learning about plant	
• **Doing Writing**	**1**
Pupil 13: We have to write out all the experiments in our experiment copy, I don't like that.	
• **Telescope**	**1**
Pupil 8: We still work in the books though and it's harder. Telescope things weren't great and books and all.	
• **Biology**	**1**
Pupil 5: Biology, it's boring.	
• **Water**	**1**
Pupil 2: Not really. I didn't like learning about water and ice and just didn't think it was any use.	
Category 3: Repeating Topics • **Yes - repetition**	**7**
Pupil 1: I have ya you'd be repeating most of the stuff. Pupil 2: Ya it but was a bit different the teacher explains more about what you're doing. Pupil 9: It doesn't come to mind but i do like remember doing something we did before. Magnets it was actually. Pupil 11: It's sort of boring, you've learned it before and like magnets there's not much to learn and then you do it again. Pupil 12: Magnets we got this metal thing and we picked the magnet up and we got a nail and we did them exactly in primary school Pupil 9: No it was all boring. Pupil 12: Once you have it learned once it's kind of pointless doing it again.	
• **No - repetition**	**5**
Pupil 5: No, all brand new this year. Pupil 17: It's a lot better because we do experiments.	

Pupil l 18: We've done a couple. I liked the one where you turned that thing...the thing that smells like smelly eggs. Pupil 19: We never did that in primary school. Pupil 6: New stuff you're not going over the new stuff..	
• **New Work/More Detail**	**7**
Pupil 3: The more words and more details. Pupil 14: Like the plant thing, we did more work that what we did in primary school, then that made it harder. It was just kind of boring in primary school. Pupil 16: Learning all the names of the different parts of the body was harder now. We didn't do that in primary school Pupil 4: Last year you didn't have to learn anything but this year you sort of have to know it all. Pupil 5: We get to do it in more detail here, in primary school you're not given a reason why we do it but now you know, it has like a meaning to it. Pupil 6: The experiments are better and more detailed. Pupil 21: More experiments, there's nothing I don't like. It's better than last year we do more experiments and we do more stuff.	
• **More Interesting**	**2**
Pupil 5: It's more like interesting because its new. Pupil 22: Make learning more fun, they show us clips off the internet.	
• **New Books**	**2**
Pupil 23: We didn't have science books before and you didn't have to learn anything in the chapters. Pupil 1: We didn't do much of the same experiments but a lot of the stuff in the book is kind of the same.	
• **New Equipment**	**1**
Pupil 1: Learning about the stuff you use, test tubes and that and using all these new chemicals	
Category 4: Experiments Following Transition • **Experiments Every Week**	**5**
Pupil 1: We do lots every week ... Pupil 8: We do them every week we have a double class in the lab and we do all our experiments then there. Pupil 15: I do them every week though. Pupil 16: Every week or two. Pupil 17: Ya , we always did an experiment every day we did science..	
• **Not Often/Not in Months**	**3**
Pupil 23: No, we probably only did it like once a month Pupil 20: We haven't done them in months.	

Pupil 21: We hardly ever get to do experiments anyway.	
• **In A Laboratory**	**4**
Pupil 3: Ya, in the lab. Pupil 13: Most of the time. Up in the lab not int he prefabs. Pupil 8: We do them every week we have a double class in the lab and we do all our experiments then there. Pupil 17: We're in the lab and do the experiments from the book.	
• **In A Double Class**	**3**
Pupil 1:...during the double classes Pupil 8: We do them every week we have a double class in the lab and we do all our experiments then there. Pupil 15: In the double class we might do two three small ones int he double class.	
• **Teacher Does Them First**	**3**
Pupil 2: He does them first and then he shows us and then we go and get the equipment and we do it. Pupil 4: The teacher shows u s how to do them and then we do them ourselves. Pupil 17: The teacher usually gives a demonstration and them we do it.	
• **Do Them In The Books/Take Notes**	**2**
Pupil 20: We just read the book in the class Pupil 21:...and take notes and have to learn them then	
• **Hard to Remember**	**5**
Pupil 5: Stuff in the three different parts of science. None that stood out. Pupil 19: We only did one good one i can remember and that was it really. The volcano that was it. Pupil 7: Can't remember. No favourite one. Pupil 20: No we don't do them often. Pupil 21: I can't remember the last experiment we did	
• **In Groups**	**4**
Pupil 3: Depends, sometimes we do it in groups. Its better because your with your friends and its 'funner'. Pupil 18: Usually we do it with the person beside you and we share out eh boring stuff. Pupil 11: Easier, your partner is easier to work with were more mature. Pupil 22: Easier to work with people.	
• **Food Experiments**	**2**
Pupil 9: Ya like the food experiments was the last thing we did. We were testing all the food out. Pupil 10: We were in groups and had different food to test.	
• **A Laboratory Copy**	**2**

Pupil 11: We put the results in our lab copy. Pupil 17: We write them in the copy after.	
• **Better/Good**	**1**
Pupil 12: Yai like doing them, its good not to have to learn them.	
• **Filtering Water**	**1**
Pupil 1: We've done about filtering water and how to separate salt from water.	
• **Teacher Does Them At the Same Time**	**1**
Pupil 12: She does it while we're doing it, at the same time	
• **Teacher Shows Them First**	**4**
Pupil 1: No Mr ***** shows them to use before. Pupil 2: He explains them clearly. Pupil 13: And our teacher explains it always. Pupil 19: Because teacher does it first and explains how to do it and helps us if we're stuck.	
• **More Work/Take Longer**	**5**
Pupil 4: More difficult. Longer do more stuff and they take longer. Pupil 5: More difficult, coz there is more stuff to do. Pupil 15: Its kind of the same things we learn about but it's just harder now Pupil 11: There's way more detail in sec school and way more words for things. Pupil 14: More difficult. Longer do more stuff and they take longer.	
• **Pupils Asking Questions**	**1**
Pupil 2: Padraig asks questions...because you get to know more .	
• **Good to Work With Friends**	**2**
Pupil 19: The teacher is there if your stuck and you can ask your friends stuff. Pupil 12: It's easier to do it because you only have two people in your group whereas the last time you might have had six or seven not everyone got to have a go.	
• **Have to Be More Precise/Harder**	**4**
Pupil 13: Sometimes it's hard with all the stuff you have to get and make sure your measuring right and using the right chemicals for the right tests Pupil 12: It's grand if you listen, sometimes you screw things up and it ruins the whole thing. Pupil 13: Like today someone put the wrong thing in the test tube today and it screwed it all up. Pupil 14: It didn't work out for us at all today.	

• **Teacher Can Help You**	**3**
Pupil 3: He helps us like even when we're doing them, during the experiment. Pupil 9: The teacher always explains it for us. Pupil 19: The teacher is there if your stuck and you can ask your friends stuff.	
• **More Writing**	**2**
Pupil 6: There's more writing after it (the experiment). PupiI 20: I don't like all the writing we have to do. I just want to like do the experiments and not be reading all bout them and that like	
• **More Interesting**	**2**
Pupil 10: It's harder but it's more interesting for us. Pupil 17: I think it's better its 'funner'	
• **More Reading From The Book**	**1**
Pupil 7: And way more reading from the book before we do any experiment at all.	
• **More Equipment**	**1**
Pupil 16: With all the different things like the Bunsen burner and microscopes we never had them before.	
Category 5: Science Book • **Write Out Experiments**	**6**
Pupil 1: Yes. We like, before we do an experiment we learn about what were going to do, then we go into the double class to do the experiment. Pupil 2: Ya, I kind of like it, and we have a copy. We write out the experiments and we write out the method and everything. Pupil 3: We read it, it's ok Pupil 8: We write down about the experiments but we got a new experiment books and now we write it down in that. Pupil 10: We've to write out our experiments Pupil 15: Its different, we have to describe it more and write out lots of experiments.	
• **Comparison to Last Year**	**8**
Pupil 1-3: We had no book last year. Pupil 3: Its different to last year we don't do as much writing now because its mostly questions Pupil 9: We only had worksheets last year. We didn't really know what we're doing. Pupil 12: I don't mind all the writing, last year we didn't really learn as much science as this year. Pupil 14: Last year like, every class we got the workout sheets and you had to write every bit of it out into a copy again	

Pupil 20: Yes like last year.	
• **Experiment Workbook**	**4**
Pupil 1: We write in every class in our workbook and in our copy. Pupil 6: It's different to last year. The workbook, we didn't really write them up, I really think it's boring, there's not enough space. Pupil 7: The workbook is for experiments I really hate it, it's really boring Pupil 10: The book and workbook helps you to do it.	
• **Write in Copies**	**4**
Pupil 1: We write in every class in our workbook and in our copy. Pupil 4: We have the two science copies. Graphs on one side and the other is a normal copy and we use it every day. Pupil 9: Too much writing in it. Pupil 15: Ya our copy we answer questions	
• **More Interesting**	**3**
Pupil 6: Ya I like it and you can write it up after you do it and you can look at it after and do diagrams. Pupil 11: Yes, I like reading it, there's interesting stuff in it. Pupil 18: Ya, it has a lot more interesting points that last year and this one comes with a workbook.	
• **Boring**	**1**
Pupil 19: Ya, some of them a boring we've already done them but the majority is okay.	
• **Taking Notes**	**1**
Pupil 11: We sort of use one for notes and drawing diagram and the other is for questions.	
• **More Discussion/Talking**	**1**
Pupil 2: It's alright because we don't do too much writing we more of the time he tells us stuff and he asks us questions and we talk about it and that.	
Category 6: Open Day/Pre Transfer Visit • **Visited Classroom**	**1**
Pupil 2: We went around to all the classes and they showed us all like, the woodwork class, science class and that.	
• **Showed Experiments**	**3**
Pupil 6: We saw the 2nd years doing stuff in the lab with acids, just watching them do it. Pupil 12: He showed us a bit of red blue tack and it was bouncy. Pupil 13: We did experiments about electricity and how it travels through the body	
• **Visited the Laboratory**	**1**

Pupil 4: I remember the lab but it was all bad furniture and now it's all shiny.	
• **Did Not Do Experiments**	**2**
Pupil 15: We didn't do any experiments that day though, I don't remember. Pupil 12: Not really, because it was kind of boring.	
• **Parents Only**	**1**
Pupil 18: Our parents did.	
• **Entry Exams**	**1**
Pupil 19: We had just entry exams.	
• **Different School**	**1**
Pupil 10: I went to one in a different school	
Category 7: Expectations Following Transition • **Not Enough Experiments**	**6**
Pupil 6: It thought we'd be doing way more experiments. Pupil 7: No, because we don't do enough experiments in class, we should do one once a week. Pupil 9: Ya, it's the same, though I thought we'd be doing more experiments and fun stuff but now it's all work. Pupil 10: I thought it would be all experiments every second day and that, but it's more writing now. Pupil 11: The same, more experiments... Pupil 22: I thought exp would be different like, the experiments are not like babyish but we could do harder things.	
• **Too Much Writing**	**3**
Pupil 6: Ya, like you do a lot of writing... Pupil 12: There's a load of writing Pupil 13: I knew there'd be lots of writing but I thought we'd be in the lab more.	
• **Skip Planning**	**2**
Pupil 9: ...so we kind of skip the planning part and just go and do the experiment. Whole class puts steps in order Pupil 14: We put it in words and we have to try to put it in the order and whatever was the best one you'd put that up.	
• **Better**	**5**
Pupil 4: Its better than I expected, we do more experiments I thought we'd do more writing and that. Pupil 5: Ya, I thought we'd be doing more experiments and we are.	

Pupil 3: Ya it pretty much is I'm happy enough. Pupil 11: Ya it's a much better atmosphere. Pupil 12: Better experiments to be doing and that.	
• **Not In The Laboratory Enough**	**2**
Pupil 22 ... and we on ly get in the lab every three weeks for the double. Pupil 21...but were only in the lab every three weeks and it's not a lot really.	
• **No Dissections**	**1**
Pupil 17: We all thought we'd all be doing biology and cutting stuff up.	
• **Had Previous Knowledge**	**2**
Pupil 15: I have brothers so I kind of knew. Pupil 16: I sort of thought it would be the same, I knew the school	
• **Not Like On The Telly**	**2**
Pupil 20: I thought it would be like the telly like dangerous and theat. But it's not, we only use the Bunsen burner and that was the worst. Pupil 22: Like on the telly, dissecting things and stuff	
• **No Explosions**	**1**
Pupil 21: Loads of explosions, it's kind of boring though now thinking it wouldn't be my favourite.	
Category 8: Future Studies • **Yes**	**9**
Pupil 1-2: I will i think. Pupil 3: Proably pick one of the subjects. Pupil 4: I might. Pupil 8: Probably ya , yes. Pupil 9: Ya would pick one part. Pupil 10: Ya id like ot keep doing biology its interesting Pupil 14-15: Yes	
• **No**	**8**
Pupil 5: No i don't think I'll stick with any of them. Pupil 7: No, i just wouldn't. Pupil 11: Its hard, you have to work at it. Pupil 16-19: No.	

Pupil 21: No, it gets harder in leaving cert.